Benthic marine algae of the South China Sea: Floristics, community ecology and biogeography

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University of Hawaii, 1990

BENTHIC MARINE ALGAE OF THE SOUTH CHINA SEA: FLORISTICS, COMMUNITY ECOLOGY AND BIOGEOGRAPHY

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF THE UNIVERSITY OF HAWAII
IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY
IN BOTANICAL SCIENCES (BOTANY)

DECEMBER 1990

by

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Acknowledgements

Thanks first go to Dr. Isabella Abbott and C. K. Tseng for assistance throughout this project, from inception through the specimen identifications which they both oversaw, to the completion. Thanks go to the administration, faculty and students of Zhanjiang Fishery College, Zhanjiang, Guangdong Province, China. Liu Sijian, President of the College, provided logistical support. Prof. Li Weixin, Ding Zenfen, Li Liquan were enthusiastic supporters of the project and were all instrumental in the success of the Liezhou Peninsula field work. Students of Prof. Li assisted greatly with tasks of specimen pressing and processing. Identifications were conducted with the assistance of Chinese specialists, including Dong Meiling (Chlorophyta), Lu Baoren (Phaeophyta) and Xia Bangmei and Zhang Junfu (Rhodophyta), to whom I am extremely grateful. Prof. Zhu at Nanjing University took on the examination of those green taxa unidentifiable in Qingdao. Field research was partially funded through the East West Center, Honolulu, Hawaii and the Waimea Botanical Garden, Oahu, Hawaii. Dr. Abbott made her encyclopedic knowledge and extensive library on issues of Asia and seaweeds openly available to me, and I am truly grateful. Dr. Paul Larned put the species tables into final desktop published form. Dr. Kent Bridges assisted with many aspects of this work, not the least of which was assistance with desktop publishing and computer graphics capabilities. Special thanks are due for his strong support, and especially his willingness to spend parts of his sabbatical year assisting with this project. Prof. Dieter Mueller-Dombois provided many useful comments as applications of community analysis techniques were being worked out. Kanehiro Kitayama provided valuable discussions on theoretical aspects of the analyses and comparison with terrestrial systems techniques. I acknowledge the permission to reproduce Appendix B, which originally appeared in the *Bulletin of Marine Science*, from the Bulletin's editor, W. J. Richards. Dr. Sanford Siegel, Chairman of the Botany Department, and a member on this dissertation committee, passed away the day before the final copy was completed. His rare wisdom and strong support will be missed.

Abstract

Among the many areas of the Pacific Ocean area where the marine algae are poorly known, the continental coast of the Northern South China Sea has stood out because no floristic investigations had been conducted in an expanse of over 2,000 km. A large collection of algal specimens was made from the Leizhou Peninsula in southern Guangdong Province and in the south of Hainan Island. There were 219 species in 99 genera of Chlorophyta (55 species), Phaeophyta (49 species) and Rhodophyta (115 species). The taxa represent a mix of tropical and subtropical species, and contain a number that previously have not been reported for China. Presence/absence data from this collection was subject to community ecology analysis techniques using COENOS, a computer software program. This provided a useful way of showing which taxa can be expected to be found together most of the time, some of the time, or almost never. These results allow the selection of certain taxa that can be used as indicator species in order to test relationships with other floras. The floristic data in turn are compared to a database which was compiled of nearly 20,000 records of over 2,000 taxa from other parts of the warm water western Pacific. Comprehensive tables of species citations of green, brown and red algal species are presented, listed by area in the warm water western Pacific, including the northern South China Sea islands, Taiwan, the Ryukyus islands of Japan, Vietnam, Malaysia, the Philippines and Northern Australia. This study represents the first time that algal distribution information for this area has been gathered together. The use of selective analyses of a taxonomic databases can predict by biogeographical means, the locations most in need of collections and study, can help establish baseline floristic information for applcation in monitoring, and can assist in the selection of appropriate mariculture sites.

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Introduction

The effects of local environmental factors and wide-scale geographic factors on the presence of seaweed species or communities are poorly understood. As with marine floras with most of the world, the marine algal flora of the western Pacific, which borders on continental and island Asia, is poorly known. There isn't enough known of the algal flora of the area to say that such a flora has continental affinities as the flowering plants do (Quisumbing, 1978), or island affinities that are more discrete units as represented by the flora of Guam (Tsuda and Chiang, 1982) or the Northwest Hawaiian Islands (Abbott, 1989), for example. For both plants and animals there are within the boundaries of the western Pacific such species-rich marine and terrestrial areas of as Borneo, Malaysia, and the Philippines (for marine diversity see Ekman, 1935, 1953, Briggs, 1974 and Springer, 1982). However, in the continental borders of the South China Sea, species numbers tend to diminish. Marine habitats change from open ocean with moderate to strong water movement characteristic of the eastern coasts of Taiwan and the Philippines, for example, to relatively low water motion shown by the sandy-muddy western shores near the continental coasts (Wyrtki, 1961; Muromtsev, 1963; Watts, 1971). Natural environmental factors such as the annual inundation by flood waters of the numerous rivers within the region, bringing loads of soil that settle on the sandy or rocky bottom, or man-made factors such as pollution or shoreline alteration, would be expected to strongly affect the marine flora in this area. The manner in which these factors affect the algal flora remain to be clarified.

The geographic area delineated within this literature review as an area of biogeographic interest is the warm water western Pacific (Figure 1). As used here, the area constitutes the tropical and subtropical marine area of Pacific Ocean waters (*sensu* Wyrtki, 1961, including northwest Australia) abutting continental Asia. The region is bounded on the north and south by the limits of consolidated biotic reef (see Howe 1912, 1933 for use of this term for the more frequently used, but misleading term "coral reef"). The western boundary is that of Pacific Ocean waters, the eastern boundary is the line of archipelagic islands associated with the Asian continent (including the Ryukyu Islands, Taiwan, the Philippines, Papua New Guinea, and eastern Australia). The South China Sea is the largest of several seas in the

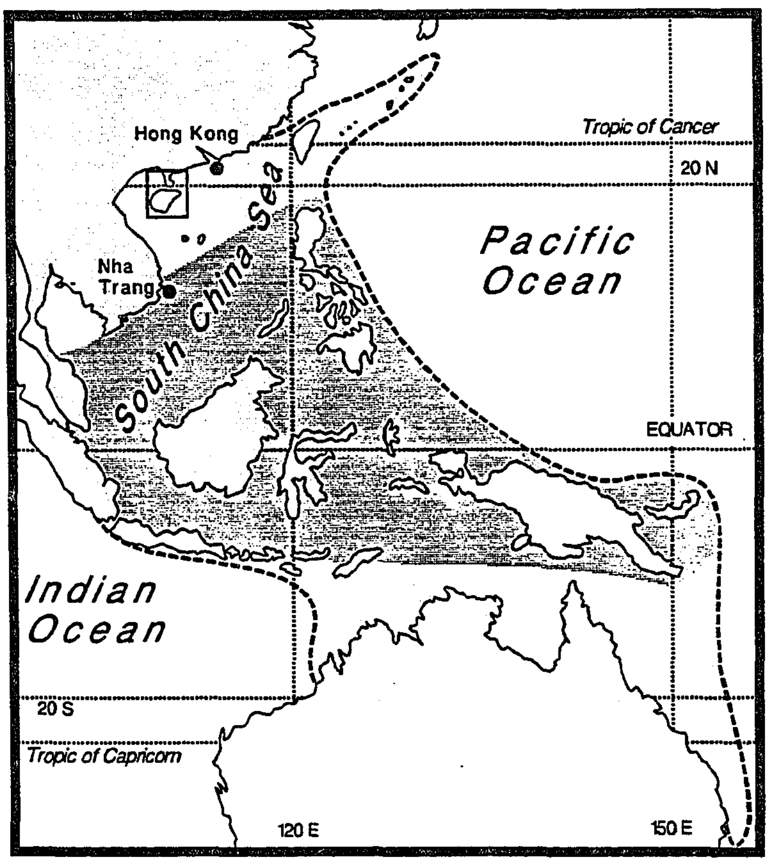


Figure 1.1. The warm-water western Pacific area (bounded by dashed lines). Tropical and subtropical limits are taken as those of consolidated biotic reef, in the north and south, the western boundary is that of Pacific Ocean waters, and the eastern limit is the line of archipelagos associated with continental plate boundaries (Indo-Australian and Eurasian Plates). The Indo-Malayan Archipelago region (shown as a roughly triangular, shaded area) is considered to be a global center of species diversity, however there are no established boundaries.

Indo-Malayan archipelagic region (Morgan and Valencia, 1983). The northern area of this sea extends into the Taiwan Strait, and includes Hong Kong, the geologically continental island of Hainan in south China, northern Vietnam and the coral islands of Dong Sha (Pratas Islands) and Xi Sha (the Paracels).

Section 1. History of Phycology in the warm water western Pacific

Seaweeds have been distinguished and used in Asia for centuries (Tseng and Chang, 1961; Lewis and Norris, 1987), and have been studied within a Linnaean context from the early 1800's, although preceded by pre-Linnaean observations of Rumphius (1741). The stages in adoption of phycology, in a scientific context, follow trends documented for phycology in South America (Oliviera, 1981) and science in general (Basalla, 1967; Kay, 1972). Science is initiated, in these models, with records from Europeans who are present for short periods of time. There is a period characterized by the work of the first local phycologists, based on more abundant material and more precise collection information. The scientific scope is still predominantly descriptive in the second phase. The final period in the transition is the establishment of a firm, integrated and diverse local scientific base.

Collections made by European expeditions and the various collectors assigned to them figure prominantly in accounts of the historical development of phycology within this region, although there are also scattered publications based on collections made by monks living in the area. Among the first phycologists who published on algae from the China coast were Turner (1808-1819) and C.A. Agardh (1820-1828). Specimens were collected from the Philippines as early as 1837 by Augustinian monks (Silva *et al.*, 1987), but there are no extant specimens. Accounts of the historical development of phycology in Asia (Silva *et al.*,1987 for the Philippines, Tseng, 1940 for Hong Kong, Lewis and Norris, 1987, Appendix A, for Taiwan, and Womersley, 1959, 1984 and Ducker, 1979, 1981 for Australia) emphasize European expeditions in their early history. For the most part collectors aboard expeditions were naturalists in the broad sense, having no specific phycological or even botanical background. Few of the naturalists collected algae. Of those in the early Pacific explorations (prior to 1840) who did collect algae was the French botanist C. Gaudichaud. While aboard the corvette *La Bonite* in 1836-1837 he provided the first clearly documented algal record from Hong Kong (Tseng, 1940). Specimens collected by the naturalist Eduard von Martens on the Preussische Expedition nach Ost-Asien in 1861 were published in 1866 by Martens' father, Georg, a European-based botanist. H.N. Mosley, the naturalist on the Challenger expedition, collected algae in 1874-1875 in Asia which were recorded by the British botanist Dickie (1877). The lieutenant on the *Vettor Pisani* collected algae in 1884 which were published by Piccone in 1886 and 1889. The Siboga Expedition to the Indonesian region (1899) accounted for the most extensive collections, published by Barton (1901), Gepp and Gepp (1904, 1911), Foslie (1901), Reinbold (1901) and Weber-van Bosse (1904, 1913, 1921, 1923, 1928). The total number of marine algal taxa reported by 1930 from these expeditions was less than 200.

The transition to local investigations began at the turn of the century with Okamura's Japanese studies (1895 *et seq.*). Trained in Germany, as part of the post-Meiji westernization of Japan, this remarkable scientist became the pioneer phycologist, and the founder of generations of western-oriented seaweed researchers in Japan. Due to his energy and interests, an extensive Asian publication record was built up in the early 20th century, which included records from a large area of Asia. Western scientists were slow to become familiar with these publications. This led to many erroneous assessments by western scientists of the state of phycological knowledge in Asia (see Lewis and Norris, 1987 for anecdotes), including the oversight of many described taxa. When Okamura died in 1938, over 600 species of marine algae were known from Japan, which at that time included the "Southern Islands" or the Ryukyus and Taiwan, accounting for Japan's warm-water element not otherwise present within its geographic boundaries.

Strong economic influences have motivated seaweed research in Asia since the 1930's in Japan, since the 1950's in China (Tseng and Chang, 1954, 1959a; Tseng and Wu, 1954) and in the last 20 years for tropical areas such as northern Borneo and the Philippines (Doty, 1977), Malaysia (Xia and Abbott, 1987) and Thailand (Abbott, 1988b).

Records from the warm water western Pacific as a whole have never been compiled and assessed, even in a preliminary format. Therefore, the area which would be expected to have a high global diversity and some of the greatest potential economic benefit, is in fact one of the least known. Only in the last decade have records for areas within the region been gathered for initial evaluation. Checklists now exist for northern Australia (J.A. Lewis 1984, 1985, 1987), Taiwan (J.E. Lewis and Norris, 1987), the Philippines (Silva *et al.*, 1987) and

Malaysia (Phang, 1986). Although not generally regarded as tropical or subtropical, China and Japan each have marine territory in this region. A flora of China is in preparation (Tseng, pers. comm.) and a checklist for Japan is being compiled. Published reports for the warm water western Pacific have been compiled for this review and are presented in Table 1. The following section provides a historical phycological review for the countries of China, Vietnam, Malaysia, Japan and the Philippines within this region.

China. There is a history of at least 2,000 years of recognition and use of seaweeds in China. By tracing records through annals from coastal counties, herbals, dictionaries and other general public literature, Tseng and Chang (1961, 1962b) presented the long history of traditional uses. They brought the folk names of algae into a scientific context by tracing name usage to identifiable material and located the earliest clear reference to the recognition of seaweeds to the dictionary known as the *Er Ya*. Also known also as the Literary Expositor, this book dates to the third century, B.C. (Needham, 1970). Seaweeds are still used as medicines and foods (Xia and Abbott, 1988).

Although most Chinese research is written in Chinese, there has been a conscious effort by Tseng and his co-workers to communicate their findings in English, or in Chinese with English abstracts. Since abstracts give conclusions and may provide little insight as to the methodology or ways of thinking, non-Chinese readers frequently do not derive a clear understanding of the studies. A book of color photographs of common marine algae was published in English (Tseng, 1983) which has helped bridge the communication gap. A seaweed flora is now in preparation (Tseng, pers. comm.).

The earliest phycological information on China came from Hong Kong. There is a strong representation of the brown genus *Sargassum* in early publications (J. Agardh, 1848, 6 species; Greville, 1848, 4 species; Kützing, 1849, 2 species; Debeaux, 1875, 3 species). Setchell (1931-1936) devoted four parts of a five-part series on Hong Kong seaweeds to this genus. C.K. Tseng's extensive Hong Kong collections from 1932 to 1934 were reported in a number of papers (1935, 1936a, 1936b, 1937, 1938, 1940). By 1940 over a century had passed since the first scientific reports, and yet less than a hundred species had been reported.Indeed, J. Tilden (1929) reported on "all species previously noted by investigators" but cited only one non-western reference. Tilden listed 92 marine algal species from China, including six from Taiwan. Lewis and Norris (1987) point out that the actual number of taxa

Table 1. Published reports of benthic marine algal taxa in the warm water western Pacific. Taxonomic compilations of the historical record are indicated as reviews. Individual reports used in the reviews are not listed.

Country	References
Ryukyu Islands	Kuroiwa, 1899; Yendo, 1902, 1909-1918; Yamada, 1930-44, 1934, 1936; Okamura, 1936; Segawa & Kamura, 1960; Itono, 1969, 1973, 1977; Yoshizaki & Tanaka, 1986; Yoshizaki, 1979.
Taiwan	J. E. Lewis & Norris, 1987 [Review]; Chiang & Wang, 1987; Yoshida, 1988.
Hong Kong	Tseng, 1940 [Review], 1942a, 1943a, b, 1944a, b, 1945, 1948, 1983; Tseng & Gilbert, 1942; Chiu, 1954; Chang *et al.*, 1963; Lee, 1964, 1965, 1966; Widdowson, 1966; Hodgkiss & Lee, 1981 [Review, partial], 1984, 1984; Tseng *et al.*, 1982; Hodgkiss, 1984; Ho, 1986a, b, 1987; Wu, 1987.
Philippines	Coppejans & Prud'homme van Reine, 1989a, b; Kraft, 1986a; Silva *et al.*, 1987 [Review].
Tropical Australia	Gabrielson & Kraft, 1984; Huisman & Kraft, 1983, 1984; Jones & Kraft, 1984; Kraft, 1984a, b, 1986a, b, 1988a, b; J. A. Lewis, 1984, 1985, 1987 [Reviews]; Miller & Kraft, 1984; Robbins & Kraft, 1985; Wynne & Kraft, 1985; Wynne *et al.*, 1984.
Indonesia	Barton, 1901; Foslie, 1901; Reinbold, 1901; Gepp & Gepp, 1904, 1911; Weber van Bosse, 1904, 1913, 1921, 1923, 1928; Taylor, 1966; Coppejans & Prud'homme van Reine, 1989a, b.
Malaysia	Weber van Bosse, 1928; Zaneveld, 1950a, 1950b, 1952, 1955, 1956, 1959 [Review, partial]; Phang, 1986 [Review].
Papua New Guinea	Weber van Bosse, 1904, 1913, 1921, 1923, 1928; Coppejans & Meinesz, 1988; Kraft, 1986a.
Vietnam	Dawson, 1954, 1957; Pham, 1962, 1969; Tanaka & Pham, 1962.
Thailand	Foslie, 1901; Reinbold, 1901; Egerod, 1971, 1974, 1975; Maneerat, 1974; Velasquez & Lewmanomont, 1975; Ogawa & Lewmanomont, 1983, 1984; Kamura & Choonhabandit, 1986; Abbott, 1988b.
Hainan Island	Tseng, 1935; 1936b, 1941a, b, 1942b, 1983; Tseng & Gilbert, 1942; Tseng & Chang, 1962b, c; Chang & Xia, 1962, 1988a, b, c; Chang *et al.*, 1963; Xia, 1963; Xia & Yamamoto, 1985; Tseng & Lu, 1988.
Xi Sha Island	Tseng & Chang, 1962c; Fan & Wang, 1974; Chang *et al.*, 1975; Fan et al., 1975, 1978; Tseng & Dong, 1975, 1978; Chang & Xia, 1978a, b, 1979, 1980a, b, 1981, 1983; Chang & Zhou, 1978; Tseng & Lu, 1978, 1979, 1982, 1988; Dong & Tseng, 1980; Lu, 1980; Lu & Tseng, 1980; Zhang & Xia, 1983; Zhang & Zhou, 1980a, b; Zheng, 1980; Zhu & Liu, 1980.

published by 1928 for Taiwan alone was over 200. Factors creating barriers to communication have no doubt become reduced, but language is still apparently a significant limit to the scope and depth of relevant literature referenced in phycology today (Lewin, 1981a).

Research activities in China began in the 1930's where earliest activities were at Nanjing University, Amoy University and Shandong University, and where C. Y. Chiao, T.G. Chin and Tseng, worked, respectively. Chiao studied freshwater algae, Chin marine diatoms, and Tseng benthic marine algae.

Chinese phycologists have been very active in pure and applied phycological research since the 1950's, led by C.K. Tseng. Tseng began work on seaweeds in the 1930's, while an instructor in Fujian Province. At that time he visited and collected in Hong Kong, and on Taiwan and Pratas and Hainan Islands, among other places. After receiving his Ph.D. at Michigan under W. R. Taylor, and working for five years at Scripps Institute of Oceanography, he returned to mainland China and began pure and applied phycological research, developing a very active, strong and diverse phycology program at the Academia Sinica Institute of Oceanology in Qingdao. Until his retirement from the directorship of the Institute in 1984, Dr. Tseng had served both as Director and head of the phycological research division. Following his retirement he has continued to be active with many marine biology projects, and continues to direct the phycological programs.

The main contributions made at the Qingdao institutes since the 1950's are in systematics and large-scale culture of economic algae such as *Laminaria* and *Porphyra*. The systematics studies are on a par with western publications along the same lines but show the unavailability of western publications during the period of the cultural revolution (mid 1960's to mid 1970's). The contributions of field development and management of economic seaweeds, *Laminaria* in particular. The natural ranges have been extended thousands of kilometers and general mariculture manipulations are outstandingly successful.

Despite its long coastline, and the dependency of Chinese people on the ocean for food, phycology as an academic subject has been downplayed in China. It was first introduced in 1928 by H.H. Chung at Amoy University, Fujian Province. This course was followed in 1936 by a phycology course at Shandong University, located in Qingdao, offered by C.K. Tseng, who had moved from Amoy University to Shandong University in the 1930's. In 1948 and 1949 Tseng taught courses in marine phycology and economic phycology, respectively, at

Shandong University. The National Academy of Sciences (Academia Sinica) has since strongly supported phycology. There are now many research or experimental laboratories where persons can be trained in phycology and its practical aspects. Additionally, a large very active institute directs studies of freshwater and bluegreen algae at Wuhan, on the Yangtse River.

Marine algal studies from the southern part of China (south of Shanghai) have become more common since 1972, with an increasing number of publications on southern algae, but logistics still favor northern projects. There are phycological facilities under the Academia Sinica South China Sea Institute, Guangzhou, located in Shantou and Zhanjiang, Guangdong Province. Mariculture facilities in northern Hainan Island are actively investigating species of *Eucheuma*. Phycology is taught by Prof. Lii Weixin at the Zhanjiang Fisheries College, Zhanjiang. Prof. Li's research interests focus on the primarily northern genus, *Grateloupia*.

There is no published history of southern collections. The information provided here was obtained anecdotally from J.F.Zhang (also known as C.F. Chang) and C.K. Tseng. In the 1950's Tseng brought his research group to Hainan Island several times, where accomodations could only be found in a high school gymnasium. In Japan, similar conditions prevailed with Professor Yukio Yamada and his students in Kyushu in the 1930's (I.A. Abbott, pers. comm.).

J.F. Zhang visited Leizhou Peninsula on several occasions, primarily to collect *Gracilaria*. Transportation was the biggest problem, resulting in the necessity to walk dozens of miles daily. Other southern locales in which there has been phycological interest are Weizhou and Naozhou Islands. The first is in Guangxi Province, west of Leizhou Peninsula, the later is near and to the east of Zhanjiang. Prof. K. C. Fan, originally from Taiwan, returned to mainland China in the early 1960's after obtaining his Ph.D. in the U.S.A. He and Prof. Lii planned to conduct floristic studies on Leizhou Peninsula, but they were assigned other non-scientific duties during the Cultural Revolution. After a delay of more than 15 years, the project ended with Fan's death just as it was getting restarted.

For the many thousands of miles of coastline of China, there are too few phycologists working to bring the knowledge of accumulated data up to date. The situation is comparable to that of having 3-4 phycologists divided between the east and west coasts of the U.S.A. for

20 years, rather than having dozens of phycologists during the last 150 years on each coast, many working for significant parts of their lifetimes. The limitations are inherent in the geography and the amount of scientific manpower. Because of these limitations, the Chinese strategy has been to specialize in order to cover the general (mostly northern) situation. For all of these reasons, the southern flora has been mostly neglected.

One outstanding exception is the Xi Sha archipelago which has been and continues to be an important research site, despite the extremely harsh field conditions. Each year from 1976 to 1979 phycologists traveled to Hainan Island from Qingdao, then by boat to Xi Sha, to spend 3 months collecting under difficult conditions. Accomodations were only available in a military base, food was virtually all canned, and all potable water had to be brought in by investigators. These expeditions resulted in a series of special tropical papers (Chang and Xia, 1978a, 1978b, 1979, 1980a, 1980b, 1983; Chang *et al.*, 1975; Chang and Zhou, 1978; Tseng and Dong, 1978; Dong and Tseng, 1980) which contributed significantly to previous reports from this archipelago (Fan and Fan, 1974; Fan *et al.*, 1975, 1978). Outstanding collections of *Liagora* were made possible only because of the long-term visit during the spring season (I. Abbott, pers. comm.).

Vietnam. For many years Professor Pham Huang Ho, formerly at Saigon University, was actively working on the flora of Vietnam in addition to other biological duties he had for the government. Pham received his Ph.D. from France with P. Drach and J. Feldmann, and he now resides in Paris. Pham's major algal contribution (he is also a flowering plant systematist) was a seaweed flora of Vietnam (1969) which focused around, and south of, the Nha Trang area.

A floristic investigation of a number of different habitats in the Nha Trang area was conducted over a three month period by E. Yale Dawson in the mid-1950's. His reports on this study (1954, 1957) provide a large amount of ecological floristic information. Dawson was wary of all his identifications from Vietnam collections, however, noting the lack of bibliographic sources and of specimens with which to identify tropical western Pacific seaweeds. He resolved these difficulties by assuming floristic affiliations with the Caribbean and wide morphological variability. Experience may demonstrate that his assumptions were correct, but it has not been possible to test this adequately to date. Dawson's study may be seen as one which brought an international perspective to the Asian flora, and made an audience of phycologists aware of the uncertainty which is involved in taxonomy of marine algae from previously unknown places. Another of Dawson's contributions was his demonstration that completely different communities of seaweeds were present within very close geographic range, and therefore it is necessary to sample a wide variety of habitats if a representative species list is to be had.

Malaysia. Malaysia, including peninsular Malaysia and Malaysian Borneo, has a coastline of almost 3,500 km (Table 2). There are few published records on the seaweed flora,except for those of Zaneveld (1950a; 1950b; 1952; 1955; 1956; 1959). More recently, Phang (1986) has brought the information from Zaneveld up to date, and contributed new records and observations. The many collections of Burkill that are available in a number of herbaria (British Museum, Natural History, University of California, Berkeley, and the Bishop Museum) should aid in establishing a larger flora than is now known.

Indonesia. The numerous islands in Indonesia would most likely yield one of the Pacific's more diverse and interesting algal floras. It is unfortunate that very few investigations have been conducted on which to base a preliminary algal flora upon which biogeographic observations could be extrapolated. While algal collections formed a minor part of the Siboga Expedition, they constitute the main, though dated, source of information on seaweeds of the area (Barton, 1901; Gepp and Gepp 1904, 1911; Foslie, 1901; Reinbold, 1901; Weber van Bosse, 1913; 1921; 1923; 1928). Zaneveld's publications on Malaysia (see above) also included citations for Indonesian seaweeds.

Japan. There have been and are presently hundreds of phycologists in systematics, numerous others in commercial and other aspects of economic phycology in Japan. Presently there are over 300 marine phycologists, most specializing on a specific taxonomic group or floristic area (Yoshizaki, pers. comm.). As mentioned earlier, Okamura exercised considerable influence on the development of phycology in Asia. Upon returning from abroad, he spent almost four decades in the environs of Tokyo from which it was convenient to conduct research and to do fieldwork. His contemporaries, K. Yendo, and T. Miyabe studied certain taxa that Okamura did not, and thus advanced the accumulation of algal information. Y. Yamada (1925a; 1925b; 1926; 1930-1944; 1931; 1934; 1936; Yamada and Kinoshita, 1948;

1950) and S. Segawa (Segawa and Kamura, 1960) were students of Okamura; nearly all phycologists in Japan were trained by them. There is a partitioning of effort among the various workers, and consolidation of studies toward a comprehensive checklist now being developed (Yoshida, *et al.*, 1985), which is preface to a major re-working of Okamura's flora (1936) which emphasized the temperate flora. Few Japanese are working on the tropical and subtropical aspects of their flora, despite their considerable history of phycological exploration in Taiwan (Lewis and Norris, 1987) and other southern areas. A temperate to cold water flora of Japan would nevertheless be a major contribution, as it would contain perhaps 95% of those species present throughout the northern Pacific

The Philippines. The published records of benthic marine algae from the Philippines have been assembled by Silva *et al.* (1987) into a catalog containing 910 species in 190 genera of red, green and brown taxa. The authors emphasize that their catalog is merely a compilation of records, assembled to spur critical examination of the published record and to "integrate published information on the taxonomy and distribution of Philipppine benthic marine algae and thus provide a foundation for future exploration and research". As well, they "...decided to incorporate as much information as was pertinent to understanding the taxonomic structure and nomenclature adopted..." and focused on the need to investigate the reliability of the determinations, commenting that "...very little critical work has been done on Philippine marine algae."

Their goal was to "...facilitate and perhaps stimulate future work by pointing out geographic and taxonomic areas most in need of attention". A large number of the species recorded are regarded as dubious, owing to their naming at a time when the literature was scanty, the limits of taxa poorly understood, and the training of the person naming the species uncertain. The authors note a sharp increase in the number of papers published on seaweeds since the mid 1970's which reflects the studies of Trono (1973 *et seq.*) and others cited in the Philippine catalog. Lewis (1990, Appendix B)examines patterns in the development of the Philippine phycolgical history.

Section 2. Biogeography

In order to evaluate the distribution patterns of marine algae, and to thereby establish relationships either of taxa or of somewhat specific habitats, floras must be relied upon. Adequate floras that contain reliable identifications exist for only a fraction of the Earth's coasts and primarily temperate seas. Dixon's (1963) assessment that "it is doubtful if more than about 70% can be identified accurately in any flora or taxonomic treatise, for any part of the world" is in large part still relevant today. Among the best known floras are those of western North America (Abbott and Hollenberg, 1976; Scagel *et al.*, 1989), Great Britain (Parke and Dixon, 1968, 1976), the Mediterranean (Feldmann, 1937; 1942), Japan (Okamura, 1936) and Australia (Womersley, 1984 , 1987).

For the tropics and subtropics, comprehensive floras exist for the western Atlantic and adjacent Caribbean (Taylor, 1960). The flora of the main islands of Japan is extensively studied (Okamura, 1936), but the warmer parts of Japan less so. Several long coastal stretches continue to be floristically unknown. These include much of the southwestern coast of Africa, the southern part of Brazil and Argentina and the continental coastline of Asia from Hong Kong to southern Vietnam. There are also several countries in Asia (i.e. Vietnam, Thailand, Malaysia, the Philippines, Indonesia) which have been studied from time to time, but for which the information base is still poor. For a few, there are clear statements of governmental interest in seaweed resources which may indicate an increasing interest in research soon.

Geographic boundaries for the evaluation of benthic marine algal data are arbitrarily defined here for a region referred to as the warm water western Pacific. This region is defined as that area of the western Pacific (*sensu* Wyrtki, 1961, including Indonesia) in association with the Continental Shelf (including the archipelagoes of Japan, the Philippines and Indonesia) and bounded on the north and south by the limits of consolidated coral reefs (Figure 1). The western Pacific concept used here does not extend to the western margin of the Pacific Plate, as distinguished by Springer (1982).

Of the many kinds of biogeographic approaches applied to seaweeds, the pattern approach (Hoek, 1984b) is the one taken in general in this paper. This descriptive approach is best suited to early biogeographic assessments when the quality of the data has not clearly been determined. This is the situation with benthic marine algal data (May, 1944; Silva, 1966;

Dixon, 1971; Doty, 1973; Irvine and Price, 1978; Abbott and Norris, 1985; Lewis and Norris, 1987; Silva *et al.*, 1987; Abbott, 1988; Lewis, 1990).

These boundaries define a broad region which, by nature of temperature, currents (Wyrtki, 1961; Muromtsev, 1963; Watts, 1971) and environment is similar and would be expected to share general features of their marine floras. This area was defined to assist in evaluating the completeness of knowledge about the benthic marine algae for smaller areas within this region.

Whereas some ecologists may consider biogeography to be a branch of ecology which describes systematic distribution of plants and animals, and some biogeographers may consider ecology to be a minor branch of biogeography (Hedgpeth, 1957), the somewhat eclectic viewpoint taken here is that both can be used as tools to test for subsets of floristics, and floristics is, in turn, a subset of systematics. Ball (1969) recognizes a progression of three phases to the study of biogeography: 1) an empirical or descriptive phase; 2) a narrative phase; and 3) an analytical phase. As outlined above, the interests of this project are with phase one, description.

Marine science knowledge of all kinds in the Pacific Ocean developed much later than that for the Atlantic. In the first synthesis of marine biogeography of the Pacific, Ekman (1935) recognized the relatively shallow tropical and subtropical continental shelf waters as areas of highest diversity, and among these, the greatest marine diversity in the area extending around the Philippines, peninsular Malaysia and Papua New Guinea, referred to by Ekman as the Indo-Malayan archipelago (Figure 1).

Using a pattern approach to biogeographic analysis, studies have been made on seaweeds of the Atlantic Ocean (Humm, 1969; Hoek and Donze, 1967; Kuhnemann, 1972; Hoek, 1975; Pielou, 1977; Lawson, 1978; Searles, 1984; Alvarez *et al.*, 1988); of the Pacific Ocean (Funahashi, 1973; Pielou, 1978; South, 1979; Santelices, 1980; Murray and Littler, 1981; Womersley, 1981; Abbott and Santelices, 1985; Parsons, 1985; Santelices and Abbott, 1987) the Mediterranean Sea (Funari, 1984; Ribiera *et al.*, 1984) and worldwide (Hoek, 1984b; Joosten and Hoek, 1986; Lüning, 1985; Michanek, 1979; Yoshizaki, 1979; Yoshizaki and Tanaka, 1986). Despite the biogeographic significance, and demonstrated economic potential, an integrated understanding of the seaweeds from the western Pacific is virtually nonexistent as compared to that for other Pacific and Atlantic Ocean areas. Compared to other groups of organisms, seaweeds were rarely collected and if collected, because of changes in the characters used taxonomically, many of the early collections cannot be used without further critical re-examination. As a result, knowledge of this region's flora has increased only slowly. Alvarez *et al.* (1988) believe "that seaweed biogeography merits attention, since new algal floras are being compiled and many intriguing questions regarding distribution are being solved." Biogeographic analysis might be used as a tool that would help to identify high priority areas for floristic work.

The principle behind such analysis is that natural patterns recur. The strategy this invokes is one of dividing data a number of ways and applying the same analyses to each subset. Resulting patterns can be compared, and interpreted in terms of the evenness of the datasets,and the degree of completeness or confidence implied by the different kinds of data. Biogeographic analyses can thereby be diagnostic of data integrity.

Pacific. In general, marine biogeography with respect to marine algae is a subject which has been apparently little interest in the Pacific, owing, perhaps to the large body of water and numerous widely separated island groups. Because the separated islands could be used as experimental locations for testing biogeographic hypotheses, the Pacific would appear to be a perfect location for such studies. Perhaps it is the lack of reliable taxonomic or floristic information for this area that discourages any such studies.

In the eastern Pacific subtropics and tropics, Dawson (1961) provided a checklist of 671 taxa were reported, including 76 species of green, 139 species of brown, and 456 species of red algae for the coast from Alaska to Panama. The bulk of the algal information was on more temperate species, exemplified by Abbott and Hollenberg (1976) where

For the western Pacific temperate and subtropical regions, Okamura (1926) in the first of a group of papers on the biogeographical base of Japanese algae was a pioneer in attempting a sort of distributional pattern analysis for western Pacific algae. The second paper (Okamura, 1932) in this series presented a detailed presence/absence table of 102 pages of of all taxa known in the Pacific at that time. In the last paper in this series, Okamura (1933) discussed the reported distributions of marine algae in Pacific waters and treated 3,794 taxa. Of course, the number of taxa has both increased (new species), and decreased (new combinations and the establishment of synonyms) since that time. Of this number, 864 were listed for Japan, alone, 182 for the China Sea, and the remainder scattered throughout the Pacific. There have not been any serious examination of the distribution of marine algal taxa in the broad reaches of the Pacific since that report.

Okamura, while pre-eminent with the Japanese algal flora, had to use identifications found in the literature for taxa beyond his geographic boundaries. He worked in a period (the first third of this century) where "authority" governed the names of plants, whether they were terrestrial or marine. The term "amply distinct" to distinguish a new species from those already described would be accepted if Setchell (1914), for example, identified the taxon. While Okamura, and Yendo who was a contemporary, and Yamada who was his student, had open minds in terms of identifications (their papers show evidences of the ability to change their opinions, and even to admit error) they were nevertheless held in such high esteem that their "word was law." These attitudes, held by others, do not encourage a re-examination of the limits of species, a challenge of the features used, and broader interpretation. It allows compiled lists to stand, even when there are errors in them; it relies too heavily on the judgement of others which may be in error.

"Sound taxonomic work is a precondition for all types of biogeographical studies, and lists from different areas must be *strictly* (italics mine) comparable if conclusions are to be drawn with certainty" (Lawson and John, 1986). This and similar issues which stand as major challenges to seaweed biogeography have been raised in several contexts (May, 1944; Silva, 1966;Dixon, 1971; Doty, 1973; Irvine and Price, 1978; Abbott and Norris, 1985; Silva *et al.*, 1987; Abbott, 1988; Lewis, 1990).

The current taxonomic records for the WWWP are scattered, mostly available on a regional, i.e., country by country basis, with some of the available literature published as though no other literature of nearby areas existed, e.g., the papers on algae from India do not refer to those from Taiwan, even though they are both within the Indo-West Pacific biogeographic area (Ekman, 1953) and would be expected to have many elements in common. Except in Japan, until the 1980's there was little effort to consolidate the literature even within a single country. During the 1980's the published taxonomic record was compiled for northern Australia (Lewis, 1984; 1985; 1987), Malaysia (Phang, 1986),the Philippines (Silva *et al.*, 1987) and Taiwan (Lewis and Norris, 1987). Algal references for Hong Kong were recently gathered and published(Morton, 1990).

Another recently developed resource for distribution records is electronic databasing of biological collections at major museums, such as the U. S. National Museum of Natural History.

Section 3. Physical parameters

Oceanographic conditions are widely understood to affect seaweed floras (Chapman, 1974, 1986). Southeast Asia is characterized as "one of the regions with the most complex structure on Earth" (Wyrtki, 1961:7) because of its distribution of water and land, the configuration and complexity of its seas and basins and the number and size range of its islands. The archipelagic nations of Indonesa and the Philippines have several thousand islands each, with correspondingly extensive shorelines. The shore length for Indonesia is 35,784 miles, Philippines is 13,975, as compared to the 8,900 nautical mile shoreline of mainland China, of the 2,828 nautical mile shore of Vietnam, the shorelines of Taiwan (648 nautical miles) and Hong Kong (454 nautical miles) (Morgan and Valencia, 1984).

Numerous large and small islands subdivide the region into a network of seas, the largest of which is the South China Sea. This sea, including its major embayments, the Gulf of Thailand and the Gulf of Tonkin, encompasses an area (1,091,642 square nautical miles) which is larger than any of the other 12 Southeast Asian Seas (Morgan and Valencia, 1984).

Salinity is lowest near the continental shoreline of Asia where it is influenced by high rainfall runoff. Marine temperature extremes in the northern and southern portions of this region are not mirrored, but vary in pattern. The southeastern limit of the area under consideration is slightly south of Brisbane, Australia. Brisbane has average monthly water temperatures from 20–27°C, or a range of 7°C throughout the year. The northern Ruykyus represent the northern extension of the area and are subject to a greater, 10°C, marine temperature flux, from 18–28° C.

There is distinct seasonality in the current patterns within the Southeast Asian seas. In February, strong southbound currents flow along the coast of Vietnam in the South China Sea. Current speeds through the channels linking the Pacific Ocean and Southeast Asian waters are generally on the order of 50 cm/sec, or one nautical mile an hour (1 knot). Strongest surface currents within Southeast Asia, of about 1.5 knots, are north of Flores

Island, along the Vietnamese coast and in Selat Karimata west of Borneo (Morgan and Valencia, 1984). August surface currents are predictably different in the western South China Sea. Currents are generally northerly or northeasterly and are slower than those of February. At this time the currents are westerly in the Java, Flores and Banda Seas.

Within this seasonal pattern there is often a much more pronounced tidal current pattern subset. The tidal range is generally less than 1.5m throughout the region. Areas with wide tidal range include the head of the Gulf of Thailand (up to 3m), and the northwest coast of Australia and both sides of the Taiwan Strait (to 4.5m)(Morgan and Valencia, 1984).

Tidal currents create unique oceanographic conditions in some of the shallow, narrow straits. Within the shallow Taiwan Strait (average depth 60m) there are two flood currents and two ebb currents daily. In the southern entrance the current flows northward, in the northern entrance, it flows southward. The two currents meet along a line extending between approximately 24° 30' N on the Taiwan side, and 25°20' N on the Asian mainland. Flood current speeds at spring tides have been measured at 3.6 knots (Defense Mapping Agency, #160:95). In the passages between the lesser Sunda Islands, in the Philippines and in the Torres Strait, tidal currents of 5 to 6 knots are frequent during spring tides (Morgan and Valencia, 1984). Currents up to 11 knots have been documented in some of the straits of Indonesia (e.g., Selat Flores) (Defense Mapping Agency, #161).

Section 3. Vegetation classification

Numerical techniques which have been used to analyze community ecology patterns with seaweeds are reviewed in Chapman (1986). The Braun–Blanquet vegetation classificaion techniques may be used with cover of presence-absense data. This analysis tehnique involves sorting a species-site table so as to identify cohesive site, and species groups. This method is further explained in Chapter 3.

A computer program has been developed (Češka and Roemer, 1971; Češka, 1987) which removes the necessity for extremely time-consuming hand sorting of the table. The operator specifies the statistical grouping rules to be followed, and any person using the same data set and rules will achieve the same result. It is up to the operator to interpret the automatic results and make changes in the procedure as are appropriate.

Hypotheses

1. The seaweed flora of Leizhou Peninsula and southern Hainan Island, China is more similar to the flora of Vietnam than those of Hong Kong or the Xi Sha Islands.

2. The northern South China Sea belongs within the biogeographic region of the Indo-Malayan Archipelago.

3. The published literature is a useful basis for biogeographic evaluation.

Shallow-water marine algae of the northern South China Sea: Taxonomic Results from a Field Study in South Hainan Island and Leizhou Peninsula, China

Abstract

Southeast Asia is included in the center of biogeographic diversity of the Indo-west Pacific demonstrated for a wide variety of marine and terrestrial organisms, although benthic marine algae have not been examined in this context. With several notable exceptions, information on the marine algae of the Asiatic coasts south of Hong Kong is poor and incomplete. A biogeographic interpretation of the region based only on the published floristic data is therefore ill-advised. To provide a standard of comparison, an extensive collection of shallow-water marine algae was madc in Leizhou Peninsula (20°15-21°10'N and 109°29'-37'E) and from the southernmost area of Hainan Island (18°11'-13'N and 109°29'-37'E) between September 1986 and May, 1987. From over 2,000 specimens collected during 42 collection visits to 24 sites, 219 taxa in 99 genera, 42 families and 16 orders were identified. The collections yielded 55 species in 21 genera of green algae, 49 species in 17 genera of brown algae and 115 species in 61 genera of red algae. The taxa have nearly as many tropical as subtropical elements, for example, *Dictyopteris* and *Spatoglossum* among the subtropical browns, and *Sargassum* among the tropical browns; the order Dasycladales among tropical greens; *Acrosymphyton* sp. among subtropical reds and *Galaxaura* and *Liagora* among tropical reds. Over half of the identified genera had some specimens which could not be identified to species because they lacked species specific characteristics or were poorly known taxa. The widest taxonomic diversity and the least taxonomic certainty were both demonstrated among the red algae. Species richness was highest in the red algal orders Ceramiales, Cryptonemiales and Gigartinales. The genera most common among the collections were *Ceramium, Laurencia, Polysiphonia* and *Centroceras*. Qualitative differences in the flora are discussed for four geographically distinct areas. The data from this field study will provide a floristic basis for comparison with reports from other areas of the northern South China Sea or the warm water western Pacific.

Introduction

A center of taxonomic diversity with a wide range of terrestrial and marine organisms has generally been recognized for an area bounded roughly by the Philippines, the Malaysian peninsula and Papua New Guinea (Ekman, 1953; Kay, 1980) (see Chapter 1). The South China Sea, the locale for this study, lies just north and west of this area of high taxonomic diversity (Figure 1).

The biogeography of benthic marine algae has not been investigated for this region, nor for the tropical western Pacific as a whole. Isolated reports on the northern South China Sea flora exist for southern Vietnam, the Xi Sha Archipelago, Hainan Island, Leizhou Peninsula, Hong Kong, Taiwan and the Philippines (see Chapter 1).

Although catalogs summarizing the historical floristic literature on benthic marine algae for northern Australia (J.A. Lewis, 1984, 1985, 1987), the Philippines (Silva *et al.*, 1988), Taiwan (J.E. Lewis and Norris, 1988) and Malaysia (Phang, 1986) have been compiled and published within the last decade, critical taxonomic assessment of these records was beyond the scope of these catalogs and records from these publications have not been synthesized. Each of these catalogs constitutes, however, a first look at the history of phycological thought regarding these locations, and is useful in prompting taxonomic and biogeographic queries, and provides taxonomic reports which allow a first assessment of the regional flora.

Benthic marine algae have been reported from a number of other locations within the warm water western Pacific (see Chapter 1), although most reports were not made with a floristic objective. In Vietnam, Dawson conducted a study documenting the taxonomic range of seaweeds for a number of habitat types. Results were published in two papers (Dawson, 1954, 1957). Dawson remarked on the considerable difficulty encountered identifying Vietnamese specimens, due to the paucity of taxonomic information on the tropical Pacific flora.

The present study was undertaken for the purpose of establishing a modern, taxonomically integrated, floristically wide set of data from a relatively uninvestigated part of the warm water western Pacific. The results can then be used for further studies on biogeography and taxonomy of the area.

The marine flora of the South China Sea is poorly investigated, and is virtually unreported along more than 2,000 km of continental coastline between Hong Kong and Nha Trang, Vietnam (see Chapter 1). A thorough floristic report from this area is useful as baseline taxonomic information, and also as a basis for assessment and focus for biogeographic analysis of a larger area. This study on the benthic marine algal flora of the coastal, shallow water northern South China Sea encompasses the Leizhou Peninsula (the southernmost area of continental China) and Hainan Island, a large tropical island south of the peninsula. Discussion covers overall taxonomic representation, taxonomic distribution and diversity by site and area in relation to factors of possible collection bias, and the possibilities for taxonomic extrapolation over wider areas. This information is used in the following chapters at three levels. Presence/absence patterns within the field data are analyzed in Chapter 3 by community ecology technique. In Chapter 4, insights from the two previous chapters are applied to a comparison of all previously published reports of the occurrence of marine algae in the northern South China Sea. The data are then utilized in a larger biogeogarphic perspetive of the warm water western Pacific (Chapter 5) following the same procedure.

Materials and Methods

Collections were made from the south and east coasts of Leizhou Peninsula (20°15-21°10'N and 109°29'-37'E), and from the southernmost area of Hainan Island (18°11'-13'N and 109°29'-37'E) (Figure 2) during a nine-month period from the fall of 1986 through the spring of 1987 (Table 1). The objective was to obtain a representative collection of taxa expressive of varying ecological conditions and collected in more than one season (Figures 3-4). Specimens were processed following standard techniques. All specimens were initially sorted, pressed and given accession numbers. Specimens were formalin preserved if transport to a suitable sorting location was to be delayed. Conditions of high humidity in Leizhou Peninsula challenged the proper care of specimens.

Sites. Potential sites were chosen from topographic and navigational charts on the basis of habitat variability, suspected richness of algal growth and site access. In Leizhou, final site selection was made after discussion with members of local fisheries bureaus and the

Zhanjiang Fisheries College. South Hainan Island sites were selected finally on the basis of site access.

The four sites in south Hainan Island were geographically most removed from the Asiatic mainland (Figure 2, u-w). Thirteen sites were scattered along the east and south coasts of Leizhou peninsula (Figure 2, j-t). Seven more were located on Naozhou Island, a small island east of the peninsula (Figure 2, c-i). Environmental conditions of the sites varied widely (Table 1). There were clear water sites with high energy (k, m, v, w, x), and with quiet water (m, u, v), some high energy sites with very turbid water (n, o, q) and others with intermediate visibility (f, g, h, i). The single site with the greatest area and variety of habitat was Techan Island (a, Figure 3 A,B). Sites u, v and w (Figure 4) also cover several habitats. Of these three, site u (Figure 4A) was the most varied, and included extensive shallow sandy back reef, a reef crest, an islet on the reef crest and a reef outcrop along the harbor entrance (Figure 4A).

Included in the study were mudflats (a, l, m), sandflats with rocks and without (a,b,c,d, Figure 4D), mangroves (a,l, Figure 4 A,B), tidepools (j,m), boulder-covered sites (f,h, Figure 4D), an intertidal rock bench (g, Figure 3C) and areas with considerable reef development (h,k,u-x, Figure 4).

Sites were grouped into four geographic areas: 1) northern Leizhou peninsula; 2) Naozhou Island; 3) Quwen County; and, 4) the Sanya area of Hainan Island. As the name Leizhou ("land of thunder") suggests, this peninsula is subject to violent and prolonged storms and the surrounding waters are often turbid. The area of northern Leizhou (a and b) is a shallow, protected area with extensive intertidal mudflats. Mangroves are common, though not well-developed. Naozhou Island (c through i), borders the shallow embayment defined by the northeastern peninsula. A wide range of habitats is present along different aspects of the island. There are extensive intertidal flats on the west, and relatively deep water on other aspects. The island is notable for its extensive boulder-strewn coasts in the northeast and southeast. The south coast of Quwen County (j through t) borders the narrow (25 km) and shallow (average 44 m) Hainan Strait and is subject to swift diurnal currents (Enderton, 1984). Biotic reefs and mangroves are both sparsely present. The southern shorelines are mostly abrupt, the water very turbid.

Site t is represented in the tables by a single drift specimen of *Sargassum hornerii* (Table 6). The full subtidal collection of site t (3 species after 1 hour's snorkel search) and of Bei La Gang, positioned along the mid-eastern coast of Quwen County (a site with luxuriant and diverse growth of algae on coastal rocks), were lost. Many specimens from the rich and diverse tidal pools of site m were also lost due to decomposition within two hours of collection. This is best explained by the presence of the genus *Desmarestia* in this collection, but there is no specimen on which to base this determination. *Desmarestia* liberates an acid which leads to the deterioration of all algae exposed to it.

The four sites (u,v,w,x, Figure 4) of the Sanya area lie approximately 300 km south of Quwen County. Well-developed reefs, beaches with white sand and coralline rubble and clear warm water characterize these sites. Several habitat areas originally targeted for inclusion in this study were excluded due to logistical difficulties. For this reason, a small number of broad sites were collected thoroughly and repeatedly.

Collection Design. The objective for each collection was to obtain specimens of all taxa present. Sites included a range of depths from high intertidal to subtidal depths of 5 m. Most collections came from intertidal and shallow subtidal areas. These were mostly from the top two meters, when water was clear, and the top meter when specimens were located by touch. Mask and snorkel were used when visibility allowed.

Preparation and Identification. Specimens were sorted, pressed and given accession numbers as soon after collection as possible. Final sorting was made at the time of identification, with all specimens available for comparison. Collection number suffixes (a,b,c, etc.) were added for those epiphytes or other taxa separated at this time. Identifications were made with the assistance of a group of taxonomic specialists, at the Phycology Laboratory of Dr. C.K. Tseng, Academia Sinica Institute of Oceanology, Qingdao, Shandong Province, China. All specimens were marked with collecting number, but geographic information was not included and could not therefore be used in grouping specimens for identification. This reduced possible geographic bias in assigning names. Approximately 100 green specimens were not identifiable in Qingdao. Those were forwarded to Nanjing University for further investigation.

Duplicates of all taxa are housed at the herbarium in Qingdao (AST), and a permit for the remainder of the specimens to be shipped out of China was obtained (there is a policy within China to keep biological specimens within China, and such permits are difficult to obtain). It is anticipated that further sets of taxa will be housed at the Bishop Museum, Honolulu, Hawaii and at the National Museum of Natural History, at the Smithsonian Institution.

Results

A complete taxonomic listing, arranged systematically by family and order, is presented by site and area (Tables 2-7) for the Divisions Chlorophyta (Tables 2,5), Phaeophyta (Tables 3,6) and Rhodophyta (Tables 4,7). The data in these tables are further analyzed and compared later in this chapter and in Chapters 3, 4, 5 and 6. Frequency of sites reported by taxon is given in Figure 5.

Taxonomic information is summarized by family and genus (Tables 8,9) and by order (Table 10). These tables summarize the distribution of taxa for the four site areas. Reports of taxa collected at only one site are considered to be a special case; these taxa are referred to here as unique taxa, and are presented separately (Tables 5-7).

Floristic conditions of the sites and site areas are summarized in Tables 11-13, with an emphasis on unique taxa. Sites and areas by number of green, brown, red and total taxa, and of the number of unique taxa and percentage of unique taxa by sites and site areas are ranked in Table 11. Patterns of distribution among unique taxa are given in Tables 12 and 13.

Collection trends (Figure 5) are presented in terms of the number of sites where taxa occurred for green, brown, red and total taxa. Figure 6 presents floristic site summaries in mapped form for each site,and site area. Data are further examined from the standpoint of collecting tendency. Tables 14-16 present taxonomic representation as compared to collection representation.

Taxonomic summary: numbers and distribution of taxa by division

Taxonomically, the dominant constituent is Rhodophyta (58.2% of genera; 52.5% of species). Over half of the identified genera (72 of 102) had some specimens which were not identified to species. A disproportionate number of these were in the Rhodophyta, a not unfamiliar situation in nearly all newly collected areas in the world.

Chlorophyta. Green algae were identified to 4 orders, 12 families, 24 genera and 57 species (Tables 2,5, and 9). Each order was represented within each of the four areas, although three out of the four families in the Caulerpales were unrepresented in northern Leizhou. One family, Bryopsidiaceae, had no specimens identified to species. Further, taxonomic uncertainty led to compound generic names being adopted for the *Trichosolen/Bryopsis* and *Cladophoropsis/Boodleopsis* pairs.

The orders Caulerpales and Dasycladales, considered tropical orders, were well-represented in the collections. In southern Quwen County *Caulerpa* was particularly abundant in the early spring, growing on low intertidal boulders in dense mats. *Acetabularia parvula* and *Neomeris annulata* were commonly encountered, often in abundance, on Leizhou Peninsula, and may be under-represented in the final presence-absence table.

The area with the greatest number of green genera, 21, was Quwen. N. Leizhou was the least, with 7 genera. The most represented site, Denglou Point (k), had 17 genera. Only one genus was collected in Cunliang (Table 8). A similar pattern existed at the level of species.

Phaeophyta. Five orders of brown algae were identified, consisting of 6 families, 17 genera and 49 species (Tables 3, 6 and 9). The two orders Dictyotales and Fucales were present in all areas. Dictyotales were represented at all sites except b (Table 9). Sites w and x had members of all orders, k was missing only Sphacelariales, v missed Ectocarpaceae. Of the six families, sites w and x had representatives of all six, v and k had five each. Eleven of the 17 (65%) genera had no specimens identified to species. Two families were represented totally by genera unidentified to species (Ectocarpaceae and Sphacelariaceae). Northern Leizhou had no representatives of two orders, Ectocarpales and Scytosiphonales.

Representatives from the most widely represented order, Dictyotales (Table 9), were collected at 92% of the sites. Species number is greater in Fucales (22 species vs. 18 in Dictyotales), but only 75% of the sites had representatives of this order. The two species of Ectocarpales were represented in 29% of the sites. Dictyotaceae and Sargassaceae had the greatest number of species, 20, reported. Several genera of these two families are typically tropical (i.e., *Dictyopteris* , *Padina, Sargassum*) .

The number of brown genera per area was 14 for all areas except N. Leizhou, which had three. Sites with greatest diversity at a generic level were Denglou Point (site k, 12 genera), and Da Donghai (site w, 11 genera)(Table 8). Sites with highest representation of brown genera were sites k (12 genera), w (11), x (9). Sites g, q, s and v each had eight genera. Hong Liu (b) and Santang Point (m)each had only one brown genus. Site m, as has been mentioned earlier, was not fully represented by the final specimens, so the low representation is considered an artifact. Field notes for that site mention the rich and diverse brown component to the site.

Rhodophyta. Red taxa dominated the collections taxonomically and quantitatively, constituting 53% of the species, 58.2% of the genera, 57% of the families and 44% of the orders. Rhodophyta were represented with seven orders, 24 families, 61 genera and 115 species (Tables 4,7,8, and 9). Sixteen of the 24 sites had at least 15 red species (Table 11). Red taxa were generally present at a smaller number of sites than green or brown.

Red taxa have the largest number of unique species. Twenty-nine of the 115 species were collected from only one site and most of these were in the Nemaliales (Table 7). The collection for Yalong Bay (x) had the greatest number of unique red taxa, although it was visited only once. The four sites of the Sanya area had more unique species (13 species) than the 10 sites of Quwen (7 species), the 7 sites of Naozhou (5 species) or the two of northern Leizhou (4 species).

Four families are represented in this study entirely by genera unidentified to species: Dumontiaceae, Caulacanthaceae, Bangiaceae and Goniotrichaceae. The orders Bangiales and Porphyridiales were only collected from Naozhou Island. The orders Cryptonemiales and Rhodymeniales were absent from northern Leizhou, although present in the the other three areas. The family with the most genera was Rhodomelaceae (9), the genera with the most species were *Gracilaria* (12 species), *Laurencia* and *Liagora* (6 species each).

Discussion

The proportion of unidentified species to all species was 40% for red, compared with 31% for green and 22% for brown. The number of genera with no identified species was 29 for reds (47% of all genera), 4 for green (19%) and 5 for brown (29%).

Taxonomic summary. Each taxon was present at from one to 19 of the 24 sites (Figure 5). Representation is summarized by number of genera at each site for each family (Table 8), for family presence/absence by area (Table 9) and percentage representation by order for each area (Table 10).

Centroceras clavulatum was found at 14 sites, *Gelidium pusillum* at 13. Unidentified species of *Hypnea* were found at 19 sites, *Ceramium* at 18 and *Gelidium* and *Dictyota* each at 14. The families with the greatest numbers of represented genera (Table 8) were Dictyotaceae, Corallinaceae and Ceramiaceae, each with 7 genera.

The families most widespread (at the greatest number of total sites) in the collections (Table 9) were Ceramiaceae (23 sites), Dictyotaceae and Gracilariaceae (22) and Rhodomelaceae (21). Goniotrichaceae was restricted to one site. Five families were restricted to two sites, two families to three sites and four families were restricted to four sites. In three cases, an order is represented by a single species. At one of these, Porphyridiales, it is also from a single site.

Data quality

This study provides insights into the identifiability of different taxonomic groups. It has been emphasized that the integrity of biogeographic conclusions based on taxonomic record of seaweeds pointed out the numerous possibilities for error (May, 1944; Lewis, 1990). Hoek and Donze (1967) used published reports for biogeographic analysis, but limited the species only to those "more or less identifiable species." Doty (1973) provides insights into what these distinctions might be, and gives as examples of taxa which are more or less certain when they are reported in the literature: *Tydemannia expeditionis, Acanthophora spicifera* and *Actinotrichia fragilis*. These are considered certain because of their unique morphologies. There is much more certainty in general at a generic level, but with a large number of genera (i.e., *Halimeda, Turbinaria, Caulerpa,* among others) their utility at a species level decreases markedly due to a lack of globally determined species distinctions. In many cases there are a large number of species reported in the literature for a given genus, each with too few reports to make a biogeographic interpretation possible. This, in many cases is due to the taxonomic uncertainty at the species level. Dixon (1970) and Irvine and Price (1978) describe obstacles to modern seaweed taxonomy which underlie this confusion over names.

In the present study, although specimens were identified consistently with respect to this collection, certain taxa present clearer distributional patterns than others due to a combination of factors. Many taxa are reported from too few sites for a coherent picture to emerge. This project has very real advantages over published information, however, in having been collected with the specific intent of floristic breadth, and in having identifications made consistently during a single time, resulting in the consistent application of names. Some observations about taxonomy and representation from this study are given, below.

Acetabularia parvula may be under-represented in the final presence-absence table due to the small size of the specimens: it is easy to overlook. In 1980 this alga was found by the author in Hong Kong, but it has not yet been formally documented from Hong Kong. In the same way, but to a lesser degree, *Neomeris annulata* may be under-represented. Ectocarpales are probably more widely distributed than reported, but were overlooked because of their small size.

Members of the Dictyotaceae and Sargassaceae are difficult to overlook and thus have the greatest liklihood of thorough collection. Nevertheless, the 20 species reported here may be an under-representation simply because, in the interest of achieving taxonomically diverse collections in a limited time, the special attention necessary for complete collection of *Sargassum* was not possible. Nevertheless, *Sargassum* was collected at all but 6 sites (Tables 3, 6), all with suitable habitats.

The seven genera of the Dictyotaceae (*Dictyopteris, Dictyota, Lobophora, Pachydictyon, Padina, Spatoglossum and Zonaria*) are distinct and easily distinguishable, often growing in a conspicuous bushy form. For this reason, and the relative clarity of identifications at generic level, this family may be especially useful in biogeographic comparisons. Comparisons based on field work would have the advantage of consistent species identifications, those based on published literature would be relatively reliable at the generic level. In the Scytosiphonaceae, identification of *Colpomenia sinuosa* and *Hydroclathrus clathratus* were accidently interchanged on occasion, owing to difficulty of discrimination between young thalli. The reports for these taxa may still reflect some error.

A combination of seasonal trends and appropriate habitat were most likely responsible for the large number of unique red taxa at site x (Yalong Bay). The site was visited only once, but that was during the season of peak abundance for Nemaliales (I.A.Abbott, pers. comm.). Although certain red taxa were disproportionally represented in accession numbers, collection trends among the red algae demonstrate that the overall relationship of red algal taxa to accession numbers was in keeping with its final taxonomic representation (Tables 13-15). Red algae had the greatest frequency of occurrence. Seven of the 10 most frequently collected taxa were red (although all of those were unidentified to species, and probably represented many taxa) as were 61% of all taxa with over 10 accession numbers (Table 13). The overall representation at the generic level, 54%, is in keeping with other trends, however several genera appear disproportionally represented in terms of the number of species which were finally identified (Table 14).

Whereas *Sargassum*, a genus of brown algae with 66 collections was found to represent 20 species, none of the 73 *Ceramium* specimens were identified to species. *Hypnea*, with 99 accession numbers, had three identified species, but most specimens (77) were unidentified. These observations indicate a need for taxonomic work among these red algae.

Taxa by number of reports

To be biogeographically useful a taxon should occurr with a frequency which is too high, or too low to make geographic distinctions. In this study, the relatively high occurence of taxa collected only once throughout the field work (27% of all species) is of interest examining the possible causes for these single occurrences, and applying these observations to a strategy for selecting species within the published literature for biogeographic extrapolation. Many red algae are known to occur during narrow seasons, so its occurrence within a collection would not have biogeographic, but seasonal meaning.Taxa which were infrequently collected because of strict ecological requirements may be used as indicators. Twenty-nine of the 115 red algal species were collected from only one site and most of these were in the Nemaliales (Table 7). In many instances, it is believed that they were present at many more sites at the time of collection. If this is so, the reasons for such a skewed collection are of interest. They may include seasonality. Of those taxa reported from only one site there is a seasonal difference among red, brown and green taxa. With reds there is a higher percentage of single reports during the wintertime. The percentage of total species which were only reported from one site was approximately the same for all groups. The lowest was red with 25%, brown had 28% and green 29% (Figure 5).

Another consideration in collection bias is a tendency for certain taxa to be found individually rather than in turfs or another grouping form. These algae may have cryptic thallus morphology or be found in habitats which are seldom collected, or where visibility is low and so a smaller percentage of algal taxa which are present are collected.In turbid water, when species were located solely by touch, it is apparent that many taxa could have been present but overlooked. Some habitats may also have been systematically missed.

Six percent of the taxa were reported more than 10 times (Figure 5). These taxa cover a range of morphologies. The order Ceramiales, although consisting primarily of very small or epiphytic taxa, is highly represented in this study (Table 4, 9, 10, 12). This may suggest either a bias of the present collector for these taxa, or of other collectors against them. Alternately, it could mean that there are simply many taxa that are uniquely common within this study area. It is more likely, however, that epiphytic taxa are commonly encountered, but not reported because they cannot be assigned clear species names. A further possibility is that epiphytes are indicative of high nutrient waters.

Analysis of the collections indicates that advantages could be gained in future studies by adopting a collection strategy which was based on a preliminary species checklist and results of planning transect studies. The transects could demonstrate abundance trends and species grouping around repeating coastal formations (i.e. around all aspects of a headland, or of a bay)if the results of a large number of transects were reported. This could allow for trend identification, useful as a basis on which to select sites. Limitations to both parts of this strategy are general logistics including time and manpower, as well as the general state of phycological taxonomy (see above). Difficulties with this assumption are that seasonality would somehow have to be factored in, and it would have to be much more thoroughly understood than it is now in order to do that. In effect, this study is just such a preliminary study, and should point the way to more effective future use of limited field time.

FLORISTIC RESULTS IN THE FOUR AREAS

1. North Leizhou. The floristic characteristics of N. Leizhou are: 1) low numbers of genera and species, 2) a limited representation at higher taxonomic levels and 3) the high proportion of brown species which are unique to the area. The area is lowest in diversity of all three major taxonomic groups (Table 10)of the four areas studied. It ranks highest in the percentage of brown algal species which were unique (2 of 4 species, or 50%). The actual number of unique brown species was highest for Quwen County area (7 unique species) and at site k (2 species) within the Quwen area. Species of Ulvales were diversely represented at many sites at N. Leizhou as well as the Naozhou area, and at Denglou Point (k). These taxa are often indicative of high nutrient waters.

Only three of the 14 genera identified in this study were collected from this area (Table 8). One possible explanation could be that this represents a northern outpost of the distribution range of certain taxa. It is also possible that the habitats were unsuitable to most of the genera for reasons of natural water or substrate conditions, or effects of pollution. Those taxa present here and from only one other area (*Gracilaria blodgettii, G. tenuistipitata* and *Catenella* spp.) may be linked by similarity of habitat. No green or brown algae fit these limits.

Forty-two families are documented within this study for the flora of the northern South China Sea. Of these, 60% (25 families) were unrepresented for N. Leizhou, including 6 of the 12 green families (50%), 3 of the 6 brown families (50%) and 16 of 24 red families (67%). Fourteen of these families were present in all of the other three species areas (Table 8). If a thorough coastal survey were done of northern Leizhou Peninsula, it is likely that many of these would be found in isolated patches of appropriate habitat, but a majority of the coastline is floristically barren. In addition to those which were collected, several northern Leizhou sites were visited, and many more observed along coastal roads. Very few appeared to present the potential for diverse, floristically or taxonomically significant collections.

Prof. Lii Weixin reported that on all his previous visits to Techan Island, beginning in the early 1960's, there was much higher species diversity and algal abundance. Possible factors contributing to reduced diversity were a typhoon which hit this area several months before the study began, and a perceived trend toward increasingly poor water quality. The island is adjacent to a major South China oil port.

Hong Liu is an extensive sand and mud flat which initially appeared to be floristically barren. No taxa were found in abundance. *Gracilaria* was the most obvious alga, and therefore dominated the specimens. It grew as sparse, widely-scattered clumps. Although, in the field, specimens did not appear markedly different, three species were identified in the laboratory. If the flora had not been generally depauperate, it is unlikely that all three species would have been represented because fewer specimens of *Gracilaria* would have been collected.

Taxonomic diversity is marked between these two sites only in the red algae. Numbers of green and brown species are comparable (11 vs. 7 and 4 vs. 3, respectively) but the difference among Rhodophyta is considerable (20 vs. 6) (Table 11). The same generalization holds at genus level (Table 8). This indicates that red algae may generally be more useful biogeographic indicators, reflecting habitat differences in a more pronounced way.

2. Naozhou Island. This island presents a range of coastal habitats with a diverse and rich algal flora. It is second in overall species richness, first for green and brown algae, and third with red algae. However, except for two orders uniquely present here, the taxa are mostly found in other areas, as well (Tables 8, 10). On the basis of the percentage of the flora which is unique, Naozhou ranks third in uniqueness of green and brown taxa, and fourth for red taxa. The second most diverse site in the study is in this area, and yet that same site ranks 11 out of a possible 13 for uniqueness (Table 10).

The coast of Naozhou Island is considerably shorter than that of Quwen, and the number of sites fewer, yet the higher level taxonomic pattern is quite comparable. Numbers of genera were comperable (73 and 81) and there were no clear differences in the distributions among the green, brown and red algae. Seven families were unrepresented for Naozhou, and 6 for Quwen. Percentages of unique taxa were lower in all categories for Naozhou (Table 12).

Of the 12 green algal families represented in this study, only two were absent from Naozhou, along with one brown family (out of 6 total) and four red families (out of 24). Dasycladaceae is the only family absent in this area which is not absent from at least one other study area. The greatest number of species for this area was found at Na An (site g), and the greatest percentage of unique species (15%) at Dan Shui (Table 11). The greatest percentage of unique species was among the brown taxa (Table 12). The small species of *Acetabularia* (*A. parvula*) was abundant along the coast, and Dan Shui was the only site where a more macroscopic species (*A. calyculus*) was also found (Table 5).

Taxa which were found here and at Quwen, but nowhere else were *Valonia aegagropila, Chaetomorpha antennina, Cladophora aokii, C. rugulosa, Dictyota bartayresiana, Spatoglossum pacificum*, two species of *Sargassum*, an unidentified genus of Corallinaceae, *Corallina officinalis, Gigartina tenella, Gracilaria salicornia*, unidentified species #2 of *Gymnogongrus*, the genus *Phyllophora*, 2 species of *Hypnea, Coelothrix irregularis*, the genus *Bostrychia* and *Polysiphonia friabile*. It is possible that these require the nutrient-rich high energy water that these two areas share.

Five taxa were present here and in Sanya, but were absent elsewhere on Leizhou Peninsula. They are: *Caulerpa ambigua, Avrainvillea* species #1, *Mastophora rosea* and the genera *Acrosymphyton* and *Spermothamnion*. The first and last taxa are cryptic and easily overlooked. It is possible that all these could be found in Quwen County if they were specifically sought. Four taxa were collected from more than one Naozhou site in this area, but were found nowhere else in the study. They are: *Endarachne binghamiae*, two species of *Sargassum*, and the genus *Scinaia*. If similar habitats were carefully collected in Quwen and Hainan, it is considered likely that these would be found to be more wide-spread. A study exclusively on the distribution of *Sargassum* species on Leizhou and Hainan would be of considerable interest. This is generally an area of high diversity and abundance of this genus. One of the species collected in this study, *S. fusiforme*, is a valued Chinese herb.

3. Quwen County. One hundred fifty-five species were reported from the Quwen County sites. Twenty-three percent were unique. This area had the highest diversity ranking in this study for all groups (red, brown, green and total). Percentage of unique taxa ranked second all around. Almost half the species for the whole area were found at the single site Denglou

Point (site k). Denglou Point had the highest species richnes of the green and brown taxa of any site in this study. It ranked seventh, however, for diversity among red algae, and was third overall.

The one family absent from Quwen specimens, yet present from all other areas was the Sphacelariaceae. The order Sphacelariales was one of three orders unrepresented in Quwen collections (Table 8). It is very likely that these small algae were present, but overlooked.

Fourteen taxa, all for the most part, representative of tropical floraswere collected only from Quwen and Sanya. Green taxa were: *Anadyomene wrightii, Dictyosphaeria versluysii*, species #2 of *Avrainvillea* and *Udotea.javensis*. There were four brown taxa: *Chnoospora implexa, Dictyopteris membranaceum* and two species of *Dictyota*. The six red taxa were: *Amphiroa foliacea*, the genus *Polyopes, Hypnea nidifica, Champia parvula* (and other unidentified *Champia* specimens), *Chondria armata* and *Laurencia majuscula*.

Nineteen other taxa with potential biogeographic significance were those exclusively found in Quwen: *Caulerpa taxifolia, Grateloupia* (2 identified species and others unidentified), *Gracilaria purpurascens, Polycavernosa fastigiata, Gymnogongrus* unidentified species #3, *Solieria robusta* (and the family Solieriaceae), *Rhodymenia intricata*, all *Cryptopleura* species, *Acanthophora spicifera, Laurencia undulata*, and all *Symphiocladia*. Biogeographic significance awaits information on the distribution of these taxa across a wider geographic range.

4. Sanya. One hundred fifteen taxa, 20 (17%) of them unique, were reported from the four Sanya sites. Most taxa (67) were red. There were 27 greens, of which 18% were unique, and 21 browns, of which 14% were unique.

Sanya was third of the four areas in species richness but first in the percentage of unique taxa . Green and red subgroups were also low in richness, ranking third and second, but they also ranked highest in uniqueness. Brown algae ranked third in richness and fourth in percentage unique.

Seven families (Monostromataceae, Cladophoraceae, Gigartinaceae, Solieriaceae, Caulacanthaceae, Bangiaceae, Goniotrichaceae) were found at other areas in this study, but not here. The two orders Bangiales and Porphyridiales were unrepresented.

Several species were found exclusively in the Sanya area but at more than one site. Only one was a green taxon (*Halimeda macroloba*); there was a single brown alga, an unidentified species of *Chnoospora*. Most were tropical red taxa: *Liagora farinosa, Galaxaura rugosa, Amphiroa fragilissima, Jania capillacea, Carpopeltis* spp., *Halymenia* spp., *Gracilaria eucheumoides* (at all 4 sites) and *Tolypiocladia glomerulata*.

Alternately, those taxa present within all three Leizhou areas, but absent here were mostly green taxa (7 of 10). It is likely that the absence of these species from Sanya can be explained by the limited range of habitats sampled in Sanya. Green taxa included *Monostroma nitidum, Enteromorpha clathrata, E. flexuosa* and *E. intestinalis, Cladophoropsis zollingeri*, and unidentified species of *Chaetomorpha* and *Cladophora*, and the red taxa *Gracilaria asiatica, G. heteroclada* and *Acanthophora muscoides*. There were no brown taxa present in all three Leizhou areas but absent here.

The greatest number of taxa reported from a single site was 74 from Da Donghai (site w). This is not surprising because it was also the site which was most frequently collected, the habitat range collected was wide, and collections were made over several seasons.

Collections of this area were different for a number of reasons. These were the only sites collected repeatedly during the fall of 1986, and they were collected again in the following February. Leizhou Peninsula collections were initiated in March. Therefore seasonal shifts in the flora were more likely to be documented here than in any other area. Habitat was also drastically different from any sites on the peninsula. Biotic reefs were also extensive and well-developed.

Lack of permission for access to collecting sites forced examination at only a few open access tourism areas. With permission, and logistical support including boats, SCUBA equipment and assisitants, and with extensive collecting opportunities during the peak season (November through January) the number of reported taxa would no doubt quickly increase significantly. Only a small fraction of the available habitat types were sampled in this study, which exclude the many rocky steep headlands, the extensive bay west of Sanya (Sanya Bay) and its two main islands (West Island and East Island) at the edge of the bay. The oceanside of both islands is precipitous with a well-developed headland (Defense Mapping Agency, #93698).

The sand beach at Ya Long Bay (site x) has virtually no rock outcrops, and therefore no good place for algal attachment. Because of the rocky, often high energy sides of the bay, the hard off-shore substrate in this relatively shallow bay and the presence of several islets and islands within and on the edge of the bay, this is considered to be an ideal location for further exploration.

Flora

Biogeographic character of the taxa. It is suspected that a high percentage of the taxa reported in this study have never been before reported for the South China Sea, but verification of that will await a comparison with the published literature.

The taxa have nearly as many tropical as subtropical elements, for example, *Dictyopteris* and *Spatoglossum* among the subtropical browns, and *Sargassum* among the tropical browns; *Acrosymphyton* sp. among subtropical reds and *Galaxaura* and *Liagora* among tropical reds.

Figure 6 summarizes floristic data in terms of total green, brown and red species, and the percentage of that total which are unique for each site and for each of the four areas. The major geographic division among these collections comes between Sanya and the rest of the sites. Examining the data from the perspective of two major geographic areas further helps distinguish possible geographic from habitat differences i the taxonomic results.

Although Doty (1973) remarked on the lack of clear trends in island floras, small islands with at least one high-energy shore offer attractive study sites for the range of habitats available with exposure. When the study objective is to collect a wide range of members of the flora, collecting can be efficient on such islands. Naozhou has a range of habitats from extensive mud/sand flats to high-energy steep rock-faces to boulder-strewn embayments and headlands. Most of the coastline has granitic boulders. Subtidally there are noticeable differences in the invertebrate communities (barnacles, coral, ascidians, etc.). A second island on the west side of Leizhou Peninsula, Weizhou Island, could provide a valuable site for a comparative study with Naozhou, and lend insights into wider-scale distribution patterns (Figure 2).

Analysis by accession numbers. Although this study made no attempt to present a quantified analysis, accession numbers could be considered as possible indicators of abundance or or commonness of taxa. In anecdotal comparison between field impressions and accession numbers, it is important to note that an accession number may consist of a large number of specimens of a single species or a single specimen, and one collection period may have more than one accession number for a taxon. There was, however a general attempt to first sort by taxon, then to give a collective accession number to all members of one taxon from the sample. This method was most successful with large, morphologically distinct specimens. Accession numbers were frequently subdivided (adding suffixes a,b,c, etc.) when processed specimens were more thoroughly examined.

Taxa were sorted quantitatively by accession numbers. Genera (Table 15) and species (Table 16) with more than 10 accession numbers show a preponderance of red taxa in both groups. Of the total 29 genera, most (17) are red, while green and brown have six each. Forty-one species are mostly (22) red, with 9 each for brown and green.

The brown genera, *Sargassum*, *Padina*, *Dictyota*, *Spatoglossum*, *Lobophora* and *Colpomenia* are all common tropical genera of distinctive morphology. *Lobophora* is the most likely to be under-represented because of its growth habit. It is found most frequently as a bracket-shaped blade growing in dark crevices. Although *Colpomenia* has the fewest accession numbers of this group, several sites were in fact dominated by this taxon.

Sargassum is the genus in this study with the largest number (21) of species (Table 14), and it is probably the bulkiest non-coralline tropical seaweed genus. It often grows in thick multi-species patches in high-energy intertidal to subtidal areas. Taxonomically it is difficult, and is rarely identifiable to species except from mature specimens collected late in their growing season (late spring, usually).

Given the low likelihood of successful identification and the relatively high degree of effort in collecting and formally preparing specimens of the genus *Sargassum*, it would most likely have been omitted from this study except for the fact that there is a Chinese taxonomist (Lu Baoren) who is capable with *Sargassum* identification. For this reason a number of collections were made, resulting in 66 accession numbers. The two *Sargassum* species in Table 16 represent 25 accession numbers. The remainder were identified to species represented by fewer than 10 accession numbers each. Large stands were sometimes found of *Sargassum fusiforme*, an important Chinese medicinal alga, though few collections were made.

Of the six genera of green algae with more than 10 accession numbers (*Enteromorpha, Ulva, Monostroma, Caulerpa, Boodleopsis/Chlorodesmis* and *Bryopsis/Trichosolen*) the first three are among the commonest seaweed genera worldwide. They occur in a wide temperature range, under a variety of ecological conditions, and are especially abundant in high nutrient waters. *Caulerpa*, generally regarded as a tropical genus, was found thickly carpeting boulders at several sites in Quwen County. Of the remaining two genera, *Bryopsis/Trichosolen* was the least common, a fact not reflected by accession numbers (13 vs. 14 for *Boodleopsis/Chlorodesmis*). This is explained no doubt by the distinctive morphology and growth form of *Bryopsis*, which led to preferential collection. The absence of *Acetabularia* from this list is noteworthy because, as mentioned earlier, it grew profusely along the coasts of Leizhou Peninsula and Naozhou Island. The apparent discrepancy is most easily explained by the small size (usually less than 2 mm in diameter) and the habit (growing in indentations in boulders or coral heads) which make collection more difficult. Small specimens which are collected are more prone to be overlooked in collecting if large bulky species are present, and if collected, are more likely to be overlooked in sorting.

The two red genera with greatest number of accession numbers, *Gracilaria* and *Hypnea* present taxonomically two entirely different situations. *Gracilaria* is widely considered to be taxonomically difficult, despite recent serious study on the part of many (Xia & Yamamoto, 1985; Chiang, 1985; Norris, 1985; Abbott 1988), the features that might be used for species distinction are still being selected, tested, modified and changed. For the first time in phycology, the genus has been examined on a nearly world-wide basis (Abbott & Norris, 1985; Abbott, 1988) with taxa from the Chinese, Japanese, Hawaiian, North America and Caribbean coasts being studied together. While the taxonomy is not yet stabilized, it appears that it may be in the near future.

Hypnea, on the other hand, suffers from "geographic taxonomy" in which no attempt has been made to monograph the genus on an ocean- or worldwide scale. Until this is done, the species within the genus will be described from geographic pockets without inquiry into the status of species in other geographic areas, hence enforcing the idea of "new" species with small distribution ranges, and a lack of synthesis.

Specimens identifiable to genus, but not species. Species identification in the genus *Hypnea* is difficult because of lack of knowledge of the variability of each described taxon in each geographic area where it has been studied. Less than half (31) of the 72 genera (Table 13)have some specimens which are tentatively identifiable to species. Of the remainder, the 45 red genera are represented by 30 unidentified species; of the 10 brown genera only 4 are known species, and 5 of the 17 genera of green algae do not have identified species. The listing of genera in some of the tables, therefore, is more reliable as data points that may suggest diversity, instead of having some genera with species names, and with unidentified species within the same listing.

These genera have in common the taxonomists' dilemma shown in *Hypnea* species. Specimens cannot easily be identified without monographing the genus, or more numerous collections are required in order to study variability. In some cases, specimens from other parts of the world where studies have been made need to be borrowed, or type specimens need to be loaned in order to make the final critical evaluation. Ideally, all of these options are taken by phycologists who are systematists. These options are, however, outside the likely means of the person making first-time collections in an area where the data collected are to be used for other purposes than a systematic study (i.e. resource surveys for mariculture or wild harvest; when attempting a first-order community or biogeographic analyses, meant to be applied to some ecological or other research question).

It is, however, important that these specimens without species names be made available to those who have the systematics of Chinese marine algae as their goal, and this has been done by leaving a set of these collections at the Chinese national algal herbarium in Qingdao.

Summary

This paper provides a description of the field study, site selection and methodology and an account of the species collected with speculation on factors influencing the potential completeness or representativeness of this collection. Discussion centers on the distribution of records from a species perspective, and asks such questions as which are the most regularly/irregularly collected species, and why (morphology, habit, season, areas covered). This study was conducted with a floristic view and the belief that floristic data, along with

an awareness of some of the possible confusing factors associated with them, are the foundations to any level of biogeographic study. Monographic studies on several genera are necessary to fully identify the collection from this study.

The major drawback of this kind of study is the taxonomic uncertainty surrounding many of the benthic marine algae. This study demonstrates, however, that the information gathered under less than ideal conditions is still useful, can be examined from a number of viewpoints, and can point a predictive pathway to biogeographic analysis on a large scale. At the same time it highlights opportunities for efficient and important taxonomic studies, suggesting which taxonomic groups may be the best biogeographic indicators, and yet are presently in need of clarification.

An ideal biogeographic study would be based on a listing of all taxa present in all habitats for discrete areas associated with hypothesized factors of distribution and centers of diversity. That list of taxa would be consistently identified and named following nomenclature and standards of one time, a time in history when all species would be familiar, and all life histories and morphologies would be scientifically subsumed.

With such a secenario, tests for biogeographic factors would be quite straightforward. This does not reflect the current situation with the seaweeds.But biogeography is both a hypothesis generating exercise and a kind of litmus, or diagnostic test for the state of science of any biological organism. For it to work, data need to be organized, coherent, comparable and complete. To the degree that they are, a clear biogeographical picture can emerge. And when they're not, specific ways to advance the field will be made evident. In elucidating factors obscuring the biogeographic picture, an agenda for the field emerges.

Acknowledgements

This paper was part of Doctoral research completed at the University of Hawaii, Botany Department. Dr. Isabella Abbott was major advisor to this project, and thanks go to her, and to C.K. Tseng for assistance throughout. Dr. Tseng first suggested a floristic study of Hainan Island to be used for biogeographic comparison in the region. Field research was partially funded through East West Center, Honolulu, Hawaii. Thanks go to the administration, faculty and students of Zhanjiang Fishery College, Zhanjiang, Guangdong Province, China. Liu

Sijian, President of the College, provided logistical support. Prof. Li Weixin, Ding Zenfen, Li Liquan were enthusiastic supporters of the project, and were all instrumental in the success of the Leizhou Peninsula field work. Students of Prof. Li assisted greatly with tasks of specimen pressing and processing. Identifications were conducted with the assistance of Chinese specialists, including Dong Meiling (Chlorophyta), Lu Baoren (Phaeophyta) and Xia Bangmei and Zhang Junfu (Rhodophyta), to whom I am extremely grateful. C.K. Tseng and I.A. Abbott oversaw all identifications. Though retired and writing several books, Prof. Zhu at Nanjing University took on the examination of those green taxa unidentifiable in Qingdao. Dr. Paul Larned put the species tables into final desk-top published form; Dr. Kent Bridges assisted with many aspects of this work, not least of which was assistance with desk-top publishing and computer graphics capabilities.

Table 2.1. Field collection sites. Codes are shown on the map in Figure 2.2.

Code	Site	Colln Date	Location and Habitat
a	Te Chan Dao	3-8,10	Techan Island. At the mouth of Zhanjiang Harbor. Extensive tidal flats of sand and mud with well-developed mangrove patches up to ca. 150 m long on the SE, E, and NE sides of the island. Collections exclusively intertidal.
b	Hong Liu	4-9	Haikang County, central Leizhou peninsula. Mud/sand flat, with few,short mangroves.
c	Liu Zhu Cun	3-16	W. Naozhou Island. Mudflat with scattered,mostly small rocks forming the intertidal.
d	Dan Shui	3-16,17,19 4-28	W. Naozhou Island. Shallow bay with very gradual slope. Sand and sandy mud.
e	Nan Jiao	4-29	S.W. Naozhou Island. Rock outcrop on sandy beach.
f	Cunliang	3-19	S.E. Naozhou Island. Basaltic boulders on sandy bottom.
g	Na An	3-18,20 4-16	E. Naozhou Island. Rock bench and rock walls south of sandy beach.
h	Doulong Point	3-17,18	N.E. Naozhou Island. Basaltic boulders with coral near lighthouse.
i	N.W. Naozhou	4-28	N.W. point of Naozhou Island. Scattered boulders on sandy bottom.
j	Xujia	4-7	N.W. Quwen County. Gradual muddy intertidal with abundant small rocks and numerous shallow tidepools.
k	Denglou Point	3-13,14,4-8	S.W. point,Leizhou Peninsula. Coral reef,clear swift water,collections primarily from intertidal and high subtidal.
l	Nan Shan	5-3	Mangroves and offshore islet.
m	Santang Point	3-24	Large tidepool and adjacent rocky area. Area where fishing activity high. Most specimens lost from this collection because of presence of **Desmarestia** sp.
n	Haian Bay Islet	4-21,22	E. and S. shores of islet. Mud and sand shore with abundant rocks. All collections intertidal.
o	Haian Bay	3-27	Rocky sand bar in bay fringed with large barnacle-covered rocks. Collections made intertidal and high subtidal.
p	Baisha Dadui	3-26	Collections made S. of Baisha settlement, in high subtidal area in high subtidal, mostly from the sides of boulders.
q	Qingan Lighthouse	4-20	Rocky shoreline, south of site p. Collections intertidal and high subtidal.
r	Chikan Zi	4-23	S.E. point of headland due E. of Chikan Zi settlement. Boulders with swift water of intermediate turbidity. Rich and abundant algal flora.
s	Xia Tang	4-24	Rock bar W. of settlement. Swift water, numerous small seaweeds in tight areas between boulders.
t	Wialuo	5-4	Extensive sand and mud flats with little rock One-hour collection at 2nd rock outcrop S. of E. point from Wailou town. Very poor algal flora.
u	S.E. Sanya Bay	9-26,10-1,17,20,11-25	W. of Luhuitou Peninsula, including N. and W. sides of islet and lighthouse reef.
v	Xiao Donghai	9-27,29,10-11,20 11-24,12-4,2-20	Bay on E. side of Luhuitou peninsula, including edge of reef on N. and S. sides and shallow reeftop.
w	Da Donghai	9-26, 10-12, 13, 14, 15,16, 17,19, 2-14, 20	Bay N. of Luhuitou peninsula, main collections from reef directly E. of sand beach.
x	Ye Long Bay	2-17	Collections from western end of sand beach on and around rocky substrate, where stream enters the ocean.

Table 2.2. Field records (Chlorophyta) for taxa collected from more than one site. Locality abbreviations follow Figure 2.2.

	N. Leizhou				Naozhou Is.									Quwen Co.							S. Hainan			
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Ulvales																								
Monostromataceae																								
Monostroma nitidum Wittrock	X	X	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Ulvaceae																								
Enteromorpha clathrata (Roth) Greville	X	X	X	X	X	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
E. flexuosa (Wulfen) J. Agardh	X	X	-	X	-	-	X	[illegible]	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-
E. intestinalis (L.) Nees	X	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
E. spp.	X	X	X	X	X	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-
Ulva conglobata Kjellman	-	-	-	X	X	X	X	X	X	-	-	-	-	X	-	X	X	-	X	-	-	-	X	-
U. spp.	-	-	-	-	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-
Cladophorales																								
Anadyomenaceae																								
Anadyomene wrightii Harvey	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	X
Boodleaceae																								
Boodlea spp.	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	X	-	-	-	X	X	X	X
Cladophoropsis zollingeri (Kützing) Reinbold	X	X	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Struvea anastomosans (Harvey) Piccone *et* Grunow *ex* Piccone	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X	-
S. spp.	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Valoniaceae																								
Dictyosphaeria spp.	-	-	X	-	-	X	X	-	-	-	X	-	-	-	-	-	X	-	-	-	-	X	X	-
D. versluysii Weber-van Bosse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Valonia aegagropila C. Agardh	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
V. spp.	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-
Valoniopsis pachynema (Martens) Børgesen	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-	-	X	-	-
V. spp.	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Cladophoraceae																								
Chaetomorpha antennina (Bory) Kützing	-	-	-	-	-	X	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
C. spp.	X	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-
C. *spiralis* Okamura	-	X	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-
Cladophora aokii Yamada	-	-	-	X	X	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-
C. *rugulosa* Martens	-	-	X	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-
C. spp.	X	-	-	-	X	X	X	-	-	-	-	X	X	-	-	-	-	X	-	-	-	-	-	-
Caulerpales																								
Bryopsidaceae																								
Bryopsis spp.	-	-	-	-	X	X	X	X	-	-	X	X	-	-	-	-	-	X	X	-	-	X	X	X
Codiaceae																								
Codium geppii O.C. Schmidt	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-
C. spp.	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Caulerpaceae																								
Caulerpa ambigua Okamura	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
C. *racemosa* (Forsskål) J. Agardh	-	-	-	-	-	X	X	-	-	-	X	-	-	-	X	X	X	-	X	-	-	X	X	X

Table 2.2. (continued)

		N. Leizhou				Naozhou Is.									Quwen Co.							S. Hainan		
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
C. serrulata (Forsskål) J. Agardh	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	X	X	X	-
C. spp.	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
C. taxifolia (Vahl) C. Agardh	-	-	-	-	-	-	-	-	-	-	X	-	-	X	X	X	X	-	-	-	-	-	-	-
Udoteaceae																								
Avrainvillea sp. 1	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X
A. sp. 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
Chlorodesmis spp.	X	X	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Halimeda macroloba Decaisne	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-
Udotea javensis (Montagne) Gepp *et* Gepp	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X	-
Dasycladales																								
Dasycladaceae																								
Neomeris annulata Dickie	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X	X	-
Acetabulariaceae																								
Acetabularia parvula Solms-Laubach	-	-	-	-	-	X	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	X	-
Total (39 species)	10	7	7	7	8	12	20	7	4	2	22	6	3	2	5	4	10	4	6	0	5	14	15	6

Table 2.3. Field records (Phaeophyta) for taxa collected from more than one site. Locality abbreviations follow Figure 2.2.

	N. Leizhou				Naozhou Is.										Quwen Co.							S. Hainan		
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Ectocarpales																								
Ectocarpaceae																								
Ectocarpus spp.	-	-	-	X	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	X	X
Giffordia spp.	-	-	-	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Scytosiphonales																								
Scytosiphonaceae																								
Colpomenia sinuosa (Mertens *ex* Roth) Derbes *et* Solier	-	-	X	X	X	-	X	X	-	-	X	-	-	-	-	-	X	-	X	-	-	X	-	-
Endarachne binghamiae J. Agardh	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydroclathrus clathratus (C. Agardh) Howe	-	-	X	X	X	X	X	X	-	X	X	-	-	-	-	-	X	-	X	-	-	-	X	X
Chnoosporaceae																								
Chnoospora implexa J. Agardh	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-
C. sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Sphacelariales																								
Sphacelariaceae																								
Sphacelaria spp.	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X
Dictyotales																								
Dictyotaceae																								
D. membranaceum (Stackhouse) Batters	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	X
D. repens (Okamura) Børgesen	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	X	X	-	-	-	X	-
Dictyota bartayresiana Lamouroux	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
D. cervicornis Kützing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	X	-
D. dichotoma (Hudson) Lamouroux	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-
D. spp.	X	-	-	-	-	X	-	X	X	X	X	X	X	-	X	X	X	-	-	-	X	X	X	-
Lobophora spp.	-	-	-	-	-	X	-	X	X	X	X	-	-	-	X	-	-	-	X	-	X	X	X	-
L. variegata (Lamouroux) Womersley	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
Pachydictyon coriaceum (Holmes) Okamura	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	-
Padina australis Hauck	-	-	-	X	-	X	X	X	X	-	X	X	-	-	-	-	-	-	X	-	X	X	X	X
P. minor Yamada	-	-	-	-	X	X	X	X	-	X	-	-	-	-	X	-	X	X	-	-	X	X	X	X
P. spp.	-	-	X	-	-	-	-	-	-	-	X	-	-	X	-	X	X	X	-	-	-	-	-	-
Spatoglossum pacificum Yendo	-	-	-	-	-	-	-	-	X	-	X	-	-	-	X	-	X	X	X	-	-	-	-	-
Zonaria spp.	-	-	-	-	-	X	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	X
Fucales																								
Sargassaceae																								
Sargassum carpophyllum J. Agardh	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. coriifolium J. Agardh	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
S. fusiformis (Harvey) Setchell	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. gracile J. Agardh	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-
S. hemiphyllum (Turner) C. Agardh	-	-	-	-	-	-	X	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
S. ilicifolium (Turner) C. Agardh	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X	-	-	-	-	-	X	-	X
S. kuetzingii	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. plagiophyllum C. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-

Table 2.3. (continued)

	N. Leizhou			Nanzhou Is.									Quwen Co.								S. Hainan			
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
S. polycystum C. Agardh	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	X	X	X	-
S. spp.	-	X	X	-	-	X	X	-	-	X	X	-	-	X	X	X	X	-	-	-	X	-	-	-
S. tenerrimum J. Agardh	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Turbinaria ornata (Turner) J. Agardh	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	X	X
T. spp.	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total (35 species)	3	2	4	5	3	9	14	11	6	10	16	4	2	5	8	7	12	5	9	0	9	11	13	10

Table 2.4. Field records (Rhodophyta) for taxa collected from more than one site. Locality abbreviations follow Figure 2.2.

N. Leizhou   Naozhou Is.   Quwen Co.   S. Hainan

TAXA \ SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Nemaliales																								
Liagoraceae																								
Liagora farinosa Lamouroux	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
L. spp.	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	X
Bonnemaisoniaceae																								
Asparagopsis taxiformis (Delile) Trevisan	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Galaxauraceae																								
Actinotrichia fragilis (Forsskål) Børgesen	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	X	X
Galaxaura oblongata (Ellis et Solander) Lamouroux	-	-	-	-	X	X	X	X	-	-	X	X	-	-	X	-	X	-	X	-	-	X	X	X
G. rugosa (Ellis *et* Solander) Lamouroux	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-
G. spp.	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Scinaia spp.	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gelidiaceae																								
Gelidium crinale (Turner) Gaillon	-	-	X	-	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-
G. pusillum (Stackhouse) Le Jolis	X	-	-	-	-	X	X	X	X	-	-	-	-	-	X	X	X	X	X	-	X	X	X	-
G. spp.	X	-	X	-	X	X	X	X	X	X	-	-	-	-	X	-	X	X	-	-	-	X	X	X
Pterocladia caerulescens (Kützing) Santelices	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-
Gelidiellaceae																								
Gelidiella acerosa (Forsskål) Feldmann *et* Hamel	-	-	-	-	-	-	X	-	-	X	X	-	-	-	-	-	X	-	-	-	X	X	X	X
Cryptonemiales																								
Corallinaceae																								
Unidentified genus sp. 1	-	-	-	-	X	-	-	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-	X	X
Unidentified genus sp. 2	-	-	-	-	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphiroa dilatata Lamouroux	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-
A. foliacea Lamouroux	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	X	X	X	-
A. fragilissima (L.) Lamouroux	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-
A. spp.	-	-	-	X	-	X	-	-	X	-	X	-	X	-	X	-	X	-	X	-	X	X	X	-
Corallina officinalis L.	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
Jania adhaerens Lamouroux	-	-	-	-	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	X	X	X	X
J. capillacea Harvey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-
J. spp.	-	-	-	-	-	X	X	X	X	-	X	-	X	-	-	-	X	-	-	-	-	X	X	X
J. ungulata (Yendo) Yendo	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Mastophora rosea (C. Agardh) Setchell	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
M. spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Halymeniaceae																								
Carpopeltis spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Grateloupia filicina (Lamouroux) C. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
G. ramosissima Okamura	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
G. spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-	-
Halymenia spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-
Polyopes spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	-
Prionitis spp.	-	-	-	-	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-

Table 2.4. (continued)

	N. Leizhou		Naozhou Is.												Quwen Co.						S. Hainan			
TAXA \ SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Peyssonneliaceae																								
Peyssonnelia rubra (Greville) J. Agardh	-	-	-	-	-	-	-	X	-	-	X	X	-	-	-	-	-	-	X	-	-	X	X	-
Dumontiaceae																								
Acrosymphyton spp.	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Gigartinales																								
Gigartinaceae																								
Gigartina tenella Harvey	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
Gracilariaceae																								
Ceratodictyon spongiosum Zanardini	-	-	-	-	-	X	-	X	-	X	X	-	X	-	-	-	X	-	-	-	X	X	X	-
Gelidiopsis spp.	X	-	-	-	X	-	-	-	-	-	-	X	-	-	X	-	X	-	X	-	X	X	X	X
Gracilaria asiatica Zhang *et* Xia	X	X	-	X	-	-	-	-	-	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-
G. blodgettii Harvey	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	X	-	-	-	-	-
G. eucheumoides Harvey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X
G. heteroclada Zhang *et* Xia	-	X	-	X	-	-	X	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-
G. purpurascens Harvey in J. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	X	-	-	-	-	-
G. salicornia (C. Agardh) Dawson	-	-	X	-	-	-	X	-	-	X	X	-	-	-	-	-	X	-	-	-	-	-	-	-
G. spp.	X	-	X	X	-	X	X	-	-	-	X	-	-	-	X	X	X	X	-	-	X	-	-	-
G. tenuistipitata Zhang *et* Xia	X	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycavernosa fastigiata Zhang *et* Xia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	X
Phyllophoraceae																								
Gymnogongrus sp. 1	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	X
G. sp. 2	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
G. sp. 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	-	-	X	-	-
Phyllophora spp.	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X	X	-	-	-	-	-
Solieriaceae																								
Solieria robusta (Greville) Kylin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-
Caulacanthaceae																								
Catenella spp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Hypneaceae																								
Hypnea cervicornis J. Agardh	-	-	-	X	-	-	-	-	-	X	X	-	-	-	-	X	X	-	X	-	-	-	-	-
H. japonica Tanaka	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
H. nidifica J. Agardh	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	X	-
H. spp.	X	X	-	X	X	-	X	X	X	X	X	-	X	-	X	X	X	X	X	-	X	X	X	X
Rhodymeniales																								
Rhodymeniaceae																								
Coelothrix irregularis Børgsen	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Rhodymenia intricata (Okamura) Okamura	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	X	-	-	-	-	-
R. spp.	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	X	X	-	-	-	X	-
Champiaceae																								
Champia parvula (C. Agardh) Harvey	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-
C. spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-

Table 2.4. (continued)

TAXA \ SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
	N. Leizhou		Naozhou Is.									Quwen Co.									S. Hainan			
Ceramiales																								
Ceramiaceae																								
Callithamnion spp.	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	X	-
Centroceras clavulatum (C. Agardh) Montagne	X	-	-	X	-	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-	-	-	X	-
Ceramium spp.	X	X	-	X	X	X	X	X	X	-	X	X	X	-	-	-	X	X	X	-	X	X	X	X
Spermothamnion spp.	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Spyridia spp.	X	-	-	-	X	-	-	-	-	-	X	-	-	X	X	X	-	-	-	-	-	-	-	X
Wrangelia spp.	-	-	X	-	-	-	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Delesseriaceae																								
Cryptopleura spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
(Genus unknown) sp.	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	-	
Dasyaceae																								
Heterosiphonia spp.	-	-	-	-	X	-	X	-	-	-	-	X	-	-	-	-	X	X	X	-	-	X	-	X
Rhodomelaceae																								
Acanthophora muscoides (L.) Bory	X	-	-	-	X	X	-	-	-	-	-	-	-	X	X	X	-	-	X	-	-	-	-	-
A. spicifera (Vahl) Børgesen	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-	-	-	-	-
Bostrychia spp.	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
Chondria armata (Kützing) Okamura	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	X	-
C. spp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Herposiphonia spp.	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	-
Laurencia majuscula (Harvey) Okamura	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X
L. spp.	X	-	-	-	-	X	X	X	X	X	-	X	-	-	X	-	X	X	X	-	X	X	X	X
L. undulata Yamada	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
Leveillea jungermannioides (Hering *et* Martens) Harvey	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	X	-
Polysiphonia friabile	-	-	-	-	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
P. spp.	X	-	X	X	X	-	-	X	-	X	X	X	-	-	X	-	X	X	-	-	X	X	X	X
Symphiocladia spp.	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X	X	-	-	-	-	-
Tolypiocladia glomerulata (C. Agardh) Schmitz	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-
Bangiales																								
Bangiaceae																								
Porphyra spp.	-	-	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total (86 taxa)	16	6	7	10	12	18	34	15	15	15	23	12	5	4	25	13	23	30	39	0	19	29	40	26

Table 2.5. Field records (Chlorophyta) for taxa collected from only one site. Locality abbreviations follow Figure 2.2.

	N. Leizhou				Naozhou Is.										Quwen Co.							S. Hainan		
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Ulvales																								
Monostromataceae																								
Monostroma sp.	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ulvaceae																								
Enteromorpha linza (L.) J. Agardh	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E. prolifera (O.F. Müller) J. Agardh	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladophorales																								
Anadyomenaceae																								
Anadyomene sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Microdictyon nigrescens (Yamada) Setchell	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Boodleaceae																								
Cladophoropsis sp.	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valoniaceae																								
Ventricaria ventricosa (J. Agardh) Olsen-Stoikovich	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Cladophoraceae																								
Chaetomorpha linum (Müller) Kützing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Caulerpales																								
Codiaceae																								
Codium papillatum Tseng *et* Gilbert	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Caulerpaceae																								
Caulerpa cupressoides (Vahl) C. Agardh	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
C. sertularioides (S.G. Gmelin) Howe	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
C. verticillata J. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
C. webbiana Montagne	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Udoteaceae																								
Avrainvillea erecta (Berkeley) Gepp *et* Gepp	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Dasycladales																								
Dasycladaceae																								
Bornetella oligospora Solms-Laubach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Acetabulariaceae																								
Acetabularia calyculus Lamouroux	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total (16 species)	1	0	0	2	0	1	0	0	1	0	4	0	0	0	0	0	1	0	2	0	1	1	1	1

Table 2.6. Field records (Phaeophyta) for taxa collected from only one site. Locality abbreviations follow Figure 2.2.

	N. Leizhou			Naozhou Is.										Quwen Co.							S. Hainan			
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Scytosiphonales																								
Scytosiphonaceae																								
Rosenvingea orientalis (J. Agardh) Børgesen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Dictyotales																								
Dictyotaceae																								
Dictyopteris australis (Sonder) Askenasy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
D. latiuscula (Okamura) Okamura	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Dictyota linearis (C. Agardh) Greville	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Padina tenuis Bory	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fucales																								
Sargassaceae																								
Sargassum glaucescens J. Agardh	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. henslowianum J. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
S. herklotsii Setchell	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. hornerii (Turner) C. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
S. longifructum Tseng *et* Lu	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. myriocystum J. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
S. nigrifolium Yendo	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. swartzii (Turner) C. Agardh	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
S. vachellianum Greville	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Total (14 species)	1	1	0	0	0	1	1	1	0	0	2	0	0	0	1	0	1	1	1	1	1	0	1	0

Table 2.7. Field records (Rhodophyta) for taxa collected from only one site. Locality abbreviations follow Figure 2.2.

	N. Leizhou			Naozhou Is.						Quwen Co.											S. Hainan			
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Nemaliales																								
Dermonemataceae																								
Dermonema pulvinata (Grunow in Holmes) Fan	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dotyophycus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Liagoraceae																								
Liagora boergesenii Yamada	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
L. ceranoides Lamouroux	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
L. divaricata Tseng	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
L. paniculata sp. ined.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
L. samaensis Tseng	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
L. valida Harvey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Galaxauraceae																								
Scinaia tsinglanensis Tseng	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Gelidiaceae																								
Pterocladia caloglossoides (Howe) Dawson	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cryptonemiales																								
Corallinaceae																								
Cheilosporum jungermannioides Ruprecht et Areschoug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
C. sp.	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jania crassa Lamouroux	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
J. rubens (L.) Lamouroux	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Halymeniaceae																								
Grateloupia phuquoensis Tanaka	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Gigartinales																								
Gigartinaceae																								
Gigartina sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Gracilariaceae																								
Gracilaria coronopifolia J. Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
G. cylindrica Børgesen	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G. textorii (Suringar) De Toni	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caulacanthaceae																								
Caulacanthus sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceramiales																								
Ceramiaceae																								
Crouania sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Wrangelia penicillata (C. Agardh) C. Agardh	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Delesseriaceae																								
Caloglossa leprieurii (Montagne) J. Agardh	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dasyaceae																								
Dasya sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X

Table 2.7. (continued)

	N. Leizhou				Naozhou Is.									Quwen Co.							S. Hainan			
TAXA / SITES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Rhodomelaceae																								
Laurencia obtusa (Hudson) Lamouroux	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
L. okamurae Yamada	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
L. parvipapillata Tseng	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Porphyridiales																								
Goniotrichaceae																								
Goniotrichum sp.	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total (29 taxa)	4	0	0	2	0	1	2	0	0	0	3	0	0	0	0	2	0	2	0	0	0	1	4	8

Table 2.8. Summary of Genera by Site and Area. Absence of a family is indicated with a darkened cell. Absence of identified species within a family or order indicated with an asterisk. List arranged systematically for green, brown and red genera.

	N. Leizhou			Naozhou Island										Qwen County									Sanya				total
	a	b	SUM	c	d	e	f	g	h	i	SUM	j	k	l	m	n	o	p	q	r	s	SUM	u	v	w	x	SUM	total
Ulvales																				2F 3G								
Monostromataceae	1	1	1	-	-	-	-	-	1	1	1	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	■	1
Ulvaceae	1	1	1	1	2	2	1	2	2	1	2	-	2	-	-	1	-	2	1	-	1	2	-	·2	1	-	2	2
Cladophorales																												4F 11G
Anadyomenaceae	-	-	■	-	-	-	-	-	-	-	■	-	2	-	-	-	-	-	-	-	-	2	-	1	1	1	2	2
Boodleaceae	1	1	1 ■	1	-	1	1	2	-	-	3	-	2	1	-	-	-	-	2	-	-	3	1	1	2	1	2	3
Valoniaceae	-	-	■	1	-	-	2	3	-	1	3	-	2	-	-	-	-	-	2	-	1	3	1	2	2	-	4 ■	4
Cladophoraceae	2	1	2	1	2	1	2	2	-	-	2	-	2	1	2	-	2	-	-	2	2	2	-	-	-	-	■	2
Caulerpales																												4F 7G
Bryopsidaceae*	-	-	■	-	-	1	1	1	1	-	1	-	1	1	-	-	-	-	-	1	1	1	-	1	1	1	1	1
Codiaceae	-	-	■	1	-	1	1	-	-	-	1	-	-	-	-	-	-	-	1	-	-	1	-	-	1	-	1	1
Caulerpaceae	-	-	■	-	-	-	1	1	-	1	1	-	1	-	-	1	1	1	1	-	1	1	1	1	1	1	1	1
Udoteaceae	1	1	1	1	-	-	1	1	-	-	2	-	2	1	-	-	1	-	-	-	-	3	1	2	2	1	3	4
Dasycladales																												2F 3G
Dasycladaceae	1	-	1 ■	-	-	-	-	-	-	-	■	-	1	-	-	-	-	-	-	-	-	1	1	1	2	-	2	2
Acetabulariaceae	-	-	■	-	1	-	1	-	1	1	1	1	1	1	-	-	-	-	-	-	-	1	-	-	1	-	1	1
GENERA	7	5	7	6	5	6	1	12	5	5	17	2	17	5	2	2	4	3	7	3	6	21	5	11	14	5	17	21G
Ectocarpales																												1F 2G
Ectocarpaceae*	-	-	■	-	2	-	-	-	-	1	2	-	2	2	-	-	-	-	1	-	-	2	-	-	1	1	1	2
Scytosiphonales																												2F 5G
Scytosiphonaceae	-	-	■	2	2	2	1	3	3	-	3 ■	1	2	-	-	-	-	-	2	-	2	2	-	1	2	1	3	4
Chnoosporaceae	-	-	■	-	-	-	-	-	-	-	■	-	1	-	-	-	-	-	-	-	-	1	-	1	1	1	2	1
Sphacelariales*																												1F 1G
Sphacelariaceae*	1	-	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	■	1	1	1	1	1	1
Dictyotales																												1F 7G
Dictyotaceae	1	-	1	1	1	1	4	3	3	5	6	3	6	2	1	2	4	4	4	4	5	7	3	3	4	3	5	7
Fucales																												1F 2G
Sargassaceae	1	1	1	1	-	-	1	2	1	-	2	2	1	-	-	1	1	1	1	-	1	2	2	2	2	2	2	2
GENERA	3	1	3	4	5	3	7	8	7	6	14	6	12	4	1	3	5	5	8	4	8	14	6	8	11	9	14	17G
Nemaliales																												8F 10G
Dermonemataceae	-	-	■	-	-	-	-	1	-	-	1 ■	-	-	-	-	-	-	-	-	-	-	■	-	-	1	-	1	2
Liagoraceae	-	-	■	-	-	-	-	-	-	-	■	-	1	-	-	-	-	-	-	-	-	1	-	1	1	1	1	1
[illegible]aisoniaceae	-	-	■	-	-	-	1	1	-	-	1	-	1	-	-	-	-	-	-	-	-	1	-	-	-	1	1	1
[illegible]axauraceae	-	1	1	-	-	1	2	2	1	-	2	1	1	1	-	-	1	-	1	-	1	2	2	2	2	3	3	3
Gelidiaceae	1	-	1 ■	1	-	1	1	2	1	1	2	1	2	-	-	-	2	1	1	1	1	2	1	1	1	1	1	2
Gelidiellaceae	-	-	■	-	-	-	-	1	-	-	1	1	1	-	-	-	-	-	1	-	-	1	1	1	1	1	1	1
Cryptonemiales																												4F 14G
Corallinaceae	-	-	■	-	1	1	5	3	3	4	7	1	2	2	2	-	1	-	3	1	3	6	3	2	4	4	5	7
Halymeniaceae	-	-	■	-	-	-	-	1	-	1	1	-	-	-	-	-	2	1	-	2	2	3	-	1	4	1	4	5
Peyssonne[illegible]	-	-	■	-	-	-	-	-	1	-	1	-	1	1	-	-	-	-	-	-	1	1 ■	-	1	1	-	1	1
Dumont[illegible]-	-	-	■	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	■	-	-	1	-	1	1
Gigartinales																												8F 11G
Gigartinaceae	-	-	■	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	1	■	1	-	-	-	■	1
Gracilariaceae	2	1	2	1	1	2	2	1	1	-	3	2	2	1	1	1	2	1	2	2	3	4	3	3	3	3	4	4
[illegible]oraceae	-	-	■	-	-	-	-	2	-	-	2 ■	-	-	1	-	-	1	1	1	2	2	2	-	1	1	1	1 ■	2
Solieriaceae	-	-	■	-	-	-	-	-	-	-	■	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	■	1
[illegible]-	2	-	2	-	-	-	-	-	-	-	■	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	■	2
Hypneaceae	1	1	1	-	1	1	-	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	1	1	1
Rhodymeniales																												2F 3G
Rhodymeniaceae	-	-	■	-	-	-	-	2	-	-	2 ■	1	-	-	-	-	1	-	-	1	2	2	-	-	1	-	1	2
Champiaceae	-	-	■	-	-	-	-	-	-	-	■	1	-	-	-	-	-	-	-	-	1	1	-	1	-	-	1	1
Ceramiales																												4F 21G
Ceramiaceae	3	1	3	1	2	3	2	3	2	3	6	1	4	1	1	2	3	2	3	2	2	5	1	1	5	3	7	7
Delesseriaceae	1	-	1 ■	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	2	1	2	-	1	-	-	1	3
Dasyaceae	-	-	■	-	-	1	-	1	-	-	1	-	-	1	-	-	-	-	1	1	1	1	-	1	-	2	2	2
Rhodomelaceae	4	-	4	1	1	2	3	4	2	3	6	3	2	3	-	1	4	1	4	5	6	8	4	4	5	2	6	9
Bangiales*																												1F 1G
Bangiaceae*	-	-	■	1	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	■	-	-	-	-	■	1
Porphyridiales*																												1F 1G
Goniotrichaceae	-	-	■	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	■	-	-	-	-	■	
RED GENERA	14	4	15	5	7	12	18	28	12	13	42	13	18	11	5	4	19	8	18	21	30	46	16	22	32	24	43	61G
TOTAL	24	10	25	15	17	21	36	48	24	24	73	21	47	20	8	9	28	16	33	28	44	81	27	41	57	38	74	99G

Table 2.9. Taxonomic representation by order and family. Total number of sites in which each taxonomic group was found, and number of sites by area. NL = N. Leizhou; NZ = Naozhou Island; QW = Quwen County; SY = Sanya. * indicates that no specimens in this group were identified to species.

	Site Total	NL	NZ	QW	SY
Ulvales	17	2	7	6	2
Monostromataceae	6	2	2	2	0
Ulvaceae	16	2	7	5	2
Cladophorales	19	2	6	7	4
Anadyomenaceae	4	0	0	1	3
Boodleaceae	13	2	4	3	4
Valoniaceae	10	0	4	3	3
Cladophoraceae	13	2	5	6	0
Caulerpales	20	2	6	8	4
Bryopsidaceae*	11	0	4	4	3
Codiaceae	5	0	3	1	1
Caulerpaceae	13	0	3	6	4
Udoteaceae	12	2	3	3	4
Dasycladales	11	1	4	3	3
Dasycladaceae	5	1	0	1	3
Acetabulariaceae	8	0	4	3	1
Ectocarpales	7	0	1	3	2
Ectocarpaceae*	7	0	2	3	2
Scytosiphonales	13	0	6	4	3
Scytosiphonaceae	13	0	6	4	3
Chnoosporaceae	4	0	0	1	3
Sphacelariales*	6	1	1	0	4
Sphacelariaceae*	6	1	1	0	4
Dictyotales	22	1	7	10	4
Dictyotaceae	22	1	7	10	4
Fucales	18	2	4	7	4
Sargassaceae	18	2	4	7	4
Nemaliales	20	2	6	8	4
Dermonemataceae	2	0	1	0	1
Liagoraceae	4	0	0	1	3
Bonnemaisoniaceae	4	0	2	1	1
Galaxauraceae	15	1	4	6	4
Gelidiaceae	18	1	6	7	4
Gelidiellaceae	8	0	1	3	4
Cryptonemiales	19	0	6	9	4
Corallinaceae	18	0	6	8	4
Halymeniaceae	9	0	2	4	3
Peyssonneliaceae	6	0	1	3	2
Dumontiaceae*	2	0	1	0	1
Gigartinales	23	2	7	10	4
Gigartinaceae	2	0	1	1	0
Gracilariaceae	22	2	6	10	4
Phyllophoraceae	10	0	1	6	3
Solieriaceae	2	0	0	2	0
Caulacanthaceae*	2	1	0	1	0
Hypneaceae	19	2	5	8	4
Rhodymeniales	7	0	1	4	2
Rhodymeniaceae	6	0	1	4	1
Champiaceae	3	0	0	2	1
Ceramiales	23	2	7	10	4
Ceramiaceae	23	2	7	10	4
Delesseriaceae	5	1	1	2	1
Dasyaceae	8	1	7	9	4
Rhodomelaceae	21	1	7	9	4
Bangiales*	3	0	3	0	0
Bangiaceae*	3	0	3	0	0
Porphyridiales*	1	0	1	0	0
Goniotrichaceae*	1	0	1	0	0

Table 2.10. Taxonomic representation compared with taxonomic diversity at the level of Order. Diversity is presented as amount of representation at taxonomic subcategories. Percentage is given for all sites and within area sites.

	F	G	S	% Total	% LZ	% NZ	% QW	% SY
Chlorophyta								
Ulvales	2	3	10	67	100	100	60	50
Cladophorales	4	1	23	79	100	86	70	100
Caulerpales	4	7	20	83	100	86	80	100
Dasycladales	2	3	4	21	50	57	30	75
Subtotal	*12*	*24*	*57*					
Phaeophyta								
Ectocarpales	1	2	2	29	0	29	30	50
Scytosiphonales	2	5	6	54	0	86	40	75
Sphacelariales	1	1	1	25	50	14	0	100
Dictyotales	1	7	18	92	50	100	100	100
Fucales	1	2	22	75	100	57	70	100
Subtotal	*6*	*17*	*49*					
Rhodophyta								
Nemaliales	6	10	23	83	100	86	80	100
Cryptonemiales	4	14	27	79	0	86	90	100
Gigartinales	6	11	27	96	100	100	100	100
Rhodymeniales	2	3	5	29	0	14	40	50
Ceramiales	4	21	31	96	100	100	100	100
Bangiales	1	1	1	12	0	43	0	0
Porphyridiales	1	1	1	4	0	14	0	0
Subtotal	*18*	*61*	*115*					
Total	36	102	221					

Table 2.11. Site ranks for diversity, number of unique species and percentage of unique species. Highest rank = 1; * indicates that this rank is shared by more than one site.

Sites	Diversity Rank	Uniqueness #	Uniqueness %
a	*11	*2	3
b	18	*6	*9
c	17	-	-
d	*14	3	4
e	15	*4	-
f	9	*4	*8
g	2	*6	*11
h	12	-	*12
i	*14	*1	*11
j	13	-	-
k	3	*6	5
l	16	-	-
m	20	*6	6
n	19	-	-
o	10	*6	13
p	*14	*5	*7
q	7	*5	*11
r	8	*4	*8
s	4	*4	10
t	21	*6	1
u	*11	*5	*9
v	5	*5	*11
w	1	*2	*7
x	6	*1	2

Table 2.12. Unique species compared with total species per site.

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x
Red spp.	20	6	7	12	12	19	36	15	15	15	26	12	5	4	25	15	23	32	29	0	19	30	44	34
unique	4	-	-	2	-	1	2	-	-	-	3	-	-	-	-	2	-	2	-	-	-	1	4	8
Green spp.	11	7	7	9	8	13	20	7	5	2	26	6	3	2	5	4	11	4	8	0	6	15	16	7
unique	1	-	-	2	-	1	-	-	1	-	4	-	-	-	-	-	1	-	2	-	1	1	1	1
Brown spp.	4	3	4	5	3	10	15	12	6	10	18	4	2	5	9	7	13	6	10	1	10	11	14	10
unique	1	1	-	-	-	1	1	1	-	-	2	-	-	-	1	-	1	1	1	1	1	-	1	-
Total Spp.	35	16	18	26	23	42	71	34	26	27	70	22	10	11	39	26	47	42	57	1	35	56	74	51
Unique Spp.	6	1	-	4	-	3	3	1	1	-	9	-	1	-	1	2	2	3	3	1	2	2	6	9
% Unique	17	6	-	15	-	7	4	3	4	-	13	-	10	-	2	8	4	7	5	100	6	4	8	18

Table 2.13. Summary of Unique Species by Area. Total number of species is followed by unique (in parentheses), and the ratio of the two in percent.

	LZ	NZ	QW	SY
Greens	12 (1)	35 (4)	41 (7)	27 (5)
	8%	11%	17%	18%
Browns	6 (3)	27 (6)	36 (12)	21 (3)
	50%	22%	33%	14%
Reds	22 (4)	56 (7)	78 (17)	67 (21)
	18%	12%	22%	31%
Total	40 (8)	118 (17)	155 (36)	115 (29)
	20%	14%	23%	25%

Table 2.14. Genera with the highest taxonomic diversity.

21	Sargassum
12	Gracilaria
11	Caulerpa
6	Laurencia
6	Liagora
5	Amphiroa
5	Jania
5	Dictyota

Table 2.15. Genera most frequently collected. All with over 10 numbers are listed.

# specimens	Genus	# species	# sites	G	B	R
11	Monostroma	2	6	X		
12	Actinotrichia	1	6			X
12	Grateloupia	4	4			X
13	Bryopsis/ Trichosolen	1	11	X		
14	Acanthophora	2	8			X
14	Boodlea	1	7	X		
15	Colpomenia	1	9		X	
15	Heterosiphonia	1	8			X
16	Chondria	2	6			X
18	Lobophora	2	10		X	
19	Ulva	2	13	X		
21	Gelidiella	1	8			X
27	Spatoglossum	1	6		X	
31	Jania	6	10			X
34	Gymnogongrus	3	9			X
37	Enteromorpha	6	10	X		
38	Centroceras	1	14			X
44	Polysiphonia	2	17			X
49	Dictyota	5	15		X	
51	Padina	4	20		X	
52	Caulerpa	9	13	X		
53	Amphiroa	4	12			X
63	Gelidium	3	18			X
64	Laurencia	6	15			X
66	Sargassum	20	18		X	
70	Cladophora	3	12	X		
73	Ceramium	1	18			X
99	Hypnea	4	19			X

Table 2.16. Species with 10 or more accession numbers.

#	species	#	species
77	Hypnea sp.	17	Gracilaria sp.
73	Ceramium sp.	15	Jania sp.
56	Laurencia sp.	15	Heterosiphonia sp.
54	Cladophora sp.	15	Colpomenia sinuosa
44	Polysiphonia sp.	15	Padina australis
39	Dictyota sp.	14	Boodleopsis/Chlorodesmis
38	Centroceras sp.	14	Chondria armata
36	Gelidiopsis sp.	13	Sargassum polycystum
34	Gymnogongrus sp.	13	Bryposis/Trichosolon
33	Padina minor	12	Caulerpa racemosa
32	Gelidium sp.	12	Sargassum sp.
27	Gracilaria asiatica	11	Jania adhaerens
26	Spatoglossum pacificum	11	Gracilaria "blodgettii"
25	Gelidium pusillum	11	"crusts"
23	Galaxaura oblongata	11	Caulerpa racemosa v. peltata
21	Gelidiella aceraos	10	Ceratodictyon spongiosum
21	Amphiroa sp.	10	Monostroma nitidum
20	Enteromorpha sp.	10	Hypnea nidifica
19	Ulva conglobata	10	Cladophora rugulosa
19	Amphiroa foliacea	10	Enteromorpha clathrata
18	Lobophora sp.	10	Giffordia sp.

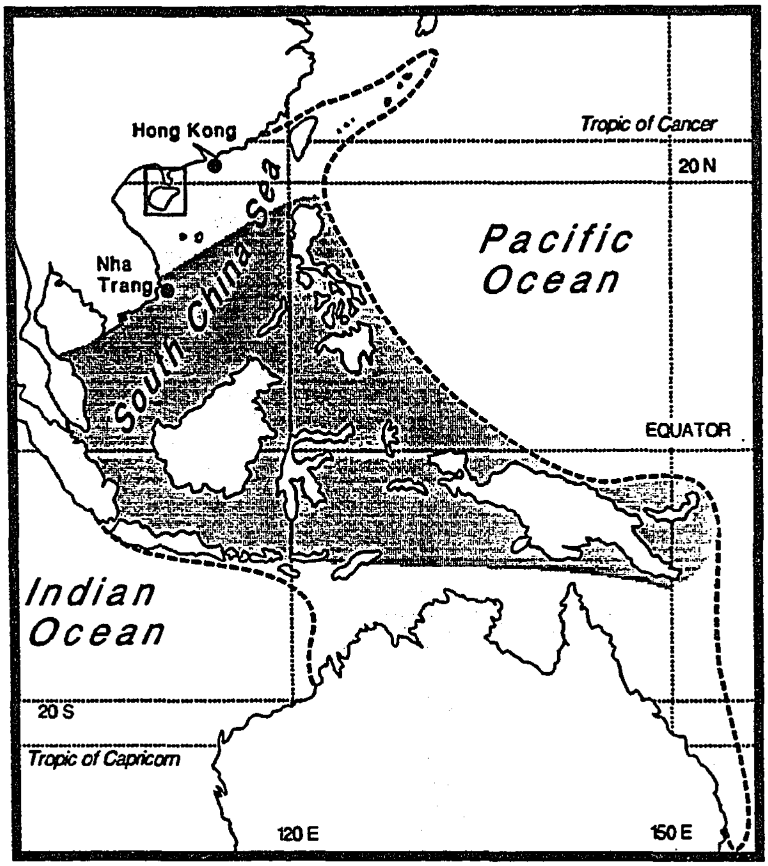


Figure 2.1.The warm-water western Pacific area (bounded by dashed lines). Tropical and subtropical limits are taken as those of consolidated biotic reef, in the north and south, the western boundary is that of Pacific Ocean waters, and the eastern limit is the line of archipelagos associated with continental plate boundaries (Indo-Australian and Eurasian Plates). The Indo-Malayan Archipelago region (shown as a roughly triangular, shaded area) is considered to be a global center of species diversity, however there are no established boundaries. Field study area boxed.

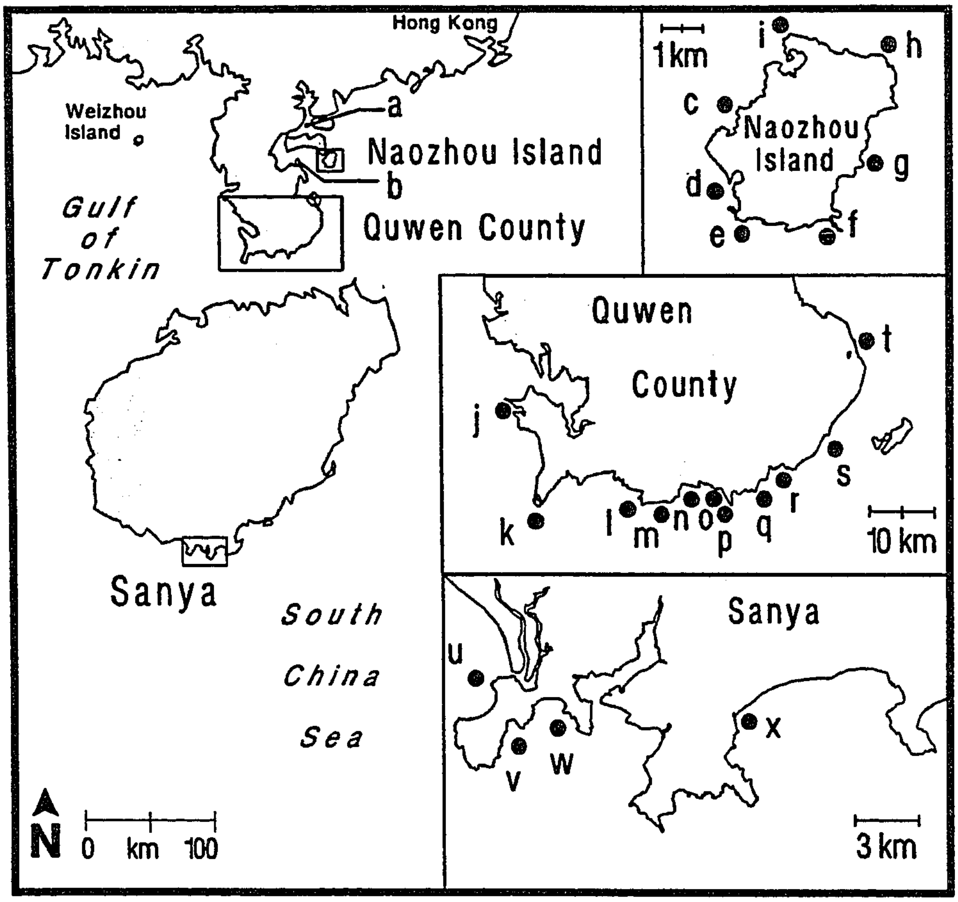


Figure 2.2. Field collection sites in the northern South China Sea. The four site areas are Northern Leizhou (sites a and b), Naozhou Island (sites c-i), Quwen County (sites j-t) and Sanya, Hainan Island (sites u-x).

Figure 2.3. **Field site habitats, Leizhou Peninsula.**

A. Mangrove stand at northeast point of Techan Island (site a), showing a mature, open stand of trees and mollusk-covered boulders along seaward side of stand.

B. Green algal hummocks (*Cladophoropsis* sp.) on pneumatic roots of mangrove, northeast point of Techan Island.

C. Rock bench (foreground) and rock walls (background) at south side of Na An beach, Naozhou Island (site g). Green algae (*Ulva* sp.) cover rocks in foreground.

D. Extensive band of boulders lining the shoreline at the northeast corner of Naozhou Island (site h). Drift brown algae (*Sargassum* spp.) cover foreground.

Figure 2.4. **Field site habitats, South Hainan Island.**

A. Southeast area of Sanya Bay (site u) taken from northern isthmus of Luhuitou Peninsula. Collections made on reef to the left of photo, subtidal bench to the right of photo and on north and west aspects of islet in photo and of lighthouse reef (behind islet in photo). Sanya harbor shiping channel passes between islet and lighthouse.

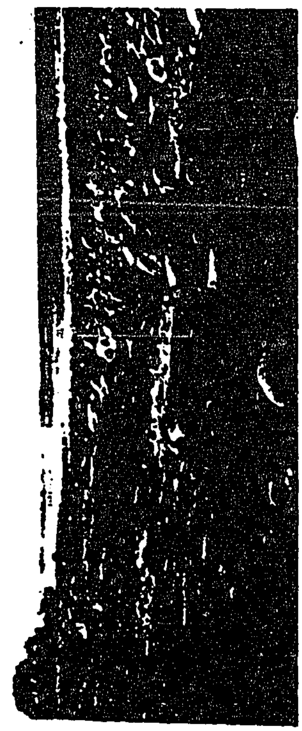
B. Northward view from southeast point of Luhuitou Peninsula, showing Xiao Donghai reef (a) and Bay (b) (site v) and eastern Da Donghai Bay (c) (site w).

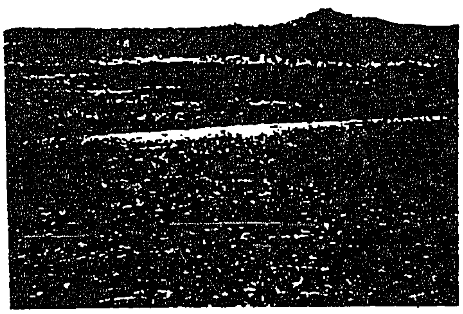
C. Reef along eastern Da Donghai Bay at extreme low tide showing isolated tide pools at reef edge (d), raised mid-reef (e) and depressed, uniform backreef (f). Most diverse collections resulted from following a transect from sandy beach along the reef edge. Photo taken from elevated rocky headland marking the southward terminus of this reef.

D. Close-up of pools from area (d), above, showing forereef morphology. Shellfish are being collected.

E. Reef in bay eastward of photo C, taken at extreme low tide. Photo taken from same location as C, above. Note exposed reef at headland of hill in mid-background (g).

F. Forereef morphology at extreme low tide, area (Photo E, g) above.







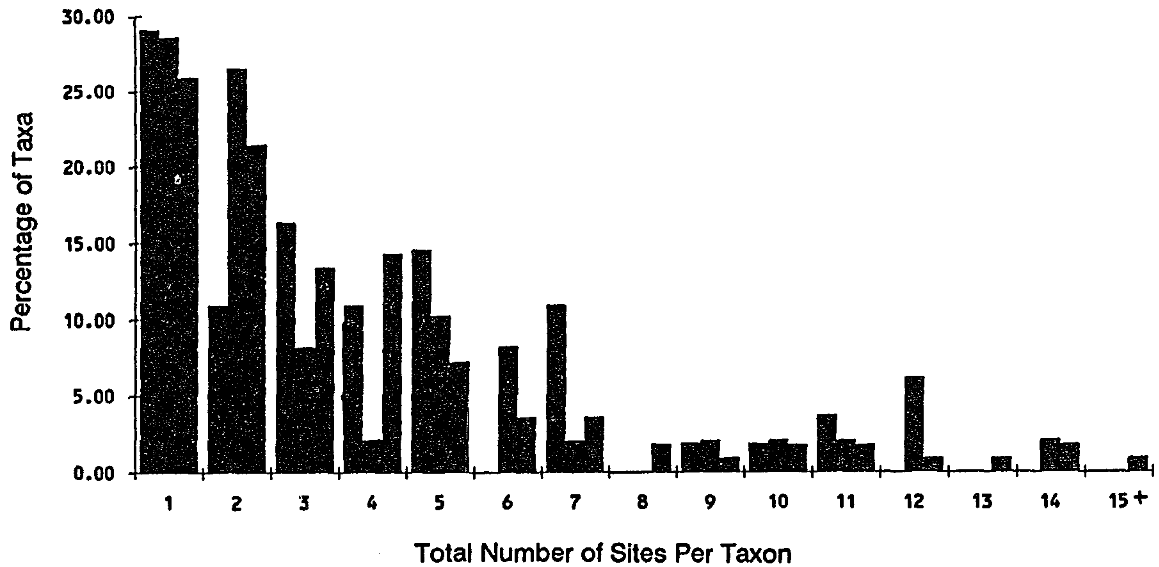



Figure 2.5. Percentage of total species by the number of sites they were reported from. Each bar contains separate components for green, brown and red taxa (left to right).

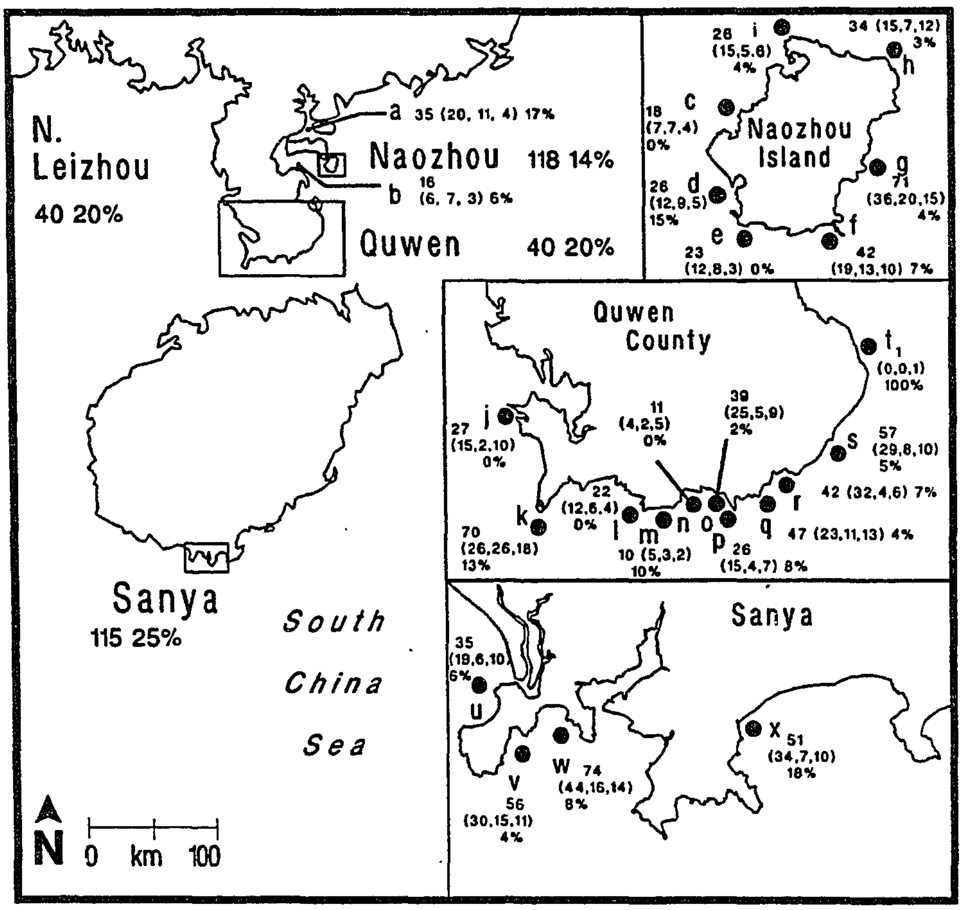


Figure 2.6. Field collection summary. Total species number (red species, green species, brown species) and percentage of unique species are presented for each site, and each of the four site areas.

Community Ecology Analysis of Shallow Water Benthic Marine Algae of the Northern South China Sea

Abstract

A collection of benthic marine algae from 24 sites in Leizhou Peninsula, Guangdong Province and south Hainan Island, Hainan Province (20°15'–21°10'N and 109°50'–110° 33'E) was evaluated and analyzed using a community ecology computer program, COENOS. Data for site occurrences of the 219 taxa of green, brown and red algae were organized three ways: 1) Chlorophyta only; 2) Phaeophyta only; 3) Rhodophyta only. Both specific and generic levels were evaluated within each grouping. Interpretable floristic patterns resulted from analyses with the full set of data at the generic level using 40/10 and 50/20 clustering rules. Species were distinctly grouped and interpretable as characteristic of the entire region or of habitat subgroups. Analyses with brown algal data at the species and genus levels varied least and therefore appear to be the most stable in structure; they were also the smallest data sets. Differences in the likelihood that a species will be collected when it is present are discussed. This study demonstrates that community analysis procedures can assist in analysis of seaweed data, in identifying natural community patterns, and in evaluation of the collection data itself.

Introduction

Marine Plants

Community analysis procedures are routinely used to better understand the patterns in the distribution of plants in different terrestrial environments. Marine and terrestrial environments and vegetation differ fundamentally. Even when methods used in their study are the same, the quality of the resulting data may differ greatly, affecting the interpretation of results. For example, there is a relatively high degree of stability in the terrestrial environment. On land, it is possible to return to the same place and find the same plant community months, years and even decades later. Seaweed communities are more elusive due to factors such as the rapid life history turnover which often follows seasonal changes, their cryptic life history phases, herbivory, and seasonal physical events like sand scouring or sand burial.

Therefore, actual community structure, as well as visible community elements, change more quickly. The concept of community, as it relates to seaweeds, is not clear (Chapman, 1986).

Seaweeds cannot necessarily be collected reliably if they are present. Species which are present may be too small to be seen, even if visibility in the water and habitat selection are not problems. To sample at one time, therefore, even if the collections cover more than one season, is only taking a small piece of what is present. Causes for the irregular and often misleading patterns which have been known to show up in seaweed distribution records have been discussed by several authors (May, 1944; Silva, 1966; Dixon, 1971; Doty, 1973; Irvine & Price, 1978; Abbott & Norris, 1985; Silva *et al.*, 1987; Abbott, 1988; Lewis, 1990).

Community ecology techniques which are based on a differential-species approach (Mueller-Dombois and Ellenberg, 1974).are appropriate to identifying seaweed distribution patterns, because only those taxa which are collected together with sufficient regularity constitute the final groupings. Taxa which are not grouped or which are grouped at a smaller number of sites are separated.

Seaweed biology is unique. Many fundamental concepts (i.e. life history phases; morphological variability with environment and season) and their variety and scope are only beginning to be appreciated. Geneticists must work through chemical compounds occurring in processes not found in other organisms. Many environments (i.e. deep water) are only beginning to be explored, and even the most accessible habitats remain to be summarily investigated in many parts of the globe. As a result of these and other factors, systematics of marine algae uses taxonomic features that are very complicated, and classification has not yet been stabilized at an alpha level. Concepts of biogeographic pattern at various scales are based on the alpha-taxonomic information, and therefore remain vague.

A record of presence, when the specimen on which that record is based is in hand, is the most reliable kind of seaweed information. To make sure that the record is correct still requires some attention to nomenclatural and taxonomic details. Absence, or lack of a record of a taxon for a particular locality in itself has very little meaning. This factor serves as a major influence in the interpretation of the data compiled from phycological studies.

Vegetation Ecology

The broad aim of vegetation ecology is to search for the underlying order in biological communities. The methods which have been devised demonstrate that order may vary with the community theory adopted.

The two early community theories held that: 1) the community can be seen basically as an organism (Clements, 1916, 1928); and 2) the community is basically an individualistic entity, with randomly assembled species (Gleason, 1926, 1939). The second theory provides a useful null hypothesis for testing community organization. Clements' viewpoint stimulated research which repudiated his community concepts. Gleason's autecological perspective is still widely held.

Two synecological hypotheses or viewpoints are those of: 1) the association viewpoint (Braun-Blanquet, 1928); and, 2) the ecosystem viewpoint (Tansley, 1935). Tansley coined the term "ecosystem," and believed that the organization of the community cannot be separated from the associated environment because the two are interrelated. The Braun-Blanquet viewpoint holds that communities can be classified like species. Each association has species characteristic to it. These are known as diagnostic or differential species. The community concept used in this paper follows Braun-Blanquet.

Mueller-Dombois and Ellenberg (1974) outline research strategies for describing community order *sensu* Braun-Blanquet. In order to describe pattern in an unbiased manner, an initial reconnaissance of an entire study area is done to establish the large-scale boundaries within which samples are taken and the sampling layout. Three requirements should be met by a sample stand. "It should be large enough to contain all species belonging to the plant community. The habitat should be uniform within the stand area, as far as one can determine this. The plant cover should be as homogeneous as possible. For example, it should not show large openings or should not be dominated by one species in one half of the sample area and by a second species in the other half" (Mueller-Dombois & Ellenberg, 1974:46). The degree to which these assessments can be met in the marine and terrestrial environments differs. Further, this strategy assumes that the integrity of taxonomic decisions is not an issue.

COENOS

The computer program COENOS (Ceška & Roemer, 1971; Ceška, 1987) was written to facilitate and standardize the application of Braun-Blanquet community analysis methods (Mueller-Dombois & Ellenberg, 1974). The most prominent feature of the clustering technique is that it classifies relevés (stands) and species simultaneously by applying two rules of constancy (given below). Sorts are done on vegetation tables, which are two-dimentional arrays of relevés and species. Relevés are listed in columns, species in rows.

> **Rule I:** Diagnostic species must occur in at least *x*% of the relevés belonging to the given relevé group and in not more than *y*% of the relevés outside this group.
>
> **Rule II:** The relevé belongs to the relevé group indicated by the given group of diagnostic species if it contains at least *x*% of these diagnostic species. (Ceška & Roemer 1971:259)

Therefore, when a standard 40/20 rule is applied, in order to be part of a species group, any given species must occur at least 40% of the time when a group is present, and cannot be present more than 20% of the time when the group is not present. Parameters of grouping are set by the software operator. Since seaweed species are likely to be present more frequently than they are collected, loose grouping rules (i.e. 20/10) may be most appropriate. Three problems which arise with hand-sorting of vegetation tables are solved with this computer program. Extremely time-consuming manual-visual procedures and frequent transcription errors are eliminated; the sorting technique can be applied by anyone to the same data with equal results; and, bias is removed in the selection of species based on knowledge of similar vegetation types (Ceška & Roemer, 1971:257).

The last characteristic makes this program an ideal tool for differentiating among cohesiveness patterns for different species in a group of collections. Species can be sorted by statistical rules, and the results compared with field observations of the collector. In this way, species can be separated between those that follow patterns which match natural phenomena and those which are shown to be irregular according to grouping rules. COENOS was written primarily to identify natural cohesiveness patterns associated with community ecology, however, it is up to the investigator to interpret the cause for cohesiveness patterns.

COENOS performs differently with datasets of different data structure, or quality. One practical application of the program suggested by the authors (Ceška & Roemer, 1971) is an evaluation of data quality, which is done by looking for divisions in data, then assessing the cause. In this way, "....the division of the data set might be the explicit purpose of a program run" (1971:267). In these cases, the strategy involved is one of identifying areas of greatest discontinuity, then interpreting factors behind the discontinuity. That strategy is applied here.

Data sets may be strongly structured with marked discontinuities, corresponding to discrete community demarcations. Alternately, they may have a less pronounced structure. The program can be set to varying cohesiveness rules, and by comparing results from different rules and subdivisions of the data, can be used to identify weak groupings of species and relevés. By selectively removing relevés, or species, the statistical groupings can be made stronger.

> When rules of different severity are used in succession for the same data set, much of the inner structure of the communities can be revealed. While less strict membership requirements may, in sufficiently species-rich data, produce very many groups, these decrease both in number and size under stricter requirements. This can be observed when making either the inside requirements or the outside requirements, or both, more restrictive. The species groups derived from the strictest tests can be regarded as the most stable ones representing the cores around which species of weaker association are arranged.(Češka & Roemer, 1971:265)

This paper is part of a several step study to make a first-level assessment of biogeographic pattern among the seaweeds of the tropical and subtropical (warm water) western Pacific. A previous paper (Chapter 2) presented the floristic results from this field study. A major conclusion from that chapter was that the taxonomic certainty varied widely among taxonomic groups. This chapter independently evaluates the degree of floristic cohesiveness from a community ecology point of view. The main objective of this study was to identify the highest level vegetation organization distinguishable.

COENOS groups data from the standpoint of indicator species using statistical rules determined by the investigator. Patterns should, in general, be more conservative as higher taxonomic levels of information are used. This principle was invoked in an attempt to identify the most basic patterns within the field area. It is the premise of the present paper that these concepts can be extended beyond testing the inner structure of the communities, to evaluating the inner structure of the data. It is believed that there are differences in the quality for the data of red, brown and green algae which correspond to their biological differences. If data are representative of natural systems, community patterns derived from progressively higher taxonomic levels of data will be progressively conservative. The interpretation of the analysis results will be in terms of what are already known as the challenges of interpreting phycological data. It is hoped that an evaluation of the evenness of quality of information from one project, collected and identified with consistency may provide insights which can be applied to the biogeographic interpretation of less consistent data sets.

Materials and Methods

A variety of habitats along a coastline extending over 350 km were sampled to gather presence-absence data on benthic marine algae for community ecology analysis. Sites were located in northern Leizhou Peninsula and south Hainan Island, between 20°15'–21°10'N and 109°50'–110°33'E (Figure 3.1). Twenty-four sites were collected, some more than once. Areas were selected according to a sampling strategy to represent the scope of the flora of the area. This entailed sampling over a wide range of habitats over a period of several months (Table 2.1). Navigational charts, topographic sheets and discussions with local fisheries professionals were helpful in site selection. Collections were generally conducted at low tide and lasted approximately one hour each. During that time an attempt was made to collect all the species present within the defined area. Further details of site selection, characterization of habitat, collection strategy, frequency of collection, collection details and floristic results are given in Chapter 2.

These collections were sorted and prepared according to standard phycological technique. Specimens were identified after the field collections were completed. All specimens were taken for identification to the Academia Sinica Institute of Oceanology, Qingdao, Shandong Province. A group of specialists made determinations (see Chapter Two). It is understood that in many cases, absolute identification would require extensive monographic research. For the purposes of this research that is not necessary, since the specimens are all consistently identified with respect to all others in this collection. Benthic marine algae were identified to 219 taxa in 99 genera of green, brown and red taxa. Presence-absence lists were then prepared for all species by site (Tables 2.2–2.7).

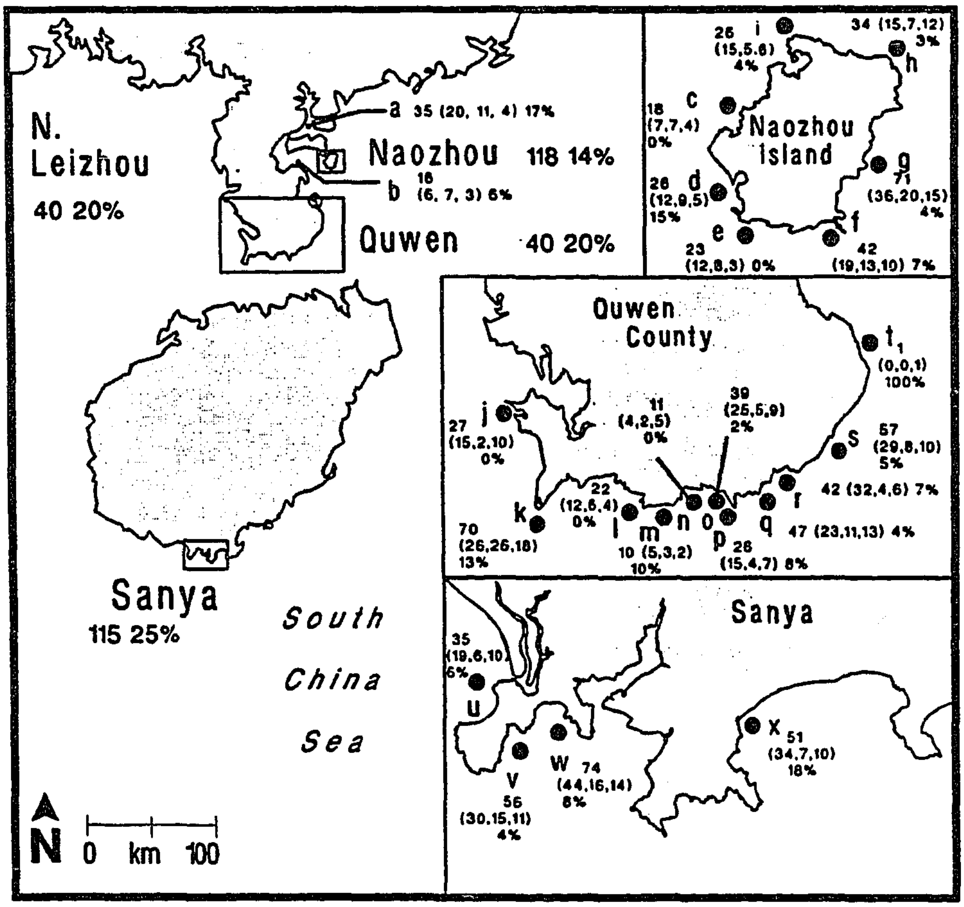


Figure 3.1. Field collection sites and floristic summary. Total species number (red species, green species, brown species) and percentage of unique species are presented for each site and area. Sites were grouped into 4 areas: northern Leizhou (sites a,b); Naozhou Island (sites c-i); Quwen County (sites j-t); Sanya (sites u-x).

Site *t* was excluded from analysis because a significant number of specimens was lost. After initial analyses, site *m* was identified as a data outlier, and was also excluded. The remaining 21 sites were used for analyses.

Site-species data were organized three ways: 1) Chlorophyta; 2) Phaeophyta; and 3) Rhodophyta. Both species and generic levels were evaluated within each grouping. Default statistical parameters (a combination of 40/10, 50/10 and 66/33, applied automatically) resulted in a high number of vegetation types.

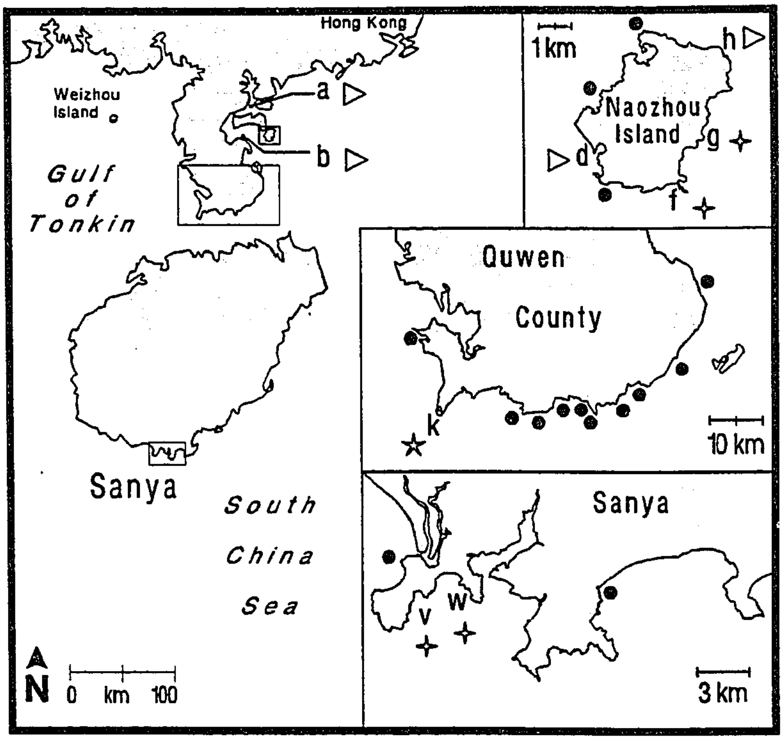
Results

Results of the analyses are shown in Figures 3.2–3.4, for Chlorophyta, Phaeophyta and Rhodophyta data, respectively. Each figure presents the COENOS diagram of species groups by site array, followed by a list of the species constituting each group. Each figure includes a map of the results.

Numbers of species groups formed from the data, and the array of groups over sites varies markedly for the three sets of data. Two groups of species were identified for data from the brown and green algae. Four species groups were identified from the data on red algae. Field data consisted of 55 species of Chlorophyta, 49 of Phaeophyta and 115 of Rhodophyta. Fifteen of the green algal taxa (27%) were grouped, 9 of the brown algae (18%) and 29 of the red algal taxa (25%). Fewest sites were grouped with the green algal data (9 of the 22 analyzed), more with the data from brown algae (14 sites and the most from the red algal data (19 sites).

Discussion

Analyses using red, green and brown algal data from this study present different interpretations. Green algal data are grouped using community ecology analysis into two sets, each consisting of four sites, which overlap at site k. The two species groups are interpretable as indicators of different habitats. Species in group one are predominantly subtidal, while those in species group two are predominantly intertidal. Site group one (sites a, b, d, and h) are, except for the last site, characterized by extensive, low-diversity intertidal mud/sand flats.



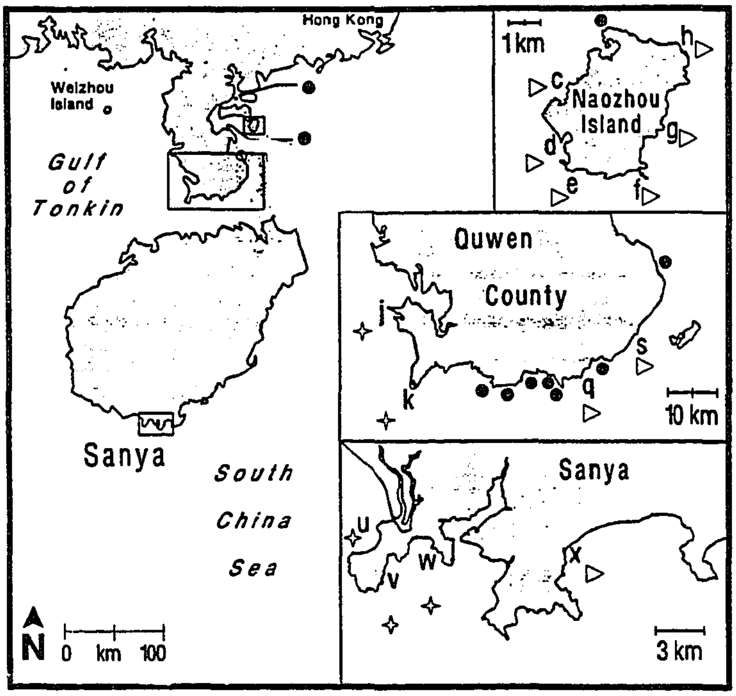
stand types 1 ▷ 2 ☆ 3 ✧

	f	g	v	w	k	a	b	d	h	c	e	i	j	l	n	o	p	q	r	s	u	x
9 spp.	X	X	X	X	X																	
6 spp.					X	X	X	X	X													

Group 1 Caulerpa serrulata, Boodleopsis sp., Neomeris annulata, Cladophora rugulosa, Valoniopsis pachynema, Anadyomene wrightii, Chaetomotpha antennina, Codium geppii, Udotea javensis

Group 2 Enteromorpha tubulosa, Monostroma nitidum, E. flexuosa, Cladophoropsis zollingeri, Chaetomorpha spiralis

Figure 3.2 Releve types from the analysis of the green species data set, under a combination of 40/20 and 50/30 selection rules. Two species groups are present. Constituent species are listed, below map. Only those sites which are grouped for this analysis are labeled.



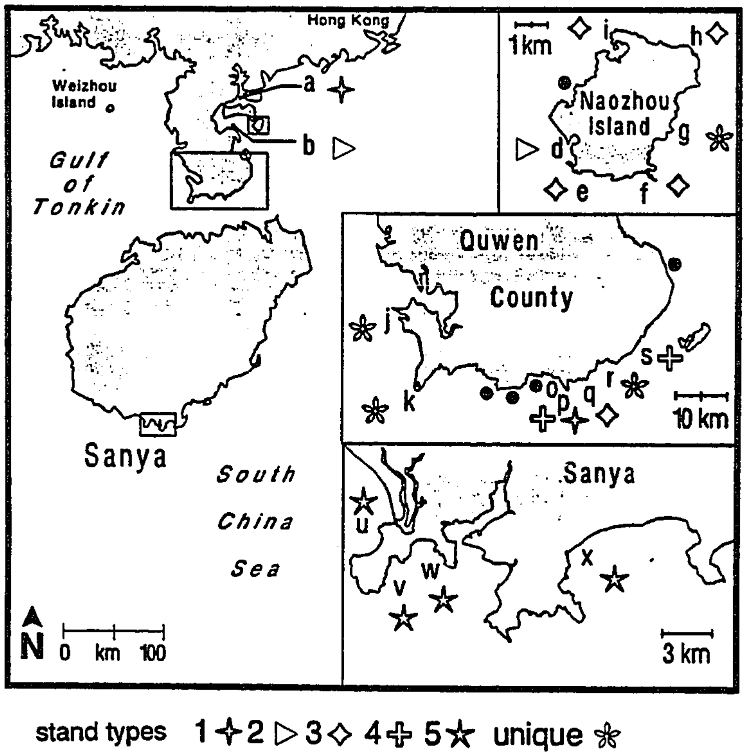
stand types 1 ▷ 2 ✧

	c	d	e	f	g	h	q	s	x	j	k	u	v	w	a	b	i	l	n	o	p	r
5 spp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
4 spp.										X	X	X	X	X								

Group 1 *Hydroclathratus clathratus, Padina australis, P. minor, Colpomenia sinuosa, Turbinaria ornata*

Group 2 *Sargassum polycystum, Lobophora variagata, Dictyopteris repens, Dicyota cervicornis*

Figure 3.3. Stand types from the analysis of the brown algal species, data and map of analysis summary. Two species groups are present. Eight field sites are ungrouped, and are unlabled in the map.



	j	u	v	w	x	g	k	e	f	h	i	q	r	o	s	a	p	b	d	c	t	n
10 spp.	X	X	X	X	X	X	X															
5 spp.		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
8 spp.						X							X	X	X							
6 spp.							X							X	X	X	X	X	X			

Group 1 *Gelidiella acerosa, Jania adhaerens, Actinotrichia fragilis, Amphiroa foliacea, Gracilaria salicornia, Gelidium crinale, Chondria armata, Hypnea nidifica, Asparagopsis taxiformis, Gracilaria eucheumoides*

Group 2 *Gelidium pusillum, Galaxaura oblongata, Ceratodictyon spongiosum, Acanthophora muscoides, Gymnogongrus* sp. #1

Group 3 Delesseriaceae (species), *Polysiphonia friabile, Hypnea japonica, Rhodymenia intricata, Polycavernosa fastigiata, Gracilaria purpurascens, Gigartina tenella, Coelothrix irregularis*

Group 4 *Gracilaria asiatica, Hypnea cervicornis, Gracilaria heterocladia, G. tenuistipitata, G. blodgttii, Acanthophora spicifera*

Figure 3.4. Stand types from the analysis of the red algal species, data and map of analysis summary. Four species groups are present. Three sites are ungrouped.

Analyses from brown algal data from this study are interpreted very differently. First, the pattern of sites where species groups are present are not the same as the green algal groups. Instead of overlapping, the two brown algal species groups are present in an imbedded array of sites. Species group one, consisting of 5 easily-identifiable species of wide Indo-Pacific distribution, is present at a wide range of sites. These represent a diversity of habitats. This suggests that this species group established a lowest heirarchical grouping of brown species which represent the entire study area. The second species group is present (sites j, k, u, v, and w) only at sites also containing the first group. These species have a biogeographic distribution which is more tropical. This corresponds with the general habitat character of these sites. Therefore, the brown algal data analyzed within this study both select species groupings representative of the field area in general, and identify a subset of those sites which have a strong tropical character in the flora.

Interpretations from red algal analyses are based on a greater number of species groupings and produce more complicated presence/absence patterns. As mentioned earlier, red algae tend to be seasonal, and this would be expected to contribute an element of randomness to the community ecology analysis. An examination of the species constituting the second two species groups supports the view than these groups represent seasonal or other occasional patterns. The first two groups, however are species which are more macroscopic and generally longer lasting. Presence/absence patterns of the last two of the four species groups are somewhat scattered with regard to the basic site trend established with the first two groups.

A pattern with the red algal data which is similar to that of the brown is the second species group. These species are grouped with a wide range of sites, and, as with the brown algal taxa, may be species indicative of the field area in general.

Conclusion

These preliminary results indicate that there are differences in the biogeographic interpretability of red, brown and green algal presence absence data. Analysis results have distinctly different interpretations among the three sets of data, and data from the Phaeophyta appear to be the most useful in biogeographic extrapolation.

An Overview of the Algal Flora of the Northern South China Sea and its Relationship to a Biogeographic Interpretation of the Warm Water Western Pacific

On the basis of a large collection of marine algae, consisting of more than 2000 numbers, made along the southern shores of China, the marine algal flora of the northern South China Sea can be characterized as showing a considerable diversity. The field study habitats were diverse, including sand or mud flats, rock benches, rock walls, areas with boulders, while others had biotic coral reefs. The area under study, in fact, is near the northern limit of such reefs along the China coast. While the largest numbers of taxa were collected in areas of active water movement, whether turbid or clear, the areas with low water movement all yielded a smaller, yet diverse number of species. The collections showed some taxa that were tropical in relationship (*Neomeris* among the green algae, *Padina* among the brown algae, for example), and others that were subtropical (*Acrosymphyton*, for example).

Phycological history in the western Pacific shows slow and long-term accumulation of knowledge over centuries in China, and a more rapid accumulation in Japan, with both classical and practical information given nearly equal emphasis in both countries.

The distribution of marine algae in this area of the warm water western Pacific definitely shows a strong dependence on habitat. With the exception of species of *Sargassum*, a dominant brown alga in the tropics and subtropics, and in the area under study, the taxa are relatively small, usually less than 6-8 cm tall, and characteristic of sandy, muddy areas. Creeping forms like the green alga *Caulerpa* are common in such habitats although not limited to them. On the other hand, the green alga, *Halimeda* was only found in the clear-water sites of southern Hainan. It can be predicted that in other parts of the warm water Pacific these genera will be found to occur in similar habitats.

Two things stand out as the major contributions of this study. The first was my making the first floristic study along the continental coastline from Hong Kong to southern Vietnam. In addition, this collection has provided the field basis for interpretation of the taxonomic literature.

The second major contribution relates to biogeography. In biogeographic studies, you can form generalizations on the basis (1) solely of the published presence/absence literature, (2) from presence/absence information comparing field study results to the literature, or (3) use of the literature and field study results with community ecology analyses as a guide to selecting those species best interpretable biogeographically. This later perspective emphasizes the viewpoint that the presence of all taxa is not equally significant and was adopted in this research.

Biogeographic problems must address biological concerns (seasonality, herbivory, variable morphology, for example) and information concerns (historical characteristics of the data, questions of biological and geographic representation). My field collections became the basis for comparison to the published literature. In examining these taxa by community ecology techniques, I have demonstrated a different kind of tool which can contribute to the analysis of published literature. I adopted an approach of separating the data on red, green and brown taxa and found that very clear patterns of species groups were identifiable from distribution information on brown and red taxa, but not green. Using community ecology techniques as a tool, I have offered a further contribution toward using floristics as a base for biogeography.

Appendix A.
A History and Annotated Account of the Benthic Marine Algae of Taiwan

Appendix A. is an original research contribution published in *Smithsonian Contributions to the Marine Sciences*, Number 29, 1987.

ABSTRACT

Lewis, Jane E., and James N. Norris. A History and Annotated Account of the Benthic Marine Algae of Taiwan. *Smithsonian Contributions to the Marine Sciences*, number 29, 38 pages, 1 figure, 1987.—Records of the benthic marine algae of the Island of Taiwan and neighboring islands have been organized in a floristic listing. All publications with citations of benthic marine green algae (Chlorophyta), brown algae (Phaeophyta), and red algae (Rhodophyta) in Taiwan are systematically arranged under the currently accepted nomenclature for each species. The annotated list includes names of almost 600 taxa, of which 476 are recognized today. In comparing the three major groups, the red algae predominate with 55% of the reported species, the green algae comprise 24%, and the browns 21%. *Laurencia brongniartii* J. Agardh is herein reported for Taiwan for the first time.

The history of modern marine phycology in the Taiwan region is reviewed. Three periods of phycological research are recognized: the western (1866–1905); Japanese (1895–1945); and Chinese (1950–present). Western phycologists have apparently overlooked the large body of Japanese studies, which included references and records of Taiwan algae.

By bringing together in one place all previous records of the Taiwanese marine flora, it is our expectation that this work will serve as a basis for further phycological investigations in the western Pacific region.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Smithsonian Year*. SERIES COVER DESIGN: Seascape along the Atlantic Coast of eastern North America.

Library of Congress Cataloging in Publication Data
Lewis, Jane E.
A history and annotated account of the benthic marine algae of Taiwan.
(Smithsonian contributions to the marine sciences ; no. 29)
Bibliography: p.
Includes index.
Supt. of Docs. no.: SI 1.34 : 29
1. Marine algae—Taiwan—Classification—Bibliography. 2. Marine algae—Taiwan—Bibliography. 3. Marine algae—Research—Taiwan—History. I. Norris, James N. II. Title. III. Series
Z5356.A6L48 1987 016.5894'0951'249 86-600251
[QK575.T28]

Contents

A History and Annotated Account of the Benthic Marine Algae of Taiwan

Jane E. Lewis and James N. Norris

Introduction

Historical Review

The history of recognizing, naming, and using marine algae in China extends far back into the early Chinese literature. Although of uncertain antiquity, the specific mention of marine algae goes back at least to the publication of the *Er Ya** or *Literary Expositor* (Tseng and Chang, 1961), a dictionary that dates to the 3rd century B.C. (Needham, 1970). Application of Latin binomials to the Taiwan marine flora, however, began only in the late 19th century (Martens, 1866). After a period of European collections and reports, a period of extensive Japanese studies during the early to mid-20th century followed. The third, or current, period is one in which the activities of Chinese investigators predominate.

The first report of benthic Taiwan algae that followed Linnean taxonomy appeared in Georg von Martens' *Die Tange* (1866), based on the botanical explorations from the German expedition to East Asia, 1860 to 1862. During this voyage von Martens' son Eduard, chief zoologist for the expedition, collected marine and freshwater algae from Java, the Philippines, Singapore, Taiwan, Hong Kong, and other East Asian areas. In this work, the elder von Martens reported seven marine species from "Tamsui" (Danshui), a northeast Taiwan seaport, including three marine algal species, *Ulva lactuca* f. *lapathifolia*, *Grateloupia filicina* f. *filiformis*, and *Caulacanthus ustulatus* var. *fastigiatus*, not again recorded from Taiwan.

During a second German expedition to East Asia (1886–1888) Dr. Warburg made phycological collections that were later published by Heydrich (1894) and De Toni (1895, 1905). This expedition covered the East Indian Ocean, the Mollucca Islands, China, Java, the southern Japanese islands, and a brief stop at Taiwan. Taiwan collection locations were noted as Jilong (a northeast seaport), south Taiwan, the east coast and "Long-kiau" on the south coast.

Among Warburg's Taiwanese algal collection, Heydrich identified 43 taxa, consisting of 24 red (Rhodophyta), 12 brown (Phaeophyta), and 7 green (Chlorophyta) species. In continued studies of the algae from this expedition, De Toni (1895) reported 36 taxa from Taiwan and in 1905 another two species. As a result of these early European investigators, over 60 marine benthic algae were reported for the Taiwan region, including many new to science.

The history of the exploration of Taiwan marine algae, as with other sciences and indeed all aspects of life, was greatly shaped during the 50-year period, beginning in 1895, of Japanese political dominance in Taiwan. Voluminous studies on the Japanese flora and fauna, then including Taiwan, were undertaken. It was during this time that exploration of the Taiwan marine flora was most intensive, dominated by the work of K. Okamura (e.g., 1900–1902, 1907–1942) and his student, Y. Yamada (1930–1944).

The first publication of this period, "New or Little Known Algae From Japan" (Okamura, 1895), included two new records of species from Taiwan. Many publications specifically addressed the Taiwan flora (Okamura, 1915b, 1931, 1935b; Oshima, 1915; Ariga, 1919, 1920, 1921; Horikawa, 1919; Yamada 1925a, 1925b, 1936a; Yamada and Tanaka, 1934; Tokida, 1941), but most references to the Taiwan flora were included as distributional notes or collection sites within general Japanese floristic works (Okamura, 1930, 1936; Yamada, 1928, 1934). Three important series con-

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* Throughout this text, Chinese place names and words not enclosed in quotation marks are spelled according to the Pin Yin romanization system.

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taining numerous, but scattered, references to Taiwan algae are *Illustrations of the Marine Algae of Japan* (Okamura, 1900–1902) and *Icones of Japanese Algae* (Okamura, 1907, 1909, 1913, 1915a, 1921, 1923, 1932, 1934b, 1935a, 1937, 1942); Yamada's "Notes on Some Japanese Algae" (1930, 1931a, 1932b, 1933, 1935, 1936b, 1941, 1944b); and Yendo's "Notes on Algae New to Japan" (1909, 1914, 1915, 1916a, 1916b, 1918).

From an early time the Japanese were interested in floristic comparisons, sometimes speculating on the reasons for disjunct species distributions or factors that might cause adjacent areas to have divergent floras (Ariga, 1920, 1921; Okamura, 1915b, 1919). One of the first comparative phytogeographic studies of the western Pacific region (Yamada, 1926) included Taiwan as one of its eight floristic areas. Of the 42 taxa compared in the region, 16 were present in Taiwan.

Japanese monographs included new or additional records of taxa for Taiwan. Among these were studies of the Corallinaceae (Segawa, 1941; Yendo, 1902) and the Florideophyceae (Tanaka, 1944), and the genera *Gelidium* and *Pterocladia* (Okamura, 1934a), *Galaxaura* (Tanaka, 1935, 1936), *Hypnea* (Tanaka, 1941), *Laurencia* (Yamada, 1931b, 1936c), *Liagora* (Yamada, 1938a), *Porphyra* (Ueda, 1932), and *Sargassum* (Yamada, 1942).

Many of the papers written specifically on Taiwan's marine flora are in Japanese. Ariga (1919) describes a 14-day collecting trip and lists 43 taxa collected. Horikawa's (1919) "Marine Algae of Taiwan" reports 20 red, 10 brown, and 15 green species, based on determinations by Okamura of specimens that had been collected by Horikawa, Nagasawa, Maki, and their students at locales around Taiwan, including Danshui and Jilong in the north, Elanbi (Olanpi) in the south, Xiao Liuqiu (Shao Liou Chou) and Lan Yu, and the Penghu (= Pescadores) Islands. In another study a year later, Ariga (1920) reported 69 taxa for the Penghu Islands and compared them with his records from "Amoy," a small island off Fujian (= Fukien) Province, southeast China coast. Although only about 135 km of the shallow Taiwan Strait separate the two sites, the floras were found to be drastically different in composition. Even when the same species occurred in both places they often exhibited marked morphological or seasonal differences. It was speculated that tidal fluctuation or substrate type may have effected these differences. In determining species names, Ariga (1919, 1920) relied heavily on the papers of Yendo and Okamura.

The papers of Ariga (1919, 1920) and Horikawa (1919) were subsequently overlooked by later authors, perhaps due in part to having been written in Japanese. Both 1919 papers use the Latin scientific names and authors of the species followed by Japanese names. Ariga, in his subsequent paper (1920), uses these Japanese names almost exclusively. Few cases are known in other languages where common names apply solely to a single species. In the course of our research, however, these Japanese names were found to be a special case because they are not common names but a Japanese version of the scientific name (Lai Chuen-fu, personal communication). When Latin binomials were introduced to Japan, the Japanese erected equivalent Japanese scientific names, one for each taxon, which were different from the Japanese common names. Because the Japanese names are listed with their Latin binomials in Okamura's flora (1936), it has been possible to translate Ariga's names into the binomial form for inclusion in the current listing.

Yamada's studies on the Chlorophyceae (1925a) and the Phaeophyceae (1925b) of Taiwan, representing his undergraduate thesis at Tokyo University under K. Okamura, are frequently cited in later publications. Most of the specimens of these papers were collected by Yamada during a short spring collecting trip to the north and south coasts of Taiwan and to the Penghu Islands, with a few additional specimens provided by T. Aoki, then a government official in Taiwan.

Economic considerations have also contributed to identification of Taiwan's marine flora. Some papers were devoted to the agarophytes in Taiwan at a time when the Japanese seaweed industry was flourishing (Okamura, 1915b, 1935b; Oshima, 1915). Taiwan's east coast was thought to possibly have a richer agarophyte flora than north Taiwan or any other coast in Japan. However, due to the presence of unfriendly aborigines (Okamura, 1915b), this hypothesis was not investigated until much later, and was found to be incorrect (Fan, 1951).

Several papers discuss Taiwan algae used as foods. The island of Lan Yu (also called Kôtôsho, Botel Tobago, or Orchid Island) has attracted much attention because of its aboriginal population, unique biology, and its close proximity (61 km) to the island of Taiwan. An issue of the *Bulletin of the Biogeographical Society of Japan* (1931, vol. 2, no. 2) was devoted to the anthropology and biology of Lan Yu, with Okamura (1931:95–122) reporting 92 taxa of benthic algae from collections made by S. Segawa during one summer month in 1930. Only about one-third of these algae (Okamura, 1931) were also known to be on both Taiwan and Lan Yu. The Lan Yu flora was considered to be Indo-Pacific in nature, whereas no specific comments were made on the affinities of the Taiwan Island marine flora. Of the many algae presumably eaten by the "Yami" tribe on Lan Yu, Okamura listed 12 (*Carpopeltis formosana*, *Laurencia* sp., *Acanthophora orientalis*, *Halymenia durvillaei* var. *formosa*, *Hypnea seticulosa?*, *Nemalion pulvinatum*, *Chondria armata*, and *Dermonema dichotoma*), also giving a Japanese transliteration of their traditional Yami names. Subsequently, Tokida (1939) published an almost identical list of algae eaten by the "Ami" people on Taiwan with the same common names.

An identification book with photographs of Japanese seaweeds published during this period (Higashi, 1934) included 12 records of Taiwan taxa. With the high scholarly level characteristic of the Japanese picturebook genre, specific names are generally considered accurate. Because these books contain records of Taiwan algae often not previously published, it is believed that distributional citations were based on Japanese herbarium material.

The Japanese flora *Nippon Kaiso-shi* (Okamura, 1936) contains numerous reports of algal species in Taiwan. This is an invaluable reference for the identification of benthic marine algae throughout the northwestern Pacific region.

In addition to the extensive Japanese publications of the period 1895–1945, some Chinese and western papers also included accounts of the Taiwan marine flora. A.D. Cotton (1915) reported nine taxa from Taiwan. Specimens of *Sargassum* were verified by K. Yendo, who visited the Royal Botanic Garden, Kew, while the paper was in preparation.

The lack of scientific communication between the East and West is perhaps characterized by J. Tilden's (1929) comments in "The Marine and Freshwater Algae of China." Although Professor Tilden claims to record "all species previously noted by investigators" for the algae of China, her account of Chinese phycological history only cites one non-western reference, a short paper by Okamura (1913) on "Chinese Edible *Nostoc*." She clearly agrees with Cotton (1915) that "Formosa [now known as Taiwan] . . . though belonging to Japan, must geographically be included with China." Though aware of Martens' (1866) account of algae, Tilden considered his determinations to be unreliable, and her account of the Taiwan marine flora was limited to only the nine taxa Cotton (1915) had reported.

Apparently unaware of the Japanese literature of 1895–1928, Tilden listed only 92 species of marine algae from the entire Chinese region, as "all that has been done in the study of Chinese algae." If the Japanese literature (e.g., Okamura, 1909–1926) and other accounts of European expeditions had been included, she would have found over 350 published records of more than 200 species for Taiwan alone by 1928. It is easy today to see the inaccuracy of Tilden's assessment; however, her conclusions were understandable considering the barriers of language, culture, and communication at that time.

Professor C.K. Tseng, as a young botany instructor from Fujian Province, made extensive collections in the 1930's throughout China. In studies of marine Chlorophyceae from Hainan Island (1936), Chinese Chaetangiaceae (1941b), Hong Kong *Polysiphonia* (1944), and "New and Unrecorded Marine Algae of Hong Kong" (1945), Tseng included several Taiwan collections, many of them new records.

The first publication by Chinese marine botanists on Taiwan after the Japanese occupation came from the Taiwan Fisheries Research Institute. Y.F. Shen and K.C. Fan (1950) compiled much of the earlier literature and studied their own collections as well as specimens from the herbarium at the National Taiwan University made from Kôtôsho by Y. Yamamoto, which resulted in a list of 62 green, 50 brown, and 142 red taxa. Locations were given as "Taiwan," "Kôtôsho" (Lan Yu), "Kasyoto" (Lu Dao) and the "Pescadores" (Penghu Islands).

Fan (1951) described eight species and two forms of the economic genera *Gelidium* and *Pterocladia* from Taiwan, with English translations of Dr. Okamura's (1935) four new taxa. *Gelidium* and *Pterocladia* were found to be restricted to the north and northeast part of the island. The distributions of the various species were compared and found to belong to two distributional groups (a disjunct north-south distribution), but Fan concluded that "[the] chief factors that delimit the mutual exclusion of these species are at present uncertain."

A list of edible marine algae (Fan, 1952) from Taiwan included 30 taxa used by Taiwan aborigines as well as those with a long Chinese tradition, with brief descriptions and localities of the algae, preparation methods, and a table of their Chinese and aboriginal names. Many species were noted to be commonly occuring only in the spring, though no reason was suggested.

Since 1960, Y.M. Chiang (now a professor at Taiwan National University), has been a major investigator of the Taiwan marine algae. Studies on floristics (Chiang, 1960, 1962a,b, 1973a,b), taxonomy (Chiang, 1981; Chiang and Chen, 1982; Yang and Chiang, 1982), reproduction (Chen and Chiang, 1982; Chiang, 1969, 1970, 1971, 1972; Chiang and Chen, 1982), and aquaculture (Chiang, 1981, 1982; Chiang and Chou, 1980; Liaw and Chiang, 1979; Nelson et al., 1983) have been the focus of his phycological contributions.

Professor Chiang began phycological publications (as a student of Y.F. Shen, Botany Department, National Taiwan University) with his two-part "Marine Algae of Northern Taiwan," the blue-green, brown, and green algae (1960), and the red algae (1962a). Included in these works were information on collection locations, habitat notes and seasonality of the major algae, identification keys, and taxonomic summaries of each of the 96 species.

After a field trip of a few days to Penghu, Chiang (1962b) recorded 26 species and noted the fragmentary nature of earlier Japanese records in the Penghu Islands. Dr. Chiang began working on Taiwan's phytogeographic affinities with "Notes on Marine Algae of Taiwan" (1973a), which included north-south distributional observations and new records of six green, six brown, and nine red algae for Taiwan and its offshore islands. "Studies on the Marine Flora of Southern Taiwan" (1973b) reported on the algae at four southern localities and compared them with the north, finding that "some northern species do not occur in the southern waters. On the contrary, there are quite many species which occur in southern Taiwan but not in the northern regions." The southern flora was also considered to be more depauperate than the northern and unique within Taiwan in having typically tropical elements, such as *Bornetella* and *Neomeris*. The water temperatures, warmer and less variable throughout the year in the south, were suggested to be partially responsible for this difference. Because Okinawa, located slightly to the north and east of Taiwan, shares tropical genera with southern Taiwan, Chiang also suggested that the Kuroshio (or Japanese) Current is likely to be a major factor in distribution.

A later series of papers focus on aspects of morphology and reproduction (Chiang and Chou, 1980; Chen, Chiang, and Chiang, 1981; Chen and Chiang, 1982; Chiang, 1982; Chiang and Chen, 1983) and vegetative reproduction in a brown alga (Chiang and Chou, 1980). These papers provide taxonomic information, some of which is new for the Taiwan flora, and others that substantiate previous records. Taxonomic studies on *Sargassum* (Chou and Chiang, 1981), *Liagora* (Chiang and Chen, 1982), and *Gracilaria* (Yang and Chiang, 1982) provide additional listings with distribution, morphology and seasonality information.

Aquaculture in Taiwan is a well-developed business principally of shellfish and fin fish, and in the last 10 years the culture of marine algae (Chueh and Chen, 1982), especially *Gracilaria* (Chen, 1976; Shang, 1976; Michanek, 1978; Ryther, 1979; Tseng, 1981a,b; Chiang, 1981; Doty, 1983), and *Porphyra* (Chiang, 1982), has received more attention from both growers and taxonomists. Of the numerous publications on seaweed culture, those providing records of native species in Taiwan were most appropriate for inclusion in this listing.

In a review of *Gracilaria* culture in Taiwan, Chiang (1981) and Hansen et al. (1981) provided taxonomic information on the three native species cultured (*G. edulis*, *G. gigas*, and *G. verrucosa*) and the techniques employed. The seaweed aquaculture program, centered in the southwest of Taiwan, began in 1961, and by 1979 about 12,000 tons of the dry seaweed were being harvested, predominately for the domestic agar industry, and about 120 tons of fresh seaweed went as feed to abalone farms.

Gracilaria is the major source of agar-agar, along with some *Gelidium*. Reports on seasonal variation of agar quality and quantity produced in Taiwan (Yang, 1982; Yang et al., 1981) provide records on the native agarophyte flora, and a comparison of agar from species in Taiwan and Micronesia (Nelson et al., 1983) provides information on Taiwan sites of natural populations.

In contrast to *Gracilaria*, *Porphyra* culture has been small-scale and irregular. Cultivation of local species in the Penghu Islands began in 1968, but studies on the life history of the local species were not initiated until 1975 (Chiang, 1982), when the "*Conchocelis*-stage" of *Porphyra* and monospore formation were investigated. This study and two on *Conchocelis* culture (Chiang and Chou, 1980; Liaw and Chiang, 1979) also provide taxonomic information on native Taiwan taxa.

Alginates, a family of chemicals used in food preparation and with a wide variety of industrial uses, which conventionally are extracted from cold-water kelps, may become an industry in Taiwan, using a tropical brown alga. Research has been conducted (Liu, 1982) on improving the quality of alginates from *Sargassum duplicatum*, a species growing naturally along the shoreline of the southern tip of Taiwan.

Green algae are also a part of Taiwan's aquaculture industry. Liu (1982) mentions use of *Chlorella*. Included in a report on chemical analysis and utilization of *Monostroma* (Wu, 1982) is information on the two native species and their distribution.

The study of biological activity and natural-product chemistry (e.g., Norris and Fenical, 1985) is a recent research interest in Taiwan. For example, in a recent paper, "Pharmacological Properties of Some Taiwan Seaweeds" (Su et al., 1982), 30 species from Taiwan were screened for antimicrobial activity.

Geographic and Oceanographic Features

The area encompassed in this study includes the main island of Taiwan and a few of its 14 associated islands as well as the 64 islands of the Pescadores Archipelago (Figure 1). The islands most commonly referred to in the phycological literature are those of Taiwan (= Formosa) (21°53′–25°18′N, 120°1′–122°0′E), Orchid Island (= Kôtôsho or Lan Yu) (22°0′–22°5′N, 121°36′–121°30′E), Green Island (= Kasyoto or Lu Dao) (22°38′–22°41′N, 121°28′–121°30′E) and the Pescadores (= Penghu Islands) (23°11′–23°46′N, 119°18′–119°42′E). The most frequented collecting sites on the Island of Taiwan have been Olanpi at the southern tip, "Tai Dung" on the east coast, and the general area of the northern tip. Bisected by the Tropic of Cancer, the Island of Taiwan is considered both tropical and subtropical. Geologically it is a continental island with a mostly sedimentary origin, and it has a coastline of roughly 1600 km.

Oceanographic conditions around the island vary in topography, temperature, and currents. The Taiwan Strait is shallow (60 m average depth) and turbid, extending westward from Taiwan some 140 to 200 nautical miles to the southeast coast of mainland China. Within the Strait, the Penghu Islands are some 40 km from Taiwan. Tidal currents around these islands reach almost 6 knots in places (USDD Nautical Map #94060). In the East China Sea northeast of Taiwan is the Ryukyu Island chain, beyond which are the main islands of Japan. To the south the Bashi Channel separates Taiwan and the Philippines. The east coast, often precipitous, marks the eastern edge of the continental shelf. The sharp drop-off continues some 4000 m below sea level, reaching the floor of the Philippine Basin. Along the southeast coast are areas of upwelling, with colder, nutrient-rich waters.

Many benthic marine algae are found growing in the

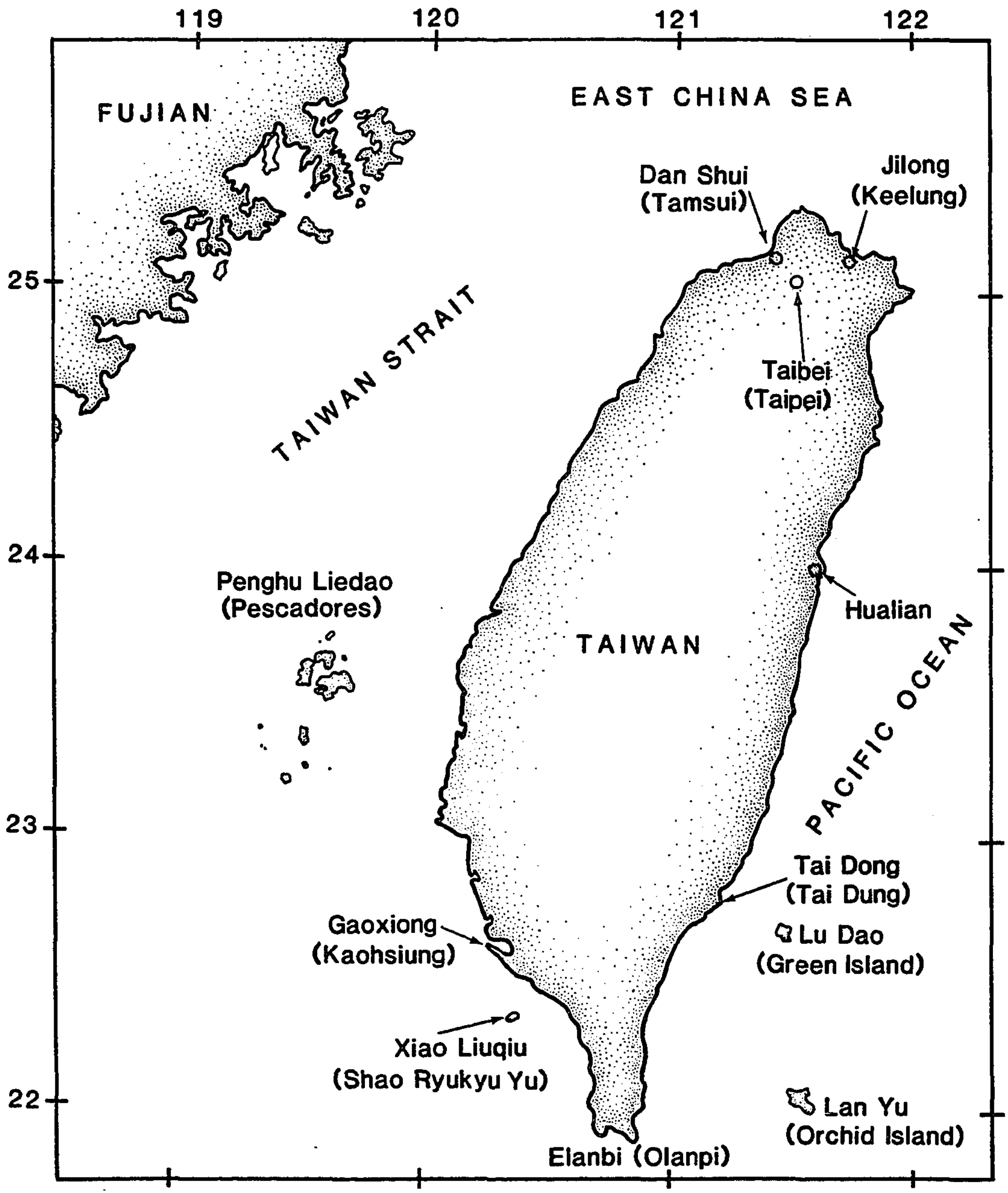

FIGURE 1.—Map of Taiwan, showing islands and locales most commonly referred to in the phycological literature.

nearshore coastal waters. Shoreline conditions in Taiwan vary from sandy to rocky shores with murky water in the north, to coral reefs with clear swift water in the south. To the east are precipitous cliffs and rough waters with deep-ocean upwellings along the coast and, in contrast, level, calm expanses of intertidal mud and sand flats along the western shoreline.

The two main currents affecting Taiwan are the Kuroshio (or Japanese) Current and the Taiwan coastal current. The Kuroshio Current brings water of high temperature and salinity up from the Philippines and the equatorial region toward southern Taiwan where it branches. The stable, main branch runs past the east coast of Taiwan at an average velocity of 30 to 40 nautical miles per day toward Japan (USDD Nautical Map #94010). A smaller branch, subject to seasonal variability, veers west through the Taiwan Strait.

Flowing south along the China mainland coastal region, the Taiwan coastal current carries colder water from north to south, and is strong in summer and weak in winter. Two smaller seasonal currents, the northeast monsoon current and the southwest seasonal current, result from an interaction between the two major currents and the prevailing winds.

Discussion

While compiling the records of Taiwan algae from the numerous publications, efforts were made to find the correct name as well as the valid date and place of publication for each of the taxa in the annotated list. Unfortunately, phycologists do not have a modern source for specific names such as *Index Kewensis* (Jackson et al., 1893 to date; see Stafleu and Cowan, 1979:397–398, for complete listing) for phanerogams, or *Index Filicum* (Christensen, 1905, 1906; see Stafleu and Cowan, 1976:501–501, for complete listing) for ferns. Our effort has shown how great the need is for such an index of algal species names, such as has recently been done for the generic names of fossil and living plants (Farr et al., 1979). In the absence of such a reference, we found the earlier works of De Toni (1895–1924) and Dawson (1962) helpful.

The Taiwan algae project was undertaken recognizing that a single bibliographic source on the Taiwan marine flora would facilitate identification of the algae and their distribution and would encourage further research within the region. It was evident that the existing literature was widely dispersed and not adequately referenced in most phycological bibliographies. It became necessary to carefully research the east Asiatic algal literature, particularly from Japan and China, and the whole Pacific region, in order to locate information on Taiwan algae. Work on this compilation commenced while the first author was employed at the Fisheries Biology Laboratory, Institute of Zoology, Academia Sinica, Taiwan. Additional extensive searches were necessary to locate original publications to establish proper citation of the binomial and to subsequently determine the current taxonomic and systematic status of each taxon. For this work, the E. Yale Dawson Phycological Library and Department of Botany libraries of the National Museum of Natural History, Smithsonian Institution, were invaluable.

The annotated list stands as a compilation of reports of attached, benthic marine taxa occurring naturally in the region of Taiwan. Efforts were taken to locate all relevant literature, and although it is possible that additional reports can be found, the present work represents the most comprehensive compilation available for the region. It must be emphasized that records are taken from published papers and that the accuracy of these identifications has not been confirmed by herbarium investigations; reported names of taxa are simply noted and arranged systematically following current convention. Verification of the determinations awaits future investigation. Some indication of accuracy may, however, be gained from the frequency and dates of the reports for any given taxon. For example, the three taxa reported by Martens (1866) that have not again been recorded may be considered in need of verification. Nevertheless, it is felt that the present list reasonably reflects the general composition of the Taiwan marine flora.

The Annotated List

There are 476 taxonomic entries in this list, systematically arranged following Abbott and Hollenberg (1976) for the red algae, and Lobban and Wynne (1981) for the brown and green algae. Below family level, genera and species within each genus are listed alphabetically. Each entry consists of (1) the currently accepted taxon name, with its author(s), and date and page of valid publication, and (2) an alphabetical list of the investigators who have reported the taxon present in the Taiwan region.

Orthographic errors in publication of taxa were found to have occurred nine times in this list (M.J. Lai and D.H. Nicolson, personal communication). These were simply corrected, with the original spelling in single quotations following "Recommendation 50F.1" of the *International Code of Botanical Nomenclature* (Voss et al., 1983).

In some cases there are additional names within the entry. In reporting a taxon from Taiwan, authors sometimes used names that have since been considered taxonomic or nomenclatural synonyms, or have been re-determined by later investigators. In all cases, the actual names used by the authors for their algal records from Taiwan are retained in this list. However, when those names differ from the currently accepted ones, they are included in the alphabetical list of references to the taxon. It is hoped that by preserving the original names, the concepts held by the authors will be indicated and later taxonomic and nomenclatural changes will be more easily integrated into this list.

Conclusion

The marine flora of this region appears to have tropical, subtropical, and temperate elements. Many authors have commented on the diversity of floral elements within this region (e.g., Ariga, Chiang, Horikawa, Okamura) and have speculated on the possible causes. As noted earlier, water quality and substrate vary greatly in the region, no doubt affecting floral elements. Southern Taiwan and especially the two southeast islands Lan Yu and Lu Dao are referred to as having a tropical/subtropical flora and the north and west as having a temperate flora, judged by the abundance of brown algae and rarity of red algal elements. These correlations are deserving of further study. Indications are that a number of physical and biotic factors interact to create this diversity of floristic types exhibited in the Taiwan region.

Based on written reports from the literature, this study makes available much previously inaccessible information basic to all phycological studies of the East Asiatic region. This comprehensive list of marine algae, treated in both historical and modern systematic contexts, constitutes a basis for further systematic and ecological investigations and biogeographical comparisons among the East Asian and Pacific areas, and serves as a possible framework for a marine flora of Taiwan.

Acknowledgments

The first author is very grateful to Jang Kun-Hsiung, Director of the Academia Sinica Zoology Institute and its Fisheries Biology Laboratory, Taipei, Taiwan, for the time and support to initiate this project, Chiang Young-Meng, Oceanography Department, National Taiwan University, Taipei, for references and encouragement throughout the project, and the Department of Botany and the Office of Fellowships and Grants, Smithsonian Institution, for support and use of the libraries, laboratory, and computers. A special appreciation is due to Isabella A. Abbott for her time, guidance, and patience and for the use of her personal library. Japanese translations were kindly provided by Lai Chuen-fu, Rika Taga, and Mason E. Hale. We thank Lai Ming-Jou and Dan H. Nicholson for discussions on nomenclature, and for checking the unpublished algal-name file at the University of California, Berkeley, J. Olsen-Stojkovich and P.C. Silva. For comments on the text, thanks go to J. Berdach, M.I. Cannon, A. Medeiros, and K.E. Bucher. Our appreciation to I.A. Abbott, K.E. Bucher, Y.M. Chiang, M.S. Doty, M.M. Littler, H.E. Robinson, and C.K. Tseng for reviewing the paper.

Benthic Marine Algae from Taiwan

CHLOROPHYTA

ULOTRICHALES

ULOTRICHACEAE

Ulothrix flaccida (Dillwyn) Thuret in Le Jolis, 1863:56.
Taniguti, 1976.

CHAETOPHORALES

CHAETOPHORACEAE

Endophyton ramosum Gardner, 1909:372.
Chiang, 1973a.

ULVALES

ULVACEAE

Enteromorpha clathrata (Roth) Greville, 1830:181.
Chiang, 1960; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tokida, 1939.

Enteromorpha clathrata var. *crinita* (Roth) Hauck, 1884:429.
As "*E. crinita*": Ariga, 1920; Chiang, 1960; Chihara, 1970; De Toni, 1895; Fan, 1953a; Heydrich, 1894; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939.

Enteromorpha compressa (Linnaeus) Greville, 1830:180.
Chiang, 1960; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939; Yamada, 1925a, 1926, 1950; Yoshikawa and Yoshikawa, 1977.

Enteromorpha intestinalis (Linnaeus) Link ex Nees, 1820:5.
Ariga, 1919; Chiang, 1960, 1973b; Fan, 1953a; Horikawa, 1919; Shen and Fan, 1950.

Enteromorpha linza (Linnaeus) J. Agardh, 1883:134.
Chiang, 1960, 1973b; Chiang et al., 1974. As "*Phycoseris lanceolata* var. *angusta*": Martens, 1866.

Enteromorpha prolifera (O.F. Müller) J. Agardh, 1883:129.
Chiang, 1960; Fan, 1953a; Shen and Fan, 1950; Taniguti, 1976.

Enteromorpha sp.
Chiang, 1973b.

Monostroma latissimum (Kützing) Wittrock, 1866:33.
Chiang, 1973a, 1973b; Okamura, 1935b; Rho, 1958.

Monostroma nitidum Wittrock, 1866:41.
Chiang, 1960; Fan, 1953a; Okamura, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1925b, 1934, 1950.
Ulva angusta Setchell et Gardner, 1920:283.
Chiang, 1973a; Okamura, 1935b.
Ulva conglobata Kjellman, 1897b:10.
Ariga, 1920, 1921; Chiang, 1960, 1962a; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939; Yamada, 1925a; Yoshikawa and Yoshikawa, 1977.
Ulva fasciata Delile, 1813:155.
Chiang, 1960, 1973b; Fan, 1953a; Shen and Fan, 1950; Tokida, 1939; Tseng, 1983; Yamada, 1935; Yoshikawa and Yoshikawa, 1977.
Ulva japonica (Holmes) Papenfuss, 1960:309.
As "*Letterstedtia japonica*": Chiang, 1973a; Okamura, 1935b; Taniguti, 1976.
Ulva lactuca Linnaeus, 1753:1163.
Chiang, 1960, 1973b; Fan, 1953a; Heydrich, 1894; Okamura, 1930, 1931; Shen and Fan, 1950; Su et al., 1982; Yamada, 1950; Yoshikawa and Yoshikawa, 1977.
Ulva lactuca f. *lapathifolia* (Areschoug) Hauck, 1884:437.
As "*Phycoseris lapathifolia*": Martens, 1866.
Ulva pertusa Kjellman, 1897b:4.
Ariga, 1919, 1920; Chiang, 1960, 1973b; Fan, 1953a; Horikawa, 1919; Okamura, 1921; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939, 1954; Yamada, 1925a; Yoshikawa and Yoshikawa, 1977.
Ulva reticulata Forsskål, 1775:187.
Arasaki, 1964; Ariga, 1920; Chiang, 1960, 1973b; Fan, 1953a; Okamura, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939; Tseng, 1936; Yamada, 1925a.
Ulva rigida C. Agardh, 1823:410.
Ariga, 1920; Yendo, 1916b.
Ulva sp.
Chiang et al., 1974.

CLADOPHORALES

Cladophoraceae

Chaetomorpha aerea (Dillwyn) Kützing, 1849:379.
Ariga, 1921.
Chaetomorpha aerea f. *versata* Heydrich, 1894:273.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950.
Chaetomorpha basiretrorsa Setchell, 1926:72.
Chiang, 1960.
Chaetomorpha brachygona Harvey, 1858:87.
Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.
Chaetomorpha crassa (C. Agardh) Kützing, 1845:204.
Ariga, 1920; Chiang, 1960, 1973b; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1950; Yoshikawa and Yoshikawa, 1977.
Chaetomorpha linum (O.F. Müller) Kützing, 1845:204.
Ariga, 1919; Chiang, 1960; Fan, 1953a; Horikawa, 1919; Okamura, 1936; Shen and Fan, 1950; Tokida, 1954; Yamada, 1925a, 1926, 1950; Yendo, 1916a.
Chaetomorpha spiralis Okamura, 1912:162.
Chiang, 1960, 1973b; Fan, 1953a.
Cladophora aokii Yamada, 1925a:85.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.
Cladophora fuliginosa Kützing, 1849:415.
Okamura, 1936; Tseng, 1983; Yamada, 1932b, 1934, 1950.
Cladophora montagnei var. *radicans* Yamada, 1925a:87.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.
Cladophora patentiramea (Montagne) Kützing, 1849:416.
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1950.
Cladophora pellucida (Hudson) Kützing, 1845:208.
Okamura, 1936; Shen and Fan, 1950. As "*C. prolifera*": Okamura, 1931.
Cladophora rugulosa Martens, 1866:112.
Ariga, 1920.
Cladophora scitula (Suhr) Kützing, 1849:399.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950.
Cladophora sibogae Reinbold, 1905:146.
Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1950.
Cladophora sp.
Ariga, 1919, 1920; Fan, 1953a; Horikawa, 1919; Okamura, 1931; Shen and Fan, 1950; Tokida, 1939.

CAULERPALES

Codiaceae

Codium adhaerens (Cabrera) C. Agardh, 1823:457.
Ariga, 1919, 1920; Chiang, 1960, 1962b; Horikawa, 1919; Okamura, 1936.
Codium arabicum Kützing, 1856:35.
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a.
Codium contractum Kjellman, 1897b:35.
Ariga, 1920; Taniguti, 1976.
Codium cylindricum Holmes, 1896:250.
Taniguti, 1976.
Codium dichotomum (Hudson) S.F. Gray, 1821:293.
Fan, 1953a; Tokida, 1954. As "*C. tomentosum*": De Toni, 1895; Heydrich, 1894; Shen and Fan, 1950.
Codium formosanum Yamada, 1950:180.
Fan, 1953a; Yamada, 1950; Yoshikawa and Yoshikawa, 1977.
Codium fragile (Suringar) Hariot, 1889:32.
As "*C. mucronatum*": Ariga, 1919; Horikawa, 1919.

Codium intricatum Okamura, 1913:74.
Ariga, 1919, 1920; Chiang, 1962b, 1973b; Fan, 1953a; Higashi, 1934; Horikawa, 1919; Shen and Fan, 1950; Yamada, 1950.

Codium reediae Silva in Egerod, 1952:389.
Chiang, 1973a.

Codium repens (P. et H. Crouan) Vickers, 1905:56.
Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a.

Codium tenue Kützing, 1856:33.
Fan, 1953a; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a.

Udoteaceae

Chlorodesmis caespitosa J. Agardh, 1887:49.
Chiang, 1973b; Chihara, 1975; Yoshikawa and Yoshikawa, 1977. As "*C. formosana*": Arasaki, 1964; Chihara, 1970; Okamura, 1930, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Yamada, 1925a.
Remarks: Ducker et al. (1965) and Ducker (1967) provide evidence for reducing *C. formosana* into synonomy with *C. caespitosa* (see also Fan, 1974).

Chlorodesmis comosa Bailey et Harvey in Harvey, 1858:29.
Ariga, 1920; Higashi, 1934; Okamura, 1931, 1936; Rho, 1958; Shen and Fan, 1950; Yamada, 1925a.

Halimeda cuneata Hering in Krauss, 1846:214.
Higashi, 1934; Okamura, 1930, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1950.

Halimeda discoidea Decaisne, 1842:102.
Ariga, 1920.

Halimeda incrassata var. *ovata* (J. Agardh) Barton, 1901:27.
Okamura, 1936; Yendo, 1909.

Halimeda macroloba Decaisne, 1841:118.
Chiang, 1973a, 1973b; Okamura, 1915a, 1935b, 1936.

Halimeda opuntia (Linnaeus) Lamouroux, 1812:186.
Ariga, 1920; Chiang, 1973b; Su et al., 1982; Taniguti, 1976; Yamada, 1926.

Halimeda renschii Hauck, 1886:167.
As "*H. opuntia* f. *renschii*": Ariga, 1919, 1920; Chiang, 1962b; Horikawa, 1919; Okamura, 1915a, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Yamada, 1925a, 1950.

Halimeda velasquezii W.R. Taylor, 1962:176.
As "*H. opuntia* f. *intermedia*" Chiang, 1962b.

Caulerpaceae

Caulerpa cupressoides var. *lycopodium* f. *amicorum* (Harvey) Weber-van Bosse, 1898:337.
Ariga, 1920.

Caulerpa freycinetti var. *freycinetti* f. *lata* Weber-van Bosse, 1898:313.
Ariga, 1920; Okamura, 1936; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977. As "*C. freycinetti* var. *typica*": Okamura, 1931.

Caulerpa racemosa (Forsskål) J. Agardh, 1873:35.
Ariga, 1919; Fan, 1953a; Horikawa, 1919; Taniguti, 1976; Tokida, 1939.

Caulerpa racemosa var. *clavifera* f. *macrophysa* (Kützing) Weber-van Bosse, 1898:361.
Ariga, 1920; Chiang, 1962b; Okamura, 1936; Rho, 1958; Segawa, 1974; Yamada, 1925a, 1926, 1950. As "*C. racemosa* var. *clavifera*": Okamura, 1913, 1931; Shen and Fan, 1950; Yamada, 1925a, 1926; Tseng, 1983.

Caulerpa racemosa var. *clavifera* f. *microphysa* (Kützing) Weber-van Bosse, 1898:361.
Okamura, 1931, 1936; Yamada, 1950.

Caulerpa racemosa var. *laetevirens* (Montagne) Weber-van Bosse, 1898:366.
Chiang, 1960, 1973b; Okamura, 1930, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1926, 1950; Yoshikawa and Yoshikawa, 1977.

Caulerpa racemosa var. *occidentalis* (J. Agardh) Bϕrgesen, 1907:379.
Yoshikawa and Yoshikawa, 1977.

Caulerpa racemosa var. *peltata* (Lamouroux) Eubank, 1946:421.
As "*C. peltata*": Chiang, 1960, 1962b; Okamura, 1931, 1932, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1936; Yamada, 1950.

Caulerpa racemosa var. *turbinata* (J. Agardh) Eubank, 1946:420.
As "*C. racemosa* var. *chemnitzia*": Chiang, 1960; Shen and Fan, 1950; Yamada, 1925a, 1926.

Caulerpa serrulata (Forsskål) C. Agardh, 1823:446.
Eubank, 1946; Segawa, 1974; Tseng, 1936; Chihara, 1975.

Caulerpa serrulata f. *lata* (Weber-van Bosse) Tseng 1936:178.
Tseng, 1983.

Caulerpa sertularioides (Gmelin) Howe, 1905:576.
Ariga, 1919; Chihara, 1975; Horikawa, 1919; Yamada, 1950.

Caulerpa sertularioides f. *longipes* (J. Agardh) Collins, 1909:415.
Ariga, 1920.

Caulerpa taxifolia (Vahl) C. Agardh, 1823:435.
Yamada, 1926.

Caulerpa webbiana Montagne, 1838:18.
Ariga, 1919; Horikawa, 1919.

Caulerpa webbiana f. *disticha* Weber-van Bosse, 1898:270.
Okamura, 1931, 1936; Shen and Fan, 1950.

Caulerpa webbiana f. *tomentella* (Harvey) Weber-van Bosse, 1898:270.
Ariga, 1920; Chihara, 1975; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1936.

BRYOPSIDACEAE

Bryopsis harveyana J. Agardh, 1887:22.
Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1950.

Bryopsis indica A. et E.S. Gepp, 1908:169.
Chiang, 1960, 1962b.

Bryopsis mucosa Lamouroux, 1809b:333.
Chiang, 1960.

Bryopsis plumosa (Hudson) C. Agardh, 1823:448.
Ariga, 1920; Chiang, 1960; De Toni, 1895; Heydrich, 1894; Okamura, 1936; Rho, 1958; Shen and Fan, 1950.

DERBESIACEAE

Derbesia lamourouxii (J. Agardh) Solier, 1847:162.
Taniguti, 1976.

SIPHONOCLADALES

SIPHONOCLADACEAE

Boergesenia forbesii (Harvey) Feldmann, 1938:584.
Chiang, 1962b, 1973b; Tseng, 1983; Yamada, 1950. As "*Valonia forbesii*": Ariga, 1919; Horikawa, 1919; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.

VALONIACEAE

Boodlea coacta (Dickie) Murray et De Toni in Murray, 1889:245.
Yamada, 1926, 1950; Yoshikawa and Yoshikawa, 1977.

Boodlea composita (Harvey et J. Hooker) Brand, 1904:187.
Chiang, 1960, 1973b; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada 1925a, 1950.

Boodlea montagnei (Harvey ex J.E. Gray) Egerod, 1952:332.
As "*B. paradoxa*": Chiang, 1960; Okamura, 1936; Shen and Fan, 1950.

Boodlea siamensis Reinbold, 1901:191.
Chiang, 1962b; Okamura, 1931, 1936; Shen and Fan, 1950; Yamada, 1925a.

Boodlea van-bosseae Reinbold, 1905:148, '*van Bossei*'.
Okamura, 1919, 1931, 1936; Shen and Fan, 1950. As "*B. bosseae*": Ariga, 1919; Horikawa, 1919.
Remarks: Following the examples given under Article 73.9 of the *International Code of Botanical Nomenclature* (Voss et al., 1983), "a hyphen is correctly used in an epithet after a word which could stand independently . . .," we spell the species name "*van-bosseae.*"

Chamaedoris orientalis Okamura et Higashi in Okamura, 1931:98.
Okamura, 1931, 1932, 1936; Shen and Fan, 1950.

Cladophoropsis herpestica (Montagne) Howe, 1914:31.
Shen and Fan, 1950.

Cladophoropsis sundanensis Reinbold, 1905:147.
Chiang, 1960; Su et al., 1982.

Cladophoropsis zollingeri (Kützing) Reinbold, 1905:147.
Chiang, 1960; Shen and Fan, 1950; Su et al., 1982; Taniguti, 1976; Tseng, 1983. As "*C. fasciculatus*": Okamura, 1930, 1931; Tseng, 1983; Yamada, 1925a.
Remarks: There has been some question as to when and where the combination *Cladophoropsis zollingeri* was validly published. Most authors (e.g., Papenfuss, 1950; Chiang, 1962a; Taniguti, 1976) have accepted *C. zollingeri* (Kützing) Børgesen (1905:288) as correct. According to Article 33.1 of the *International Code of Botanical Nomenclature* (Voss et al., 1983), "the combination is not validly published unless the author definitely indicates that the epithet or epithets concerned are to be used in that particular combination." Parallel to the examples, such as *Eulophus*, cited in the Code, Børgesen (1905) has merely stated that "*S. zollingeri*" belongs here but did not actually make the combination in *Cladophoropsis*. The earliest valid combination we are aware of is: *C. zollingeri* (Kützing) Reinbold 1905:147.

Dictyosphaeria bokotensis Yamada, 1925a:81.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a, 1950.

Dictyosphaeria cavernosa (Forsskål) Børgesen, 1932:2.
Chiang, 1960, 1973b; Shen and Fan, 1950; Taniguti, 1976; Tseng, 1983. As "*D. favulosa*": Ariga, 1920; Okamura, 1930, 1931, 1936; Yamada, 1925a, 1926.

Microdictyon japonicum Setchell, 1925:107.
Chiang, 1962b; Tseng, 1983; Shen and Fan, 1950. As "*Rhipidiphyllon reticulatum*": Ariga, 1920; De Toni, 1895; Heydrich, 1894.
Remarks: Fan (1974:249–250,253–254) reviews taxonomic problems with the genus *Rhipidiphyllon* Heydrich, 1894:281. The type-locality for this genus is in east Taiwan.

Microdictyon nigrescens (Yamada) Setchell, 1925:107.
Okamura, 1936; Shen and Fan, 1950; Fan, 1974; Yamada, 1950. As "*Rhipidiphyllon nigrescens*": Yamada, 1925a.

Microdictyon okamurae Setchell, 1925:107, '*okamurai*'.
Okamura, 1931; Shen and Fan, 1950; Tseng, 1983.
Remarks: The correct spelling for the Latinization of Professor Okamura's name is "*okamurae*" and has been corrected throughout this study.

Struvea anastomosans (Harvey) Piccone et Grunow ex Piccone, 1884:20.
Ariga, 1920; Tseng, 1983.

Struvea delicatula Kützing, 1866:1.
Chiang, 1960; De Toni, 1895; Heydrich, 1894; Oka-

mura, 1930, 1931, 1936; Shen and Fan, 1950; Yamada, 1925b, 1926.

Valonia aegagropila C. Agardh, 1823:429.
Chiang, 1973b; Chihara, 1975; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1950; Yoshikawa and Yoshikawa, 1977.

Valonia fastigiata Harvey in J. Agardh, 1887:101.
Okamura, 1931; Shen and Fan, 1950.

Valonia utricularis (Roth) C. Agardh, 1823:431.
Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1926; Yendo, 1914.

Valonia verticillata Kützing, 1849:508.
Okamura, 1930.

Valoniopsis pachynema (Martens) Børgesen, 1934:10.
Chiang, 1960, 1973b; Shen and Fan, 1950; Tseng, 1983; Yamada, 1950; Yoshikawa and Yoshikawa, 1977. As "*Valonia confervoides*": Ariga, 1920; Okamura, 1909, 1931, 1936; Yamada, 1925a.

ANADYOMENACEAE

Anadyomene wrightii Harvey in Gray, 1866:48.
Ariga, 1920; Chiang, 1973b; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1926, 1950.

DASYCLADALES

ACETABULARIACEAE

Acetabularia gigas Solms-Laubach, 1895:23.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.

Acetabularia major Martens, 1866:25.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.

Bornetella sphaerica (Zanardini) Solms-Laubach, 1893:92.
Chiang, 1973b.

Neomeris annulata Dickie, 1874:198.
Chiang, 1973b.

PHAEOPHYTA

ECTOCARPALES

ECTOCARPACEAE

Ectocarpus breviarticulatus J. Agardh, 1847:7.
Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b, 1950.

Ectocarpus laurenciae Yamada, 1931a:66.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1931a.

Ectocarpus spinosus Kützing, 1843:288.
Heydrich, 1894; Shen and Fan, 1950.

Ectocarpus van-bossea Setchell et Gardner in Setchell, 1924:170.
Yamada, 1950.

Ectocarpus sp.
Chiang, 1976.

Feldmannia formosana (Yamada) Itono, 1973:162.
As "*Ectocarpus formosanus*": Yamada, 1950.

Giffordia mitchelliae (Harvey) Hamel, 1939:xiv.
As "*Ectocarpus mitchelliae*": Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.

CHORDARIALES

CORYNOTHLAEACEAE

Leathesia difformis (Linnaeus) Areschoug, 1847:376.
Taniguti, 1976.

SPHACELARIALES

SPHACELARIACEAE

Sphacelaria furcigera var. *tenuis* Yamada, 1941:196.
Shen and Fan, 1950; Yamada, 1941.

Sphacelaria tribuloides Meneghini, 1840:2.
Chihara, 1975; De Toni, 1895; Heydrich, 1894; Okamura, 1897, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.

DICTYOTALES

DICTYOTACEAE

Dictyopteris delicatula Lamouroux, 1809b:332.
Yamada, 1950.

Dictyopteris repens (Okamura) Børgesen, 1920a:265.
Tseng, 1983; Yoshikawa and Yoshikawa, 1977. As "*Neurocarpus repens*": Okamura, 1931, 1936; Shen and Fan, 1950.

Dictyopteris undulata Holmes, 1896:251.
Tseng, 1983. As "*Haliseris undulata*": Okamura, 1907. As "*Neurocarpus undulata*": Higashi, 1934; Okamura, 1930, 1936; Shen and Fan, 1950. As "*N. undulata* f. *plana*": Chiang, 1960; Okamura, 1930, 1936.

Dictyota bartayresii Lamouroux, 1809b:331.
Okamura, 1931, 1936; Shen and Fan, 1950.

Dictyota ceylanica var. *anastomosans* Yamada, 1950:186.
Yamada, 1950; Yoshikawa and Yoshikawa, 1977.
Dictyota dichotoma (Hudson) Lamouroux, 1809a:42.
Ariga, 1919; Higashi, 1934; Horikawa, 1919; Okamura, 1930; Rho, 1958; Shen and Fan, 1950; Tokida, 1954; Yamada, 1925b.
Dictyota dilata Yamada, 1925b:252.
Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yamada, 1925b.
Dictyota divaricata Lamouroux, 1809a:43.
Chiang, 1960; Okamura, 1930; Shen and Fan, 1950; Yamada, 1925b.
Dictyota hamifera Setchell, 1926:92.
Yamada, 1950.
Dictyota linearis (C. Agardh) Greville, 1830:xliii.
Ariga, 1919, 1920; Horikawa, 1919.
Dictyota patens J. Agardh, 1882:93.
Taniguti, 1976.
Remarks: Howe (1920) and Allender and Kraft (1983) consider this taxon to be a synonym of *D. bartayresii* Lamouroux.
Dictyota spinulosa Hooker et Arnott, 1838:275.
Ariga, 1920.
Dilophus okamurae Dawson, 1950:83, *'okamurai'*.
Chihara, 1970, 1975; Fan, 1953b; Segawa, 1974; Tseng, 1983. As *"D. marginatus"*: Chiang, 1960; Okamura, 1936; Shen and Fan, 1950.
Dilophus radicans Okamura, 1916:7.
Chiang, 1960; Okamura, 1936; Shen and Fan, 1950.
Remarks: Fan (1953b) considers this name to be in need of synonomy since he believes *D. radicans* may be the prostrate form of *Padina commersonii* (see also Lewis et al., 1987).
Lobophora variegata (Lamouroux) Womersley, 1967:221.
Tseng, 1983. As *"Gymnosorus collaris"*: Ariga, 1920. As *"Zonaria variegata"*: Heydrich, 1894.
Pachydictyon coriaceum (Holmes) Okamura, 1899:39.
Ariga, 1920; Chiang, 1976; Chihara, 1970; Okamura, 1936; Rho, 1958; Shen and Fan, 1950.
Padina arborescens Holmes, 1896:251.
Higashi, 1934.
Padina australis Hauck, 1887:44.
Chiang, 1960, 1962b; Okamura, 1931, 1932, 1936; Rho, 1958; Shen and Fan, 1950; Su et al., 1982; Tseng, 1936, 1983; Yamada, 1925b, 1931a, 1950.
Padina boryana Thivy in Taylor, 1966:355.
Tseng, 1983.
Remarks: Papenfuss (1977) considered both *P. tenuis* (C. Agardh) Bory and *P. commersonii* Bory to be synonyms of *Lobophora variegata* (Lamouroux) Womersley, and recognized *P. boryana* Thivy as the name for this taxon. Tseng (1983) apparently follows this, listing *P. commersonii* as a synonym of *P. boryana*, whereas Womersley and Bailey (1970) and Allender and Kraft (1983) considered *P. commersonii* and *P. boryana* to be synonyms of *P. tenuis*.
Padina crassa Yamada, 1931a:67.
Ariga, 1920; Chiang, 1960; Yoshikawa and Yoshikawa, 1977.
Padina durvillaei Bory, 1827:591.
Ariga, 1920; Chiang, 1973a; De Toni, 1895; Heydrich, 1894; Okamura, 1935b; Shen and Fan, 1950.
Padina japonica Yamada, 1931a:69.
As *"P. pavonia"*: Ariga, 1919; De Toni, 1895; Heydrich, 1894; Horikawa, 1919.
Padina minor Yamada, 1925b:251.
Chiang, 1960, 1962a, 1962b, 1973b, 1976; Chihara, 1975; Okamura, 1931, 1932, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tseng, 1983; Yamada, 1925b, 1931a, 1950; Yoshikawa and Yoshikawa, 1977.
Padina tenuis Bory, 1827:590.
As *"Padina commersonii"*: Okamura, 1931, 1936; Shen and Fan, 1950; Yamada, 1925b, 1931a.
Remarks: See "Remarks" herein under *Padina boryana* Thivy in Taylor.
Spatoglossum pacificum Yendo, 1920:2.
Chiang, 1973a.
Zonaria coriacea Yamada, 1925b:249.
Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.
Zonaria diesingiana J. Agardh, 1841:443.
Ariga, 1920; Chiang, 1960; Okamura, 1930; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.
Zonaria flabellata (Okamura) Papenfuss, 1944:341.
As *"Homoeostrichus flabellatus"*: Taniguti, 1976.
Zonaria harveyana (Kützing) Areschoug, 1851:26.
As *"Homoeostrichus multifidus"*: Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.
Zonaria nigrescens Sonder, 1845:50.
Heydrich, 1894; Shen and Fan, 1950.
Zonaria stipitata Tanaka et Nozawa, 1962:183.
Chiang and Chou, 1980.
Zonaria sp.
Su et al., 1982.

SCYTOSIPHONALES

ISHIGEACEAE

Ishige okamurae Yendo, 1907:154, *'okamurai'*.
Chiang, 1960, 1973b; Higashi, 1934; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Yamada, 1925b.
Ishige sinicola (Setchell et Gardner) Chihara, 1969:3.
As *"I. foliacea"*: Rho, 1958; Tseng, 1936.

PUNCTARIACEAE

Petalonia fascia (O.F. Müller) Kuntze, 1898:419.
As *"Ilea fascia"*: Chiang, 1960, 1976; De Toni, 1895; Rho, 1958; Shen and Fan, 1950; Tokida, 1954; Yamada, 1925b. As *"Phyllitis fascia"*: Heydrich, 1894.

SCYTOSIPHONACEAE

Chnoospora implexa (Hering) J. Agardh, 1848:172.
Chiang, 1960; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939; Tseng, 1983; Yamada, 1925b, 1950.
Chnoospora minima (Hering) Papenfuss, 1956:69.
Chiang, 1976; Segawa, 1974. As "*Chnoospora pacifica*": Okamura, 1931, 1936; Shen and Fan, 1950; Tokida, 1939; Yamada, 1950.
Colpomenia sinuosa (Mertens et Roth) Derbès et Solier in Castagne, 1851:95.
Ariga, 1919, 1920; Chiang, 1960, 1976; De Toni, 1895; Heydrich, 1894; Horikawa, 1919; Okamura, 1930; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1954; Yamada, 1925b, 1950; Yoshikawa and Yoshikawa, 1977.
Endarachne binghamiae J. Agardh, 1896:27.
Ariga, 1919, 1920; Chiang, 1960, 1973b, 1976; Cotton, 1915; Fan, 1953a; Higashi, 1934; Horikawa, 1919; Okamura, 1930, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tilden, 1929; Tseng, 1983; Yamada, 1925b.
Hydroclathrus clathratus (Bory) Howe, 1920:590.
Chiang, 1960, 1962a, 1973b; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tseng, 1983; Yamada, 1950; Yoshikawa and Yoshikawa, 1977. As "*H. cancellatus*": De Toni, 1895; Heydrich, 1894; Higashi, 1934; Okamura, 1897, 1931; Yamada, 1925b.
Rosenvingea orientalis (J. Agardh) Børgesen, 1914:26.
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983. As "*Hydroclathrus orientalis*": De Toni, 1895; Heydrich, 1894.
Scytosiphon lomentaria (Lyngbye) J. Agardh, 1848:126, '*lomentarium*'.
Chiang, 1973a, 1976; Okamura, 1935b, 1936; Segawa, 1974; Tokida, 1954; Yamada, 1925b, 1928. As "*S. lomentarius*": Chihara, 1970, 1975.

FUCALES

CYSTOSEIRACEAE

Cystoseira prolifera J. Agardh, 1848:215.
Chiang, 1976.
Cystoseira sp.
Nizamuddin, 1970.
Hormophysa triquetra (Linnaeus) Kützing, 1843:359.
Chiang, 1973a; Okamura, 1935b; Su et al., 1982.

SARGASSACEAE

Sargassum amabile Yamada, 1944a:1.
Shen and Fan, 1950.
Sargassum aquifolium (Turner) C. Agardh, 1820:12.
Okamura, 1931, 1936; Shen and Fan, 1950.
Sargassum baccularia (Mertens) C. Agardh, 1824:304.
Chou and Chiang, 1981.
Sargassum berberifolium J. Agardh, 1848:337.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.
Sargassum binderi Sonder in J. Agardh, 1848:328.
Chiang, 1976; Chou and Chiang, 1981; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.
Sargassum carpophyllum J. Agardh, 1848:304.
Chou and Chiang, 1981; Yamada, 1942.
Sargassum coriifolium J. Agardh, 1889:86.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.
Sargassum coriifolium f. *duplicatum* Yamada, 1950:192.
Yamada, 1950; Yoshikawa and Yoshikawa, 1977.
Sargassum coriifolium f. *prolongatum* (Okamura) Yamada, 1950:192.
Yamada, 1950. As "*S. prolongatum*": Okamura, 1931, 1932, 1936; Shen and Fan, 1950.
Sargassum crassifolium J. Agardh, 1848:326.
Chihara, 1975; Chou and Chiang, 1981; Tseng, 1983; Yamada, 1942, 1950; Yoshikawa and Yoshikawa, 1977.
Sargassum crispifolium Yamada, 1931a:72.
Chiang, 1960, 1962b.
Sargassum cristaefolium C. Agardh, 1820:13.
Ariga, 1920; Chiang, 1976; Chou and Chiang, 1981; Cotton, 1915; Okamura, 1931, 1935b, 1936; Shen and Fan, 1950; Tilden, 1929. As "*S. biserrula*": De Toni, 1895; Heydrich, 1894.
Sargassum duplicatum J. Agardh, 1889:90.
Ariga, 1921; Chiang, 1976; Chou and Chiang, 1981; Liu, 1982; Okamura, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925b.
Sargassum echinocarpum J. Agardh, 1848:327.
Yamada, 1950.
Sargassum fulvellum (Turner) C. Agardh, 1820:34.
Ariga, 1920.
Sargassum glaucescens J. Agardh, 1848:306.
Chiang, 1973a; Chou and Chiang, 1981; Okamura, 1935b.
Sargassum hemiphyllum (Turner) C. Agardh, 1820:39.
Ariga, 1920; Chiang, 1976; Chou and Chiang, 1981; Tilden, 1929; Tseng et al., 1985.
Sargassum henslowianum C. Agardh in J. Agardh, 1848:315.
Chou and Chiang, 1981.
Sargassum heterocystum Montagne, 1842:250.
Chou and Chiang, 1981.
Sargassum horneri (Turner) C. Agardh, 1820:38.
Ariga, 1919; Chiang, 1960; Chou and Chiang, 1981; Horikawa, 1919; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Tokida, 1954; Tseng et al., 1962, 1985; Yamada, 1925b.
Sargassum ilicifolium (Turner) C. Agardh, 1820:11.
Ariga, 1920; Chou and Chiang, 1981; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.
Sargassum ilicifolium var. *conduplicatum* Grunow in Weber-van Bosse, 1913a:160.
Yamada, 1942.

Sargassum kasyotense Yamada, 1942:553.
Shen and Fan, 1950; Yamada, 1942.
Sargassum kuetzingii Setchell, 1931:249.
Chou and Chiang, 1981.
Sargassum kushimotense Yendo, 1905:157.
Chou and Chiang, 1981.
Sargassum muriocystum J. Agardh, 1848:314.
Ariga, 1920; De Toni, 1895; Okamura, 1895, 1936; Shen and Fan, 1950.
Sargassum plagiophyllum C. Agardh, 1824:309.
Yamada, 1942.
Sargassum polycystum C. Agardh, 1824:304.
Ariga, 1920; Chou and Chiang, 1981; Okamura, 1931, 1936; Shen and Fan, 1950, Su et al., 1982; Tseng, 1983; Yamada, 1942, 1950; Yoshikawa and Yoshikawa, 1977. As "*S. microphyllum*": Chiang, 1976; Yamada, 1925b.
Sargassum rostratum J. Agardh, 1896:55.
Chou and Chiang, 1981; Okamura, 1936; Shen and Fan, 1950; Tseng et al., 1985.
Sargassum sandei Reinbold in Weber-van Bosse, 1913a:158.
Chiang, 1960, 1976; Chou and Chiang, 1981; Okamura, 1936; Segawa, 1974; Yamada, 1925b; Yoshikawa and Yoshikawa, 1977.
Sargassum sandei f. *heterophyllum* Yamada, 1950:192.
Yamada, 1950.
Sargassum serratifolium C. Agardh, 1820:16.
Chiang, 1973a.
Sargassum siliquosum J. Agardh, 1848:316.
Chiang, 1976; Chou and Chiang, 1981; Okamura, 1931, 1936; Rho, 1958; Shen and Fan, 1950; Yamada, 1925b, 1942.
Sargassum swartzii (Turner) C. Agardh, 1820:11.
Yamada, 1942.
Sargassum telephifolium (Turner) C. Agardh in J. Agardh, 1889:107.
Okamura, 1931, 1936; Shen and Fan, 1950.
Sargassum tenuifolium Yamada, 1942:505.
Yamada, 1942.
Sargassum vulgare C. Agardh, 1820:3.
Ariga, 1919; Horikawa, 1919.
Sargassum sp.
Chiang, 1962b, 1976; Chiang et al., 1974; Chou and Chiang, 1981; Su et al., 1982.
Turbinaria conoides (J. Agardh) Kützing, 1860:24.
Chiang, 1973b; Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983.
Turbinaria filamentosa Yamada, 1925b:243.
Chiang, 1960, 1976; Fan, 1974; Shen and Fan, 1950; Yamada, 1925b. As "*T. filiformis*": Okamura, 1936; Yoshikawa and Yoshikawa, 1977.
Remarks: Fan (1974:252, 254) suggests that the characteristic of this species (i.e., elongate filiform receptacle) may not reflect a species difference, but rather reflect an ecological or physiological state.
Turbinaria ornata (Turner) J. Agardh, 1848:266.
Chiang, 1960, 1962b, 1976; De Toni, 1895; Okamura, 1895, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Yamada, 1925b, 1950.
Turbinaria trialata (J. Agardh) Kützing, 1860:24.
Chiang, 1962b; Yamada, 1950.
Turbinaria sp.
Ariga, 1919; Horikawa, 1919.

RHODOPHYTA

GONIOTRICHALES

Goniotrichaceae

Chroodactylon ornatum (C. Agardh) Basson, 1979:67.
As "*Asterocytis ornata*": Shen and Fan, 1950; Tanaka, 1944, 1952. As "*Asterocytis ornata* f. *simplex*": Shen and Fan, 1950; Tanaka, 1944, 1952. As "*Asterocytis ramosa* f. *simplex*": Tanaka, 1944.
Stylonema alsidii (Zanardini) Drew, 1956:72.
As "*Goniotrichum alsidii*": Tanaka, 1952.
Remarks: See Wynne (1985) for discussion of use of the generic name *Stylonema* Reinsche, and Drew and Ross (1965) on use of some generic names in the Bangiophycidae.

BANGIALES

Erythropeltidaceae

Erythrotrichia biseriata Tanaka, 1944:86.
Shen and Fan, 1950; Tanaka, 1944, 1951, 1952.
Erythrotrichia carnea f. *tenuis* Tanaka, 1944:92.
Shen and Fan, 1950; Tanaka, 1944.

Bangiaceae

Bangia atropurpurea (Roth) C. Agardh, 1824:76.
Ariga, 1920. As "*B. fuscopurpurea*": Chiang, 1962a, 1973b; Fan, 1953a; Okamura, 1936; Rho, 1958; Sheath and Cole, 1984; Shen and Fan, 1950; Tanaka, 1950, 1952; Taniguti, 1976; Tokida, 1954.
Bangia yamadae Tanaka, 1944:84, '*yamadai*'.
Shen and Fan, 1950; Tanaka, 1944, 1950, 1952.
Bangia sp.
Chiang, 1973b.
Porphyra angusta Okamura et Ueda in Ueda, 1932:28.
Liaw and Chiang, 1979; Wang and Chiang, 1977.
Porphyra crispata Kjellman, 1897a:15.
Ariga, 1920; Chiang, 1962a; Chihara, 1975; Dawson, 1954c; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1952; Taniguti, 1976; Wang and Chiang, 1977; Ueda, 1932.

Porphyra dentata Kjellman, 1897a:13.
Wang and Chiang, 1977.
Porphyra suborbiculata Kjellman, 1897a:10.
Okamura, 1930, 1936; Wang and Chiang, 1977.
Porphyra sp.
Wang and Chiang, 1977.

NEMALIALES

Remarks: For discussion on the correct spelling of the name of this order see Nicolson and Norris, 1983.

ACROCHAETIACEAE

Liagorophila endophytica Yamada, 1944b:16.
Fan, 1974; Shen and Fan, 1950; Yamada, 1944b. As "*Liagora orientalis*": Yamada, 1938a.

DERMONEMATACEAE

Dermonema frappieri (Montagne et Millardet) Børgesen, 1942:42.
Chiang, 1969, 1971, 1973b; Chihara, 1975; Segawa, 1974; Tseng, 1983.
Dermonema gracile Martens ex Weber-van Bosse, 1921:204.
Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tokida, 1939; Tseng, 1945. As "*D. dichotomum*": Ariga, 1920; Chen and Chiang, 1982; De Toni, 1895; Fan, 1974; Heydrich, 1894.
Dermonema pulvinata (Grunow in Holmes) Fan, 1962:337.
Chen and Chiang, 1982; Chihara, 1975; Fan, 1953a; Tseng, 1983; Umezaki, 1972. As "*Nemalion pulvinatum*": Chiang, 1962a; Chihara, 1970; Okamura, 1931, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939.
Remarks: Papenfuss (1967:96–97) points out that *Dermonema* Heydrich had been a nomen nudum until Heydrich (1894:289) published *D. dichotomum*. The type-locality for the genus is therefore Taiwan (see also Fan 1974:249, 253).
Dotyophycus yamadae (Ohmi et Itono) Abbott et Yoshizaki, 1981:225.
Chiang and Chen, 1983.
Liagoropsis schrammi (P. et H. Crouan in Mazè et Schramm) Doty and Abbott, 1964:443.
Fan, 1974. As "*L. maxima*": Shen and Fan, 1950; Yamada, 1944c.
Yamadaella cenomyce (Decaisne) Abbott, 1970:117.
Chiang, 1973b. As "*L. annulata*": Okamura, 1931, 1936. As "*L. caenomyce*": Chihara, 1975; Segawa, 1974; Shen and Fan, 1950; Tseng, 1941a; Yamada, 1938a.

LIAGORACEAE

Helminthocladia australis Harvey, 1863, pl. 272.
Chen et al., 1981.
Liagora boergesenii Yamada, 1938a:11.
Chiang, 1971, 1972; Chiang and Chen, 1982; Chihara, 1975; Shen and Fan, 1950; Yamada, 1938a.
Liagora ceranoides Lamouroux, 1816:239.
Chiang and Chen, 1982.
Liagora ceranoides var. *leprosa* (J. Agardh) Yamada, 1938a:21.
Segawa, 1974; Shen and Fan, 1950; Yamada, 1938a.
Liagora ceranoides var. *pulverulenta* (C. Agardh) Yamada, 1938a:21.
Shen and Fan, 1950; Yamada, 1938a.
Liagora decussata Montagne, 1849:64.
Chiang and Chen, 1982; Shen and Fan, 1950; Yamada, 1938a.
Liagora farinosa Lamouroux, 1816:240.
Chihara, 1975; Shen and Fan, 1950; Tseng, 1941a; Yamada, 1938a.
Remarks: Recently Fan and Wang (1974:492) proposed a new generic name, *Ganonema*, for this taxon. However, we follow the opinion of Abbott (1976:130), and for the time being continue to recognize this taxon as a *Liagora* (see also Norris and Bucher, 1982:190).
Liagora orientalis J. Agardh, 1896:99.
Ariga, 1920; Chiang and Chen, 1982; Fan, 1974; Okamura, 1936; Shen and Fan, 1950; Yamada, 1932b. As "*L. formosana*": Yamada, 1938a.
Remarks: Yamada (1944b:18–19) reduced his species *L. formosana* (1938a:32) into synonomy with *L. orientalis*.
Liagora rugosa Zanardini, 1851:36.
Ariga, 1920.
Liagora segawai Yamada, 1938a:1.
Chiang and Chen, 1982.
Liagora setchellii Yamada, 1938a:13.
Chiang and Chen, 1982; Shen and Fan, 1950; Tseng, 1941a; Yamada, 1938a; Yoshikawa and Yoshikawa, 1977.
Liagora valida Harvey, 1853:138.
Chiang and Chen, 1982; Okamura, 1931, 1936; Shen and Fan, 1950.

CHAETANGIACEAE

Actinotrichia fragilis (Forsskål) Børgesen, 1932:6.
Chihara, 1970, 1975; Shen and Fan, 1950; Tseng, 1941b. As "*Actinotrichia rigida*": Ariga, 1920.
Galaxaura arborea Kjellman, 1900:72.
Ariga, 1920; Chiang, 1962a; Yendo, 1918; Yoshikawa and Yoshikawa, 1977.
Remarks: The taxonomy and nomenclature of this genus have been confused by morphological plasticity and uncertain life histories. Since the hypothesis of an alternation of morphologically different sexual and tetrasporic forms of *Galaxaura* (Howe 1917, 1918), there has been much speculation as to which tetrasporic and sexual "species" represent stages within the same life history (e.g., Børgesen, 1920b; Chou, 1945, 1947; Dawson, 1953;

Taylor, 1960). We hold the opinion that until culture studies conclusively link the different reproductive stages into the life history, each reproductive form should be recognized by its previous species name.

Galaxaura canaliculata Kützing, 1849:530.
Heydrich, 1894; Shen and Fan, 1950.

Galaxaura clavigera Kjellman, 1900:76.
Chiang, 1962b; Itono, 1977a; Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1936.
Remarks: Papenfuss, Mshigeni, and Chiang (1982:411) consider this species to be a synonym of *Galaxaura marginata* (Ellis et Solander) Lamouroux.

Galaxaura distenta Harvey, 1859:331.
Ariga, 1920.

Galaxaura elegans Tanaka, 1935:52.
Okamura, 1936; Shen and Fan, 1950; Tanaka, 1935, 1936.

Galaxaura elongata J. Agardh, 1876:529.
Itono, 1977a; Okamura, 1936; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1941b; Yendo, 1916b; Yoshikawa and Yoshikawa, 1977.
Remarks: Considered a synonym of *G. rugosa* (Ellis et Solander) Lamouroux (1816:263) by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura falcata Kjellman, 1900:73.
Ariga, 1919; Horikawa, 1919, Taniguti, 1976.

Galaxaura fasciculata Kjellman, 1900:53.
Itono, 1977a; Okamura, 1936; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1941b.

Galaxaura fastigiata Decaisne 1842:116.
Ariga, 1920; Chiang, 1962a, 1962b; Chihara, 1970, 1975; Itono, 1977a; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tanaka, 1936; Tanaguti, 1976; Yoshikawa and Yoshikawa, 1977.
Remarks: Considered a synonym of *G. oblongata* (Ellis et Solander) Lamouroux (1816: 262) by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura filamentosa Chou in Taylor, 1945:139.
Itono, 1977a.

Galaxaura lapidescens (Ellis et Solander) Lamouroux, 1816:264.
De Toni, 1895.

Galaxaura lapidescens f. *villosa* J. Agardh, 1876:530.
Heydrich, 1894; Okamura, 1897; Shen and Fan, 1950.

Galaxaura latifolia Tanaka, 1935:54.
Okamura, 1935a, 1936; Shen and Fan, 1950; Tanaka, 1935, 1936.

Galaxaura oblongata (Ellis et Solander) Lamouroux, 1816:262.
Chiang, 1973a, 1973b; Okamura, 1935b; Su et al., 1982.

Galaxaura obtusata (Ellis et Solander) Lamouroux, 1816:262.
Itono, 1977a; Okamura, 1936; Papenfuss, Mshigeni, and Chiang, 1982; Shen and Fan, 1950; Su et al., 1982; Tanaka, 1936; Tseng, 1941b.

Galaxaura pacifica Tanaka, 1935:55.
Itono, 1977a; Okamura, 1935a, 1936; Shen and Fan, 1950; Tanaka, 1935, 1936.
Remarks: Considered a synonym of *G. rugosa* (Ellis et Solander) Lamouroux (1816:262) by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura robusta Kjellman, 1900:85.
Chihara, 1970, 1975; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Tanaka, 1936.
Remarks: Considered a synonym of *G. obtusata* (Ellis et Solander) Lamouroux by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura rudis Kjellman, 1900:43.
Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1941b.
Remarks: Considered a synonym of *G. lapidescens* (Ellis et Solander) Lamouroux by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura marginata (Ellis et Solander) Lamouroux, 1816:264.
Papenfuss, Mshigeni, and Chiang, 1982. As "*Galaxaura tenera*": Chiang, 1973a, 1973b; Okamura, 1935a; Su et al., 1982.
Remarks: Material from Taiwan determined as *G. tenera* was re-identified by Papenfuss, Mshigeni, and Chiang (1982) to be this species.

Galaxaura veprecula Kjellman, 1900:80.
Ariga, 1920; Chihara, 1975; Itono, 1977a; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1983; Yendo, 1918.
Remarks: Papenfuss, Mshigeni, and Chiang (1982) consider this species to be a synonym of *G. marginata* (Ellis et Solander) Lamouroux.

Scinaia boergesenii Tseng, 1941:100.
Shen and Fan, 1950.

Scinaia cottonii Setchell, 1914:103.
Shen and Fan, 1950.

Scinaia moniliformis J. Agardh, 1885:72.
Chiang, 1962a; Yoshikawa and Yoshikawa, 1977.

Scinaia pseudojaponica Yamada et Tanaka in Yamada, 1938b:127.
Chiang, 1962a, 1970, 1975b; Shen and Fan, 1950.

BONNEMAISONIACEAE

Asparagopsis taxiformis (Delile) Trevisan, 1845:45.
As "*A. sanfordiana*": Ariga, 1919; Fan, 1953a; Horikawa, 1919; Okamura, 1931, 1936; Shen and Fan, 1950.

Delisea fimbriata (Lamouroux) Montagne, 1844:155.
Chihara, 1970, 1975. As "*D. japonica*": Cotton, 1915; Tilden, 1929.

GELIDIALES

Gelidiaceae

Gelidium amansii Lamouroux in Kützing 1868:16.
Cotton, 1915; Fan, 1953a; Okamura, 1913, 1915b, 1930; Oshima, 1915; Rho, 1958; Santelices and Stewart, 1985; Tilden, 1929; Tokida, 1954.
Gelidium amansii f. *elegans* Okamura, 1934a:56.
Chiang, 1962a; Fan, 1951.
Gelidium amansii f. *latioris* Okamura, 1935b:443.
Chiang, 1962a; Fan, 1951; Okamura, 1935b, 1936; Shen and Fan, 1950.
Gelidium "cartilagineum".
Ariga, 1919; Horikawa, 1919.
Remarks: As with all taxa in this paper, we are reporting the name used by the author in recording the taxon from Taiwan. We recognize that Dixon (1967) has shown the basionym *Fucus cartilagineus* Linnaeus (1753) to be correctly *Plocamium cartilagineum* (Linnaeus) Dixon. However, in this case, we suggest the material of Ariga (1919) and Horikawa (1919) probably belongs to *Gelidium*, rather than *Plocamium*, but cannot be sure what species it is.
Gelidium crinale (Turner) Lamouroux in Bory, 1825:191.
Ariga, 1920.
Gelidium divaricatum Martens, 1866:30.
Okamura, 1934a, 1936; Taniguti, 1976.
Gelidium japonicum (Harvey) Okamura, 1901:57.
Arasaki, 1964; Ariga, 1919, 1920; Chiang, 1962a; Fan, 1951, 1953a; Higashi, 1934; Horikawa, 1919; Okamura, 1901, 1915b, 1930, 1934a, 1936; Oshima, 1915; Santelices and Stewart, 1985; Shen and Fan, 1950.
Gelidium kintaroi (Okamura) Yamada, 1941:201.
Fan, 1951, 1953a; Shen and Fan, 1950. As *"G. clavatum"*: Okamura, 1934a, 1935a, 1935b, 1936.
Gelidium latiusculum Okamura, 1935b:443.
Chiang, 1962a; Fan, 1951, 1953a; Okamura, 1935b, 1936; Shen and Fan, 1950.
Gelidium pacificum Okamura, 1914:99.
Okamura, 1915b; Oshima, 1915.
Gelidium planiusculum Okamura, 1935b:442.
Chiang, 1962a; Fan, 1951, 1953a; Okamura, 1935b, 1936; Santelices and Stewart, 1985; Shen and Fan, 1950.
Gelidium pusillum (Stackhouse) Le Jolis, 1863:139.
Chiang, 1962a; Fan, 1951; Santelices and Stewart, 1985; Taniguti, 1976. As *"Acrocarpus pusillus"*: Martens, 1866.
Gelidium pusillum f. *foliaceum* Okamura, 1934a:51.
Ariga, 1920; Taniguti, 1976.
Gelidium subcostatum Okamura in Schmitz, 1894:1.
Ariga, 1919; Horikawa, 1919.
Gelidium yamadae (Okamura) Fan, 1951:10.
Fan, 1951, 1953a. As *"G. densum"*: Okamura, 1935b; Shen and Fan, 1950.
Remarks: Fan (1951) considers *G. densum* invalid on the basis of an earlier homonym.
Gelidium sp.
Ariga, 1920.
Pterocladia nana Okamura, 1934a:64.
Chiang, 1962a, 1973b; Fan, 1951.
Pterocladia tenuis Okamura, 1934a:62.
Arasaki, 1964; Chiang, 1962a, 1962b, 1973b; Fan, 1951, 1953a; Okamura, 1935b, 1936; Segawa, 1974; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976. As *"Gelidium corneum* var. *pinnatum"*: Heydrich, 1894. As *"P. capillaceum"*: Ariga, 1920; Chihara, 1970, 1975; Okamura, 1915b; Oshima, 1915.

Gelidiellaceae

Gelidiella acerosa (Forsskål) Feldmann et Hamel, 1934:533.
Ariga, 1920; Chiang, 1973b; Chihara, 1975; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977. As *"Gelidiopsis rigida"*: Okamura, 1931.

CRYPTONEMIALES

Dumontiaceae

Dudresnaya japonica Okamura, 1908:209.
Shen and Fan, 1950.

Rhizophyllidaceae

Remarks: Placed in the Cryptonemiales By Kylin (1956), this family was later transferred by Wiseman (1975) to the Gigartinales (see also Kraft (1981) and Wynne and Kraft (1981)). However, West and Hommersand (1981) noted "there is no major evidence to suggest that the [Rhizophyllidaceae] is closely related to either order," and retained it in the Cryptonemiales.
Chondrococcus hornemannii (Mertens) Schmitz, 1895:170, *'hornemanni'*.
Arasaki, 1964; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950. As *"Desmia hornemannii"*: Chiang, 1962a, 1973b; Chihara, 1970; Su et al., 1982; Yoshikawa and Yoshikawa, 1977.
Rhodopeltis borealis Yamada, 1931a:75.
Arasaki, 1964; Chihara, 1975; Nozawa, 1963, 1970; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yamada, 1931a.
Rhodopeltis gracilis Yamada et Tanaka in Yamada, 1935:30.
Arasaki, 1964; Nozawa, 1963, 1970; Okamura, 1936; Shen and Fan, 1950; Yamada, 1935.
Rhodopeltis setchelliae Yamada, 1935:33, *'setchellii'*.
Nozawa, 1963, 1970; Okamura, 1936; Shen and Fan, 1950; Yamada, 1935.

Peyssonneliaceae

Peyssonnelia caulifera Okamura, 1899:8.
Ariga, 1920.
Peyssonnelia distenta (Harvey) Yamada, 1930:29.
Ariga, 1920; Chiang, 1962a, 1962b; Okamura, 1899, 1936; Shen and Fan, 1950; Yamada, 1930; Yoshikawa and Yoshikawa, 1977. As "*P. involvens*": Okamura, 1909.
Peyssonnelia rubra (Greville) J. Agardh, 1852:502.
De Toni, 1895; Heydrich, 1894; Okamura, 1897, 1931, 1936; Shen and Fan, 1950.

Corallinaceae

Amphiroa beauvoisii Lamouroux, 1816:299.
As "*A. pusilla*": Okamura, 1936; Segawa, 1974; Shen and Fan, 1950. As "*A. zonata*": Chiang, 1962a.
Remarks: Recently Norris and Johansen (1981:6) considered *A. zonata* to be a taxonomic synonym of *A. beauvoisii* Lamouroux.
Amphiroa bowerbankii Harvey, 1849b:97.
De Toni, 1895; Heydrich, 1894; Shen and Fan, 1950.
Amphiroa ephedracea (Lamarck) Decaisne, 1842:124.
Chihara, 1970; De Toni, 1895; Okamura, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950. As "*A. exilis*": Heydrich, 1894; Yendo, 1902.
Amphiroa fragilissima (Linnaeus) Lamouroux, 1816:298.
Yoshikawa and Yoshikawa, 1977.
Amphiroa multifida Kützing, 1858:27.
De Toni, 1895; Heydrich, 1894; Shen and Fan, 1950.
Amphiroa pusilla Yendo, 1902:13.
Rho, 1958; Su et al., 1982.
Amphiroa spp.
Ariga, 1920.
Cheilosporum anceps Yendo, 1902:18.
Shen and Fan, 1950.
Cheilosporum jungermannioides Ruprecht in J. Agardh, 1852:546.
Chihara, 1975; Okamura, 1931, 1936; Segawa, 1941, 1974; Shen and Fan, 1950; Tseng, 1983. As "*Amphiroa cultrata* var. *globulifera*": De Toni, 1895; Heydrich, 1894. As "*C. cultratum*": Yendo, 1902.
Jania adhaerens Lamouroux, 1816:270.
Chiang, 1962a, 1962b; Okamura, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Taniguti, 1976. As "*Corallina adhaerens*": De Toni, 1905; Heydrich, 1894; Yendo, 1902. As "*Corallina decussato-dichotoma*": Okamura, 1931, 1936; Segawa, 1974. As "*J. decussato-dichotoma*": Arasaki, 1964; Chiang, 1962a; Chihara, 1970, 1975; Shen and Fan, 1950; Taniguti, 1976.
Jania radiata Yendo, 1902:26.
Chiang, 1962a.
Jania tenella Kützing, 1858:41.
Chiang, 1962a.
Jania undulata Yendo, 1902:26.
Shen and Fan, 1950.
Lithophyllum perulatum Foslie, 1900:18.
De Toni, 1895; Okamura, 1936; Shen and Fan, 1950; Yendo, 1902. As "*Melobesia pustulata*": Heydrich, 1894.
Lithophyllum spp.
Ariga, 1920.
Lithothamnium membranaceum (Esper) Foslie, 1905:72.
De Toni, 1895; Okamura, 1936; Shen and Fan, 1950. As "*Melobesia membranaceae*": Heydrich, 1894; Yendo, 1902.
Lithothamnium spp.
Ariga, 1920.
Mastophora pygmaea Heydrich, 1894:300.
De Toni, 1895; Fan, 1974; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950; Yendo, 1902.
Remarks: Fan (1974:251, 254) considers the taxonomy of this species suspect and encourages study of the type specimen and type-locality specimens to confirm the identity of Heydrich's plant.
Mastophora rosea (C. Agardh) Setchell, 1943:129.
Chiang, 1973b; Chihara, 1975; Segawa, 1974; Su et al., 1982; Taniguti, 1976; Yoshikawa and Yoshikawa, 1977. As "*M. macrocarpa*": Chiang, 1962a; De Toni, 1905; Heydrich, 1894; Okamura, 1931, 1936; Shen and Fan, 1950; Yendo, 1902.
Melobesia farinosa Lamouroux, 1816:315.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950; Yendo, 1902.
Melobesia spp.
Ariga, 1920.
Tenarea tumidulum (Foslie) Adey, 1970:7.
As "*Dermatolithon tumidulum*": Chiang, 1973a; Okamura, 1935b.

Endocladiaceae

Gloiopeltis complanata (Harvey) Yamada, 1932a:117.
As "*Endocladia complanata*": Ariga, 1920. As "*Gloiopeltis cervicornis*:" Ariga, 1921.
Gloiopeltis furcata (Postels et Ruprecht) J. Agardh, 1851:235.
Chiang, 1973b; Fan, 1953a; Shen and Fan, 1950.
Gloiopeltis tenax (Turner) J. Agardh, 1842:68.
Chiang, 1969, 1973a; Okamura, 1935b.

Cryptonemiaceae

Carpopeltis angusta (Harvey) Okamura, 1910:66.
Ariga, 1920; Shen and Fan, 1950.
Carpopeltis cornea Okamura, 1936:553.
Arasaki, 1964; Chihara, 1975; Okamura, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Su et al., 1982.

Carpopeltis flabellata (Holmes) Okamura, 1935a:39.
Ariga, 1920; Chiang 1962a.
Carpopeltis formosana Okamura, 1931:110.
Fan, 1953a; Okamura 1931, 1936; Shen and Fan, 1950; Tokida, 1939.
Carpopeltis rigida (Harvey) Schmitz, 1895:168.
Ariga, 1920; Chihara, 1975; Okamura, 1909, 1930, 1936; Rho, 1958; Segawa, 1974; Shen and Fan 1950; Yoshikawa and Yoshikawa, 1977.
Grateloupia carnosa Yamada et Segawa in Yamada, 1938b:126.
Chiang, 1962a.
Grateloupia filicina (Wulfen) J. Agardh, 1851:180.
Ariga, 1919, 1920; Chiang, 1962a, 1973b; De Toni, 1895; Horikawa, 1919.
Grateloupia filicina f. *filiformis* (Kützing) Pilger, 1911:310.
As "*G. filiformis*": Martens, 1866.
Grateloupia okamurae Yamada, 1941:204, '*okamurai*'.
Chiang, 1973a.
Grateloupia ramosissima Okamura, 1913:60.
Chiang, 1962a, 1973a; Chihara, 1970, 1975; Dawson, 1954c; Rho, 1958; Segawa, 1974; Shen and Fan, 1950.
Halymenia ceylanica (Harvey) Kützing, 1866:33.
As "*H. formosa*": Okamura, 1909. As "*H. durvillaei* var. *formosa*": Tokida, 1939. As "*H. durvillaei* var. *ceylanica*": Ariga, 1920; Chiang, 1962a; Okamura, 1936; Shen and Fan, 1950.
Halymenia durvillaei Bory, 1826, pl. 15.
Fan, 1953a.
Polyopes polyideoides Okamura, 1895:447.
Chiang, 1973a, 1973b; Okamura, 1935b.
Polyopes sp.
Heydrich, 1894.

GIGARTINALES

SOLIERIACEAE

Eucheuma arnoldii Weber-van Bosse, 1928:421.
Kraft, 1972. As "*E. cupressoideum*": Shen and Fan, 1950.
Eucheuma "*audiolis*".
Tseng and Chen, 1977; Tseng, 1984.
Remarks: This species name is apparently a nomen nudum (fide M.S. Doty).
Eucheuma cottonii Weber-van Bosse, 1913b:115.
Tseng and Chen, 1977.
Eucheuma crassum Zanardini, 1878:36.
Shen and Fan, 1950; Yamada, 1936a.
Eucheuma crustaeforme Weber-van Bosse, 1928:415.
Okamura, 1931, 1936. As "*E. cottonii*": Okamura, 1931.
Eucheuma gelatinae (Esper) J. Agardh, 1852:628.
Chihara, 1975; Doty and Norris, 1985; Shen and Fan, 1950; Tseng, 1983; Tseng and Chen, 1977; Yamada, 1936a.
Eucheuma muricatum (Gmelin) Weber-van Bosse, 1928:413.
Higashi, 1934; Shen and Fan, 1950.
Eucheuma muricatum f. *depauperata* Weber-van Bosse, 1928:415.
Ariga, 1920; Okamura, 1936. As "*E. muricatum*": Okamura, 1931. As "*E. spinosum*": Okamura, 1909, 1915b.
Eucheuma okamurae Yamada, 1936a:125, '*okamurai*'.
Shen and Fan, 1950.
Eucheuma papulosa Cotton et Yendo in Cotton, 1914:220.
Cotton, 1915; Tilden, 1929.
Eucheuma serra J. Agardh, 1852:626.
Chiang, 1962a, 1973b; Chihara, 1975; Segawa, 1974; Shen and Fan, 1950; Su et al., 1982; Tseng and Chen, 1977; Yamada, 1936a; Yoshikawa and Yoshikawa, 1977.
Eucheuma spp.
Ariga, 1920.
Meristotheca coacta Okamura, 1930:97.
Arasaki, 1964; Okamura, 1930, 1936; Segawa, 1974; Yoshikawa and Yoshikawa, 1977.
Meristotheca papulosa (Montagne) J. Agardh, 1876:584.
Arasaki, 1964; Chiang, 1962a; Fan, 1953a; Okamura, 1936; Segawa, 1974; Tseng, 1983.

HYPNEACEAE

Hypnea boergesenii Tanaka, 1941:233.
Chiang, 1962a; Fan, 1953a; Shen and Fan, 1950; Tanaka, 1941; Tseng, 1983.
Hypnea cenomyce J. Agardh, 1852:452.
Shen and Fan, 1950; Tanaka, 1941; Yoshikawa and Yoshikawa, 1977.
Hypnea cervicornis J. Agardh, 1852:451.
Yoshikawa and Yoshikawa, 1977.
Hypnea charoides Lamouroux, 1813:131.
Chiang, 1973b; Fan, 1953a; Shen and Fan, 1950; Tseng, 1983.
Hypnea chordacea Kützing, 1847:776.
Arasaki, 1964; Shen and Fan, 1950; Tanaka, 1941.
Hypnea chordacea f. *simpliciuscula* (Okamura) Tanaka, 1941:232.
Chiang, 1962a; Chihara, 1975; Shen and Fan 1950; Tanaka, 1941.
Hypnea cornuta (Lamouroux) J. Agardh, 1852:449.
Shen and Fan, 1950; Tanaka, 1941.
Hypnea esperi Bory, 1828:157.
Shen and Fan, 1950; Tanaka, 1941.
Hypnea hamulosa (Turner) Lamouroux, 1813:44.
Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1941.
Remarks: Several authors (e.g., J. Agardh, 1852:447; De Toni 1924:477; Okamura, 1936:611; Tanaka, 1941:245; Shen and Fan, 1950:339; Weber-van Bosse, 1928:453; and Zanardini, 1858:270) have incorrectly

cited "Montagne 1850:n.16 (page 9)" as the original place of publication.

Hypnea japonica Tanaka, 1941:236.
Chiang, 1962a; Chihara, 1970; Segawa, 1974; Shen and Fan 1950; Tanaka, 1941; Tseng, 1983.

Hypnea nidulans Setchell, 1924:161.
Chihara, 1975; Okamura, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Tanaka, 1941; Yoshikawa and Yoshikawa, 1977.

Hypnea pannosa J. Agardh, 1847:14.
Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1941; Yoshikawa and Yoshikawa, 1977.

Hypnea saidana Holmes, 1896:256.
Chiang, 1973b.

Hypnea seticulosa J. Agardh, 1852:446.
Ariga, 1920; Okamura, 1931, 1936; Tokida, 1939.

Hypnea spinella (Greville) Kützing, 1849:759.
Chiang, 1962a.

Hypnea sp.
Su et al., 1982.

PLOCAMIACEAE

Plocamium oviforme Okamura, 1896:23.
Ariga, 1920.

Plocamium serratulum Okamura, 1932:100.
Okamura, 1936; Shen and Fan, 1950. As "*P. costatum*": Okamura, 1923, 1931; Yendo, 1918.

Plocamium telfairiae (J. Agardh) Harvey in Kützing, 1849:885.
Shen and Fan, 1950; Yendo, 1915. As "*P. abnorme*": Ariga, 1919, 1920; Horikawa, 1919; Okamura, 1931.

Plocamium telfairiae f. *uncinatum* Okamura, 1936:615.
As "*P. abnorme* f. *uncinatum*": Okamura, 1913.

GRACILARIACEAE

Ceratodictyon spongiosum Zanardini, 1878:37.
Arasaki, 1964; Ariga, 1920; Okamura, 1936. As "*C. spongioides*": Okamura, 1931; Shen and Fan, 1950.

Gelidiopsis hachijoensis Yamada et Segawa, 1953:112.
Yoshikawa and Yoshikawa, 1977.

Gelidiopsis repens (Kützing) Schmitz, 1895:148.
Chiang, 1962a, 1973b; Chihara, 1975; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada 1932b; Yoshikwa and Yoshikawa, 1977.

Gelidiopsis variabilis (Greville) Schmitz, 1895:148.
Yamada, 1932b.

Gracilaria arcuata Zanardini, 1858:265.
Chang and Xia, 1976; Chiang, 1973a, 1973b, 1985; Okamura, 1935b; Su et al., 1982.

Gracilaria blodgettii Harvey, 1853:111.
Chiang, 1985; Ohmi, 1958; Yang and Chiang, 1982.
Remarks: Although "*G. blodgettii*" has been reported from Taiwan (Chiang, 1985), the South China Sea (Xia, 1985), and southern Japan (Yamamoto, 1985), the relationship between them and Caribbean type specimens of *G. blodgettii* Harvey is still to be resolved.

Gracilaria bursapastoris (Gmelin) Silva, 1952:265.
As "*G. compressa*": Chen, 1976; Shang, 1976.

Gracilaria canaliculata (Kützing) Sonder, 1871:56.
As "*Corallopsis opuntia*": Arasaki, 1964; Segawa, 1974.

Gracilaria chorda Holmes, 1896:253.
Ariga, 1920; Chen, 1976.

Gracilaria coronopifolia J. Agardh, 1852:592.
Chang and Xia, 1976; Chiang, 1985; Ohmi, 1958; Tseng, 1983; Yamada, 1941; Yang and Chiang, 1982. As "*G. lichenoides* f. *coronopifolia*": Fan, 1953a.

Gracilaria crassa Harvey ex J. Agardh, 1876:417.
Chang and Xia, 1976; Chihara, 1975; Chiang, 1985; Ohmi, 1958; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1933; Yang and Chiang, 1982.

Gracilaria denticulata (Kützing) Schmitz in Mazza, 1907:138.
Chiang, 1962a, 1985; Chihara, 1975; Okamura, 1931, 1936; Yang and Chiang, 1982.

Gracilaria edulis (Gmelin) Silva, 1952:293.
Nelson et al., 1983. As "*G. lichenoides*": Chen, 1976; Chiang, 1981; Shang, 1976.

Gracilaria eucheumioides Harvey, 1859:331.
Chang and Xia, 1976; Chiang, 1973a, 1985; Okamura, 1935b; Yang and Chiang, 1982.

Gracilaria gigas Harvey, 1859:330.
Chiang, 1981; Chen, 1976; Shang, 1976.

Gracilaria incurvata Okamura, 1931:41.
Chiang, 1973a; Okamura, 1935b.

Gracilaria punctata (Okamura) Yamada, 1941:203.
Ohmi, 1958; Shen and Fan, 1950; Yamada, 1941.

Gracilaria purpurascens Harvey in J. Agardh, 1885:63.
Ohmi, 1958; Shen and Fan, 1950; Yamada, 1938b; Yoshikawa and Yoshikawa, 1977.

Gracilaria spinulosa (Okamura) Chang et Xia, 1976:148.
Tseng, 1983. As "*G. purpurascens* f. *spinulosa*": Ohmi, 1958; Shen and Fan, 1950; Yamada, 1941; Yoshikwa and Yoshikwa, 1977.

Gracilaria salicornia (C. Agardh) Dawson, 1954b:4.
Chiang, 1985; Yang and Chiang, 1982.

Gracilaria "*verrucosa*".
G. verrucosa sensu Chiang, 1981, 1985; Nelson et al., 1983; Rho, 1958; Segawa, 1974; Yang et al., 1981; Yang and Chiang, 1982 [non *G. verrucosa* (Hudson) Papenfuss, 1950:195]. As "*G. confervoides*": De Toni, 1895; Fan, 1953a; Martens, 1866; Shang, 1976; Shen and Fan, 1950; Tokida, 1954.
Remarks: A comparison with type-locality (England) specimens of *G. verrucosa* showed the Taiwan specimens are a different species (Chiang, 1985; Abbott et al., 1985), and that the Chinese and Japanese specimens identified

as "*G. verrucosa*" are the same (Xia and Yamamoto, 1985; Yamamoto, 1985; Xia, 1985) and that they too are different from the British *G. verrucosa*. Recently, Zhang and Xia (1985:177) described *G. asiatica* for the specimens from Japan and China.

Gracilaria sp.
Ariga, 1920.

SPHAEROCOCCACEAE

Caulacanthus okamurae Yamada, 1933:278, '*okamurai*'.
Rho, 1958; Taniguti, 1976; Yamada, 1933.

Caulacanthus spinellus (Hooker et Harvey) Kützing, 1849:753.
Chiang, 1973b; Shen and Fan, 1950; Yamada, 1933.

Caulacanthus ustulatus var. *fastigiatus* (Kützing) Pilger, 1920:5.
As "*C. fastigiatus*": Martens, 1866.

Phacelocarpus japonicus Okamura, 1902:79.
Shen and Fan, 1950.

SARCODIACEAE

Sarcodia ceylanica Harvey ex Kützing, 1869, pl. 33.
Chiang, 1962a; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977.

PHYLLOPHORACEAE

Ahnfeltia paradoxa (Suringar) Okamura, 1934b:13.
As "*Gymnogongrus paradoxus*": Ariga, 1920.

Gymnogongrus flabelliformis Harvey, 1856:332.
Shen and Fan, 1950; Taniguti, 1976.

GIGARTINACEAE

Chondrus crispus Stackhouse, 1797:xxiv.
Ariga, 1920; Mikami, 1965.

Chondrus ocellatus Holmes, 1896:252.
Chiang, 1973b; Fan, 1953a; Tseng, 1983. As "*C. ocellatus* f. *typicus*": Chiang, 1962a.

Chondrus ocellatus f. *canaliculatus* Okamura, 1932:84.
Shen and Fan, 1950.

Gigartina intermedia Suringar, 1870:30.
Ariga, 1921; Chiang, 1962a; Fan, 1953a; Shen and Fan, 1950; Taniguti, 1976.

Gigartina ochotensis Ruprecht in Kjeilman, 1889:31.
Ariga, 1920.

Gigartina tenella Harvey, 1859:331.
Arasaki, 1964; Okamura, 1930, 1936; Rho, 1958; Shen and Fan,.1950.

Rhodoglossum affine (Harvey) Kylin, 1928:49.
As "*Chondrus affinis*": Heydrich, 1894.

RHODYMENIALES

RHODYMENIACEAE

Chrysymenia procumbens Weber-van Bosse, 1928:470.
Okamura, 1931, 1936; Shen and Fan, 1950.

Erythrocolon podagrica (Harvey ex J. Agardh in Grunow) J. Agardh ex Kylin, 1931:14.
Shen and Fan, 1950.
Remarks: For discussion on the complicated nomenclature of this taxon see Abbott and Littler (1969:168).

Rhodymenia spinulosa Okamura, 1934b:33.
Okamura, 1934b, 1936; Yoshikawa and Yoshikawa, 1977.

Weberella micans Hauptfleisch in Schmitz and Hauptfleisch, 1897:402.
Arasaki, 1964; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yamada, 1932b.

CHAMPIACEAE

Champia parvula (C. Agardh) Harvey, 1853:76.
Chiang, 1962a; Higashi, 1934; Okamura, 1931, 1936; Shen and Fan, 1950.

CERAMIALES

CERAMIACEAE

Carpoblepharis schmitziana var. *erecta* Yamada, 1932b:273.
Okamura, 1936; Shen and Fan, 1950.

Carpoblepharis warburgii Heydrich, 1894:297.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950.
Remarks: Hommersand (1963:196) and Fan (1974) noted "*C. warburgii* has never been re-examined, but . . . it appears unlikely that this taxon belongs in *Carpoblepharis*."

Centroceras clavulatum (C. Agardh) Montagne, 1846:140.
Ariga, 1920; Chiang, 1962a, 1962b, 1973b; Chihara, 1970, 1975; De Toni, 1895; Okamura, 1931, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1928; Yoshikawa and Yoshikawa, 1977. As "*Ceramium clavulatum*": Heydrich, 1894.

Centroceras minutum Yamada, 1944c:42.
Chiang, 1962a.

Ceramium aduncum Nakamura, 1950:159.
Nakamura, 1950, 1965; Itono, 1972, 1977b. As "*Ceramium clarionense*": Dawson, 1954c.

Ceramium ciliatum (Ellis) Ducluzeau, 1805:64, var. *robustum* (J. Agardh) Mazoyer, 1938:322.
Nakamura, 1965; Itono, 1972, 1977b.

Ceramium flaccidium (Kützing) Ardissone, 1971:40.
As "*C. gracillimum* var. *byssoideum*": Itono, 1972, 1977b.

Remarks: See Womersley (1978:234-238) for discussion on the nomenclature and toxonomy of this taxon.

Ceremium gracillimum (Kützing) Griffiths et Harvey in Harvey, 1848b, pl. 206.
Nakamura, 1965; Yoshikawa and Yoshikawa, 1977.
Remarks: Womersley (1979:234) considers *C. gracillimum* to be a synonym of *C. flaccidium* (Kützing) Ardissone.

Ceramium nakamurai Dawson, 1954a:6.
Nakamura, 1965; Itono, 1972, 1977b. As "*C. equisetoides*": Nakamura, 1950.

Ceramium paniculatum Okamura, 1896:36.
Nakamura, 1965.

Ceramium tenerrimum (Martius) Okamura, 1921:112.
Chiang, 1962a; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Itono, 1972, 1977b.

Ceramium tenuissimum (Lyngbye) J. Agardh, 1851:120.
Ariga, 1921; De Toni, 1895; Heydrich, 1894; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Tseng, 1983; Yamada, 1928.

Dasyphila plumarioides Yendo, 1920:7.
Arasaki, 1964; Itono, 1977b; Okamura, 1923, 1931, 1936; Segawa, 1974; Yendo, 1920.

Gymnothamnion elegans (C. Agardh) J. Agardh, 1892:27.
Itono, 1977b. As "*Plumaria ramosa*": Okamura, 1936; Shen and Fan, 1950; Yamada and Tanaka, 1934.

Microcladia elegans Okamura 1907:1.
Chiang, 1962a.

Ptilothamnion cladophorae (Yamada et Tanaka) Feldmann-Mazoyer, 1941:375.
Fan, 1974; Itono, 1977b. As "*Spermothamnion cladophorae*": Okamura 1936, 1937; Shen and Fan, 1950; Yamada and Tanaka, 1934.

Reinboldiella schmitziana (Reinbold) De Toni, 1895:35.
Ariga, 1920.

Spyridia filamentosa (Wulfen) Harvey ex Hooker, 1833:337.
Ariga, 1920; Chihara, 1975; De Toni, 1895; Heydrich, 1894; Okamura, 1913, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950.

Tiffaniella codicola (Yamada et Tanaka) Doty et Meñez, 1960:137.
Fan, 1974; Itono, 1977b. As "*Spermothamnion codicola*": Okamura, 1936, 1937; Shen and Fan, 1950; Yamada and Tanaka, 1934.

Wrangelia velutina Harvey, 1854:546.
Okamura, 1931; Shen and Fan, 1950.

Delesseriaceae

Caloglossa bombayensis Børgesen, 1933:127.
Fan, 1952.

Claudea batanensis Tanaka, 1967:18.
Tanaka, 1967; Yoshikawa and Yoshikawa, 1977.

Haloplegma duperreyi Montagne, 1842:258.
Yamada, 1936b; Tseng, 1983.

Holmesia neurymenioides Okamura, 1932:98.
Okamura, 1936; Shen and Fan, 1950.

Martensia denticulata Harvey, 1854:537.
Ariga, 1919, 1920; Horikawa, 1919.

Martensia flabelliformis Harvey ex J. Agardh, 1863:826.
Chiang, 1962b; Chihara, 1975; Segawa, 1974; Shen and Fan, 1950; Yamada, 1936b.

Nitophyllum sp.
Ariga, 1920.

Dasyaceae

Dasya sp.
Ariga, 1919, 1920; Horikawa, 1919.

Rhodomelaceae

Acanthophora aokii Okamura, 1934b:35.
Okamura, 1934b, 1936; Shen and Fan, 1950.

Acanthophora muscoides (Linnaeus) Bory, 1828:156.
Shen and Fan, 1950.

Acanthophora orientalis (Sonder) J. Agardh, 1863:820.
Ariga, 1920; Chiang, 1962a, 1973b; Chihara, 1975; Fan, 1953a; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939; Yoshikawa and Yoshikawa, 1977.

Acrocystis nana Zanardini, 1872:145.
Chiang, 1973b; Chihara, 1975; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983.

Amansia glomerata C. Agardh, 1822:194.
Ariga, 1920; Chiang, 1973b; Chihara, 1975; Okamura, 1930, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977.

Bostrychia tenella (Vahl) J. Agardh, 1863:869.
Ariga, 1920; Chiang, 1962a; Taniguti, 1976; Yoshikawa and Yoshikawa, 1977.

Chondria armata (Kützing) Okamura, 1907:69.
Ariga, 1919, 1920; Chiang, 1962a, 1973b; Chihara, 1970, 1975; Fan, 1953a; Horikawa, 1919; Okamura, 1930, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939; Tseng, 1983.

Chondria dasyphylla (Woodward) C. Agardh, 1822:350.
Ariga, 1920; De Toni, 1895; Yoshikawa and Yoshikawa, 1977. As "*Laurencia dasyphylla*": Martens, 1866.

Digenia simplex (Wulfen) C. Agardh, 1822:389.
Ariga, 1920; Chihara, 1970, 1975; Fan, 1953a; Higashi, 1934; Okamura, 1931, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983.

Herposiphonia subdisticha Okamura, 1899:37.
Chiang, 1962a; Okamura, 1931, 1936; Shen and Fan, 1950.

Herposiphonia sp.
Chiang, 1962b.

Laurencia brongniartii J. Agardh, 1841:20.
Remarks: Specimens from Nanwan, Taiwan (collected

by Ger Dzeng-Joung; 21 August 1979; #*US*-071851), were identified by J. Norris as *L. brongniartii* and establish the presence of this taxon in southern Taiwan.

Laurencia flexilis var. *tropica* (Yamada) Xia et Zhang, 1982:538.
Tseng, 1983.

Laurencia forsteri (Mertens ex Turner) Greville, 1830:lii.
Ariga, 1920.

Laurencia glandulifera Kützing, 1849:855.
Ariga, 1920.

Laurencia grevilleana Harvey, 1854:545.
Ariga, 1920, Su et al., 1982.
Remarks: Saito and Womersley (1974:839) considered *L. grevilleana* to be a taxonomic synonym of *L. brongniartii* J. Agardh.

Laurencia obtusa var. *densa* Yamada, 1931b:226.
Dawson, 1954c; Shen and Fan, 1950; Yamada, 1931b, 1936c.

Laurencia palisada Yamada, 1931b:196.
Chiang, 1962a; Shen and Fan, 1950; Su et al., 1982; Yamada, 1931b, 1936c.

Laurencia papillosa (Forsskål) Greville, 1830:lii.
Ariga, 1920; Chihara, 1975; Cotton, 1915; Okamura, 1931; Shen and Fan, 1950; Tilden, 1929; Yamada, 1936c; Yoshikawa and Yoshikawa, 1977.

Laurencia perforata (Montagne) J. Agardh, 1876:648.
Ariga, 1920; De Toni, 1895; Heydrich, 1894.

Laurencia pinnatifida (Gmelin) Lamouroux, 1813:42.
As "*L. pinnatifida* var. *simplex*": De Toni, 1895; Heydrich, 1894.

Laurencia tropica Yamada, 1931b:223.
Okamura, 1931; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1931b, 1936c.

Laurencia venusta Yamada, 1931b:203.
Okamura, 1931; Shen and Fan, 1950; Yamada, 1936c.

Laurencia sp.
Ariga, 1919; Fan, 1953a; Horikawa, 1919; Taniguti, 1976; Tokida, 1939.

Leveillea jungermannioides (Martius et Hering) Harvey, 1854:539.
Ariga, 1920; De Toni, 1895; Chiang, 1962b; Heydrich, 1894; Okamura, 1931, 1936; Rho, 1958; Shen and Fan, 1950; Tseng, 1983; Yoshikawa and Yoshikawa, 1977. As "*Polyzonia jungermannioides*": Okamura, 1897.

Murrayella periclados (C. Agardh) Schmitz, 1893:227.
Tokida, 1941.

Murrayella squarrosa (Harvey) Schmitz, 1893:228.
Shen and Fan, 1950; Yamada, 1936b.

Neurymenia fraxinifolia (Mertens ex Turner) J. Agardh, 1863:1135.
Chiang, 1973b; Okamura, 1931; Shen and Fan, 1950; Tanaka and Itono, 1969.

Polysiphonia harlandii Harvey, 1859:330.
Segi, 1951; Tseng, 1944, 1983; Yamada, 1933; Yoshikawa and Yoshikawa, 1977.

Polysiphonia kampsaxii Børgesen, 1939:122.
Segi, 1951.

Polysiphonia pulvinata J. Agardh, 1842:124.
Segi, 1951.

Symphyocladia marchantioides (Harvey) Falkenberg, 1901: 277.
Ariga, 1920; Chiang 1962a; Chihara, 1970, 1975; Okamura 1930, 1931, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983. As "*Placophora marchantioides*": Heydrich, 1894.

Vidalia obtusiloba (Mertens) J. Agardh, 1863:1123.
Ariga, 1920; Chihara, 1975; Okamura, 1931, 1936; Shen and Fan, 1950.

INCERTAE SEDIS

WURDEMANNIACEAE

Remarks: Taylor (1960:348, 361, 633) assigned the Wurdemanniaceae to the Gelidiales; however, Farr et al. (1979) have referred *Wurdemannia* to incertae sedis.

Wurdemannia setacea Harvey, 1853:246.
Okamura, 1931, 1936; Shen and Fan, 1950.

Wurdemannia sp.
Okamura, 1931.

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Appendix B.
Evaluating Taxonomic Databases for Biogeographic Use

Appendix B. is an original research contribution published in the Bulletin of Marine Science, Vol. 47, pages 115–123. Copyright permission for inclusion in this dissertation has been obtained from the publisher.

BULLETIN OF MARINE SCIENCE, 47(1): 115–123, 1990

EVALUATING TAXONOMIC DATABASES FOR BIOGEOGRAPHIC USE

Jane E. Lewis

ABSTRACT

Reliable biogeographic generalizations generally depend on a valid and useful scientific literature. The problem in marine biology, and especially phycology, has been the assimiiation of large bodies accumulated over time and published in various languages. This paper shows how contemporary technologies can be used to bring some order to the analysis of such information. An electronic database was used to evaluate historical and taxonomic database characteristics. This analytic technique, combined with a detailed scientific background, has shown that there may be some basic patterns against which specific biogeographic hypotheses can be tested. A phycological database demonstrates these points. A substantial body of literature describes the history of collection and taxonomic analysis of benthic marine algae from the tropical and subtropical western Pacific. The haphazard nature of these data and size of the database has made this literature largely inaccessible to critical analysis. Over 11,000 citations to taxa were assembled for this study from the literature of the Philippines, Australia, Taiwan and Malaysia. Biogeographic use of floristic ratios determined from the reports of single papers is shown to be suspect. Historical trends in the total number of citations and the occurrence of new introductions of taxa to the record led to generation of a cumulative taxa curve. This history is the basis for an informed selection of reliable data. It can be combined with an evaluation of the degree of repetition and consistency in reports and selection of taxonomic groups most thoroughly reported. This approach is expected to have general applicability to any large taxonomic information base using data collected by multiple investigators working with various perspectives at different times.

What tools can we use on our marine floristic or faunistic literatures to yield biogeographically intelligent conclusions? Computerized database technology is an obvious choice. This should produce more than simple repositories, de facto electronic libraries. They should have in them the structure to acquire and retain knowledge, to respond quickly and successfully to new situations, as well as be amenable to the use of reason in solving problems effectively. They should, in short, be structured for intelligence.

The basis for this intelligently-structured electronic database is the scientific literature. Taxonomic reports on benthic marine algae exist for many areas of the tropical and subtropical western Pacific, including the Ryukyus (Okamura, 1936; Segawa and Kamura, 1960), Hong Kong (Tseng, 1940; Hodgkiss and Yan, 1981), South China (Tseng, 1983; Zhang and Xia, 1983), Vietnam (Dawson, 1954; Pham-Hoang, 1969) and Indonesia (Weber van Bosse, 1913a; 1913b). These reports have been written in several languages and published over a period of almost 170 years.

In phycology, one is faced with references of tantalizing interest but which are inaccessible or very difficult to assimilate by reason of language, differences in theoretical approach or other barriers to comparison. The researcher assumes that if one could intelligently compare these references, however preliminary that assessment might be, patterns would almost certainly be revealed of intense biogeographic interest.

The literature of Taiwan exemplifies these difficulties and more. The literature written in Chinese is published variously in simplified or traditional character bases. Japanese reports on this area use a combination of phonetic alphabets and Chinese-style characters [kanji]. Western authors add to this mix their complement of European languages. Each group also has had a distinct approach to phycology over time. Over this period both nomenclature and the phycological approach to taxonomy have been in continual change.

The field of phycology is handicapped by the scant attention historically paid to organizing the body of its literature, the basis for its scientific advancement. The haphazard nature of the data and number of records from diverse sources make the literature inaccessible to critical analysis.

In the last 5 years, authors from four areas within the warm-water western Pacific region have tackled these problems and have published taxonomic summaries which address these problems to varying degrees. With these four papers as a foundation, it is now possible to develop methods to compare the literature regionally, seeking biogeographically meaningful patterns at a larger scale.

Method

Summary papers for tropical and subtropical Australia (Lewis, 1984; 1985; 1987), the Philippines (Silva et al., 1987), Malaysia (Phang, 1986) and Taiwan (Lewis and Norris, 1987) provided the data for this study. Each citation, or single report of an individual taxon, from the summary publications was entered into an electronic, text-based database. All information was utilized as provided by the authors of the respective papers, without further nomenclatural or taxonomic judgment.

Each record included: genus and species; the country for which it was reported; bibliographic source for the report; and taxonomic position of the species (Division, Order and Family). Also included where appropriate were synonymies and other comments. Collection localities were appended for each citation from Australia and the Philippines.

Citations were entered into R:Base System 5, a commercial database program running under DOS on an IBM-compatible personal computer. Information was extracted using R:BASE CLOUT, a natural language database tool.

Results

Taxonomic Summary.—The four regions analyzed are summarized in Table 1. The total number of families, genera, species and citations published is given. Components for the Divisions Rhodophyta, Phaeophyta and Chlorophyta are also given.

Citations were most numerous for the Philippines. Comparing the number of species to the number of citations, red algae are reported an average of almost six times each, brown algae were over five each. Green species were reported, on average, almost nine times. Total citations were less for Australia though the numbers of families and genera are the greatest of any of the countries examined. The highest Australian ratio of citations to species was for green algae, but values are all lower than those of the Philippines. Taiwan has lower numbers in all taxonomic groups except brown genera, where it was only slightly greater than for brown Philippine genera. Malaysian values were lowest in all categories. The ratio of citations to species, less than two, indicates an incipient literature base.

Citations from the Philippines constitute over half of the total citations from the four summary papers. By Division, citations for the Philippines are greater than half the total for Rhodophyta (red algae) and Chlorophyta (green algae) but considerably less than half of the total Phaeophyta citations.

Biogeographic Indices.—Although biogeographic statements in marine phycology have traditionally been limited to presence/absence tables, a simple floristic index

Table 1. Summary of the database. Taxonomic constitution of the benthic marine algae reports from four areas of the tropical and subtropical western Pacific region. The number of families, genera, species and individual citations are given for the Divisions Rhodophyta (red algae), Phaeophyta (brown algae), Chlorophyta (green algae) and the total of the three groups

	Family	Genus	Species	Citation	Country
Rhodophyta	37	131	506	2,936	Philippines
	40	141	389	1,637	Australia
	31	88	255	1,092	Taiwan
	16	32	62	83	Malaysia
Phaeophyta	10	23	154	836	Philippines
	19	50	150	689	Australia
	9	24	95	428	Taiwan
	8	12	33	49	Malaysia
Chlorophyta	14	36	251	2,162	Philippines
	20	51	223	1,029	Australia
	13	25	90	517	Taiwan
	7	21	58	82	Malaysia
Total	61	190	911	5,934	Philippines
	79	242	762	3,355	Australia
	53	137	440	2,037	Taiwan
	31	65	153	214	Malaysia

(Cheney, 1977) has recently been used biogeographically (South, 1983). The Cheney index is derived by adding the number of red algal species to those of green and dividing the sum by the number of brown (R + G/B). It has been applied to Atlantic Ocean algal floras with the resulting inference that the higher the value, the more tropical the flora. This index has not previously been reported for Pacific Ocean localities.

Values of the Cheney index are plotted (Fig. 1) according to latitudinal range for Malaysia, the Philippines, Taiwan, Australia, California and several Atlantic locations. The highest value is for Jamaica, the lowest for southern Greenland. After incorporating Pacific Ocean locations, the general trend of high latitudes being related to low index values continues to be maintained. The Pacific localities are grouped, however, with somewhat lower values than for similar latitudes in the Atlantic.

The Cheney index is intriguing, even seductive, in its simplicity. But this simplicity may mask information which would help in its intelligent interpretation. Often numbers are taken from a single taxonomic publication with no apparent regard for its potential irregularities. In this way, only a small percent of available and useful information is, in fact, being utilized. For example, is the cause for the low value for Malaysia under-reportage? Is the total number of taxa for a location an important variable? Because Australia and the Philippines have extensive latitudinal ranges, and collection locations are published for each record, if their ranges were divided into several sections would the latitudinal trend continue? Can a single paper be assumed to be a good basis for this ratio? Does it matter when the paper was published or who published it, or is the index stable through time?

This illustrates the problem of taking numbers from a single report without reference to the degree of work done. Differences undoubtedly exist in the applied theory, the method used, and the degree to which each different area has been reported.

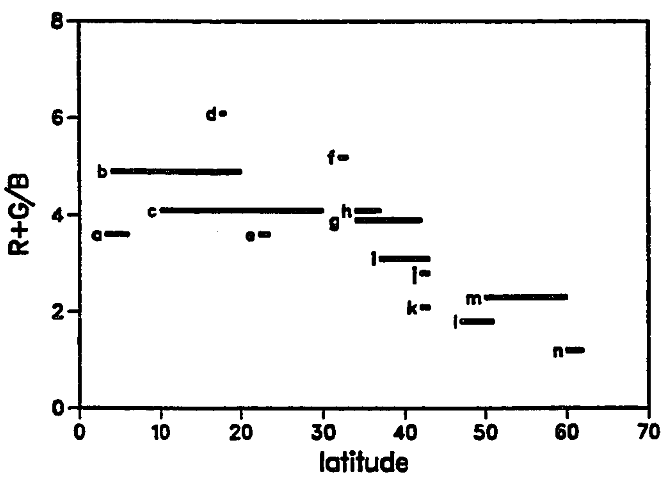

Figure 1. Latitudinal distributions of floristic indices for: (a) Malaysia; (b) the Philippines; (c) tropical and subtropical Australia; (d) Jamaica; (e) Taiwan; (f) Bermuda; (g) California; (h) North Carolina; (i) Portugal; (j) Connecticut; (k) Rhode Island; (l) Newfoundland; (m) Great Britain; (n) southern Greenland.

Data Over Time.—To the extent that floristic reportage changes over time, individual reports must be seen in an historical context. The analytical technique proposed here illustrates the temporal framework in which the database has been created. Because Philippine records are the most voluminous (5,934 citations), extend back farthest historically (to 1820) and encompass the greatest number of publications (296), it has been chosen as an example. Results of the floristic index were generated from the sum of all reports for the Philippines by decade, beginning with the 1830's (Fig. 2A).

Clumping papers by decade dampens the bias caused by individual reports and makes the Cheney index more representative of short historical periods. It was anticipated that the index would fluctuate in the early history when few papers were generated and then increasingly stabilize as a result both of increased number of reports and, presumably, greater inclusiveness in these reports. A surprising stability through the early period is followed by 60 years of high fluctuation, and several decades of relative stability with a gradual increase brings the graph to 1985. Higher values resulted in decades when red or green algae were predominantly reported, low values signaled those decades in which a relatively high number of brown algae were reported.

The next step was to examine a graph of cumulative Cheney index by decade (Fig. 2B). One might have expected that the reports would result in an asymptotic value for the index. However, this does not yet seem to have occurred, so there is no clear indication from this whether or not the present cumulative number may be regarded as representative. Large jumps in the index value, such as between the 60's and the 70's represent a relatively large increase in taxa, with few brown species. The swings of the 1890's to 1950's are moderated in this cumulative view, and show here only as a steady increase.

Interpreted biogeographically, the Cheney index indicates that the marine algal flora of the Philippines has changed in 150 years from one subarctic in nature,

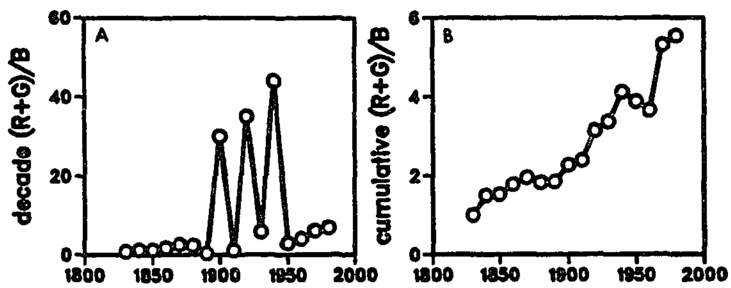

Figure 2. Marine algal floristic index (R+G/B) for the Philippines from all accumulated published reports for each 10-year period. (A) The index figured separately for each decade. (B) The index figured from cumulative reports.

to one subtropical. Clearly a method resulting in such a conclusion should be viewed with suspicion. Only after carefully characterizing the dynamics of the history of reporting on floristic or taxonomic databases can useful biogeographic conclusions be drawn.

History of Reporting.—Figure 3 illustrates several factors of the history of benthic marine algal reports, using the Philippines as an example. How prolific has the literature been, and how has this changed through time? Beginning in 1960, and then more notably from 1970 on, there has been a surge in the number of reports.

A large increase in the number of reports began in 1965, adding a large number of new taxa to the Philippine flora (Fig. 3B). Whereas the total number of citations has continually increased over the last few decades, this pattern is not reflected

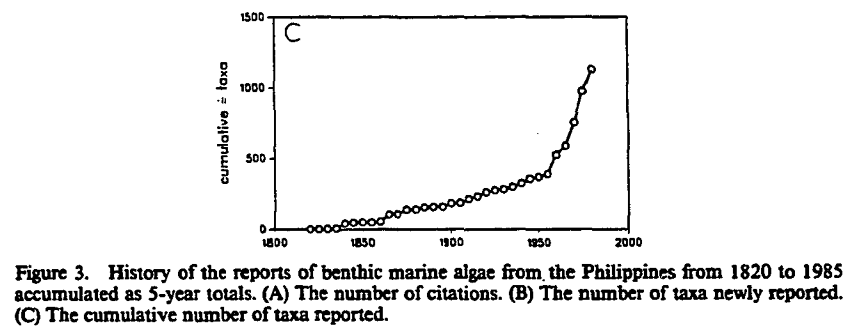

Figure 3. History of the reports of benthic marine algae from the Philippines from 1820 to 1985 accumulated as 5-year totals. (A) The number of citations. (B) The number of taxa newly reported. (C) The cumulative number of taxa reported.

in the number of new taxa being introduced. The peak for new taxa was the period from 1975 to 1980, though the 1980 to 1985 value is still very high. This suggests that, although the introduction of new taxa to the record has slowed somewhat, the record as a whole is still immature.

If reports of new taxa are declining, is the number of taxa being reported for the Philippines beginning to stabilize? A curve of cumulative reported taxa (Fig. 3C) shows a period of slow growth, which might be referred to as a kind of "grow-out" phase, followed by more than two decades of exponential growth. A plateau would be expected to appear in what might be called a "maturely reported" flora, but the total taxa do not yet show a tendency toward stabilization for the Philippines.

When a plateau is present in a cumulative taxa curve, it is then possible to ask whether biogeographically useful statements can be made. Although at species level the literature for the Philippines has not stabilized, following the same technique it is possible that taxonomic subgroups (i.e., Orders, Families or Genera), may be found which have. The researcher would attempt to identify such groups in order to begin to draw biogeographically useful conclusions. When applied to finer taxonomic levels, curves such as the last few shown are the kinds of tools which may be employed to locate stable information from the literature.

Repeat Citations.—Another type of database analysis has been used to indicate the validity of a report, specifically in revealing the biases relative to the frequency with which a taxon is reported. The importance of this relates to the common feeling, when reading taxonomic reports of seaweeds, that the name used in the publication is not "correct." The result is that literature may be discounted when there is no personal knowledge of the process used to generate it. There are ways to look at the literature and get an indication of its character, and perhaps it's validity, if not on a taxon-by-taxon basis, at least for a region as a whole.

The approach is to look at the number of times that each taxon has been reported. For example, of all tropical and subtropical Australia's reported seaweed taxa, almost 40% were reported only once; some 15% were reported eight or more times (Fig. 4). One taxon was reported 32 times over the course of the history of seaweed reports.

One should not necessarily discount all taxa only reported once, nor automatically believe reports of that taxon reported 32 times, but on a case-by-case basis a researcher familiar with seaweed taxonomy can evaluate the causes behind the number of reports and use them in selecting reliable taxa for biogeographic comparison.

Discussion

The body of taxonomic literature has been built over time from the work of diverse groups of researchers. The degree to which this literature can be used to draw floristic or biogeographic conclusions remains an open question. This paper takes the view that taxonomic literature is an extremely rich source of information from which generalizations can be drawn. But to be of use it must first be evaluated with great care.

Evaluation is necessary because the literature is the result of a series of widely diverging viewpoints which can not be assumed to be readily comparable. It may be biased by views predominating in the historical period within which it was generated or by the singular perspectives of individual researchers. Thus, by first considering how literature was generated and the motivation for its generation, it can more intelligently be utilized.

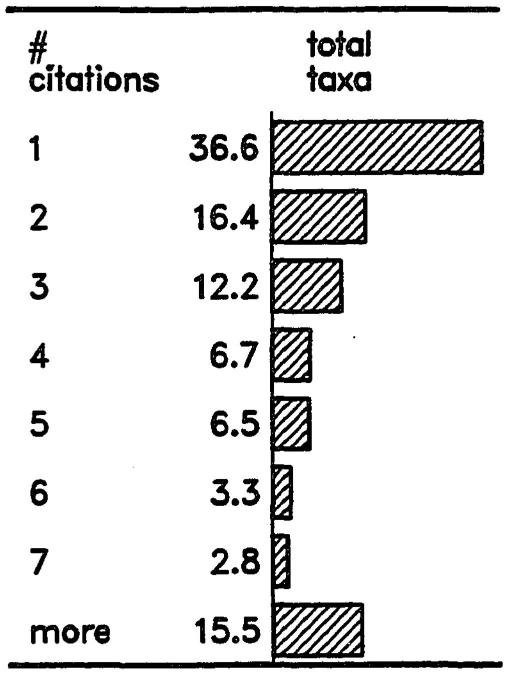

Figure 4. The number of repeat citations for Australian seaweeds. Values at the base of bars is the percent of total taxa.

Phycology provides an example of this situation. Historically the methodology whereby names are published or cited, known as the "type method," has been without significant change since the early 1800's. Beyond methodology, however, the basic theory which sets criteria for comparing or distinguishing one alga from another has changed several times in significant ways in the last 150 years. Theoretical issues of evolution began to solidify only in the 1940's. Discussion of what a species in fact is, continues to escalate with the application of molecular biology techniques. In phycology, the details of life histories, ecological information on seasonality, and the relationship of habitat to morphological plasticity are only now being worked out. This new information forces a rethinking of taxonomically reliable characters. No published comprehensive index exists to phycological literature in general, or even to nomenclatural sources of phycology in particular. Voucher specimens are rarely kept to document how particular investigators have made taxonomic determinations. All the evidence that usually remains of naming decisions are Latin binomial in publications, but we are usually left without any indication of the justification for that decision.

Because the origins of Linnaean or scientific phycology are European, Pacific Ocean phycology is today in many ways still a phycology at remove. Early investigators were participants in European voyages who collected sporadically and then sent specimens of many of the common Pacific algae to European herbaria. There they are practically inaccessible to Pacific area researchers. Far from European or American libraries, access to the old and standard taxonomy references is also difficult. When type specimens and original published descriptions are not available for reference, Pacific area researchers must rely on the opinions, publications, descriptions and specimens that are available. These are some of the historic and geographic factors to consider when evaluating the benthic marine algae literature from the tropical and subtropical western Pacific.

Other factors of evaluation are completeness and consensus. Is the taxonomic breadth of literature published for an area close to the taxonomic breadth of the actual flora? How close to taxonomic consensus are the researchers of a given geographical area (i.e., Taiwan or Australia)? Has there been consensus among the researchers in an area and those from adjacent areas, where floras are likely to have many elements in common?

As information on the biota of an area increases, the degree to which that information represents the actual biological situation should also increase. A point is eventually reached where this information becomes a fair representation of the actual flora. The challenge is to identify that point.

How can an assessment of the completeness of a floristic database be done? One may first consider the intensity of investigative activity represented in the literature. A curve can be generated to illustrate the growth of information. It would be one beginning with a small number of citations and small number of taxa recognized and, at some point the number of citations would continue to increase, but the number of new taxa would stabilize. This curve could represent the number of recognized taxa, but this becomes complicated by the presence (as there is sure to be) of conflicting taxonomic opinions.

Phases of initiation, growout (with or without exponential sections) and plateau are expected on these curves. The individual characteristics of each of the phases, and the present location of a country along the curve, marks their unique history.

As an extension to this cumulative taxa curve concept, taxonomic subsets could be used to locate taxonomic differences in investigative efforts. This could be used to address a taxonomic bias, answering questions of which taxonomic groups are more represented in different historical periods. When, then, is the taxonomic horsepower sufficient to drive the biogeographic analyses?

Only with the kinds of computer hardware and software available during the last few years has it been possible to provide timely evaluations of large databases. Database software allows for one to easily determine the degree of repetition in reports from more circumscribed taxonomic levels (i.e., Order, Family, Genus or Species). Combined with specialists' information in individual biological fields, they allow a characterization of the history of reports and establish how far along the flora is to being well-reported.

Conclusion

This paper presents an approach to the evaluation of taxonomic data emphasizing the consolidation of the published record. Unavailability of information, inconsistency of technique, taxonomic and nomenclatural confusion and the lack of a way to access the degree of confidence in reports impede investigation, but powerful and flexible computer tools available can simplify synthesis.

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DATE ACCEPTED: January 19, 1989.

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Appendix C.
Database Summary

Appendix C. is a set of three tables which present the original data from the field collections as compared with the published record for the South China Sea and the remainder of the warm water western Pacific. The first three columns are summaries of the field species (FLD), the South China Sea citations (SCS) and the warm water western Pacific (WP) citations. Following these columns are details of the South China Sea: Hong Kong (HK), Hainan Island (HN), the Xisha Archipelago (XS) and Vietnam (VN). The last columns are details of the warm water western Pacific: the Ryukyu Islands (Ryu), Taiwan (TW), the Philippines (Phil) and the tropical and subtropical areas of Australia (Aust). Three tables are presented: green, brown and red species. Within each table all taxa are listed alphabetically.

Table C.1. Comparison of field with publication records (Chlorophyta) from the warm water western Pacific.

	Summary			*South China Sea*					*WWWP*				
Green	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Acetabularia cal	X	X	X	-	-	-	X	-	-	-	-	X	X
Acetabularia cla	-	X	X	-	-	-	X	-	-	-	-	X	-
Acetabularia cre	-	X	X	-	-	-	-	X	-	-	-	X	X
Acetabularia den	-	-	X	-	-	-	-	-	-	-	-	X	-
Acetabularia exi	-	-	X	-	-	-	-	-	-	-	-	X	X
Acetabularia gig	-	-	X	-	-	-	-	-	-	-	X	-	-
Acetabularia kil	-	-	X	-	-	-	-	-	-	-	-	-	X
Acetabularia maj	-	X	X	-	-	-	-	X	-	-	X	X	X
Acetabularia med	-	X	-	-	-	-	-	X	-	-	-	-	-
Acetabularia min	-	-	X	-	-	-	-	-	-	-	-	X	-
Acetabularia moe	-	X	-	-	-	-	X	-	-	-	-	-	-
Acetabularia par	X	X	X	-	-	-	-	-	-	-	-	X	-
Acetabularia pus	-	X	-	-	-	-	X	-	-	-	-	-	-
Acetabularia ryu	-	-	X	-	-	-	-	-	-	-	-	X	-
Acetabularia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Acetabularia sp.	-	X	X	-	-	-	-	-	X	-	X	-	-
Acetabularia vel	-	-	X	-	-	-	-	-	-	-	-	X	-
Anadyomene brown	-	-	X	-	-	-	-	-	-	-	-	X	X
Anadyomene esept	-	-	X	-	-	-	-	-	-	-	-	X	-
Anadyomene lecla	-	-	X	-	-	-	-	-	-	-	-	X	-
Anadyomene plica	-	X	X	-	-	-	X	-	-	-	-	X	X
Anadyomene sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Anadyomene stell	-	X	X	-	-	-	-	X	-	-	-	X	-
Anadyomene wrigh	X	X	X	-	-	-	X	-	-	-	X	X	-
Avrainvillea cal	-	-	X	-	-	-	-	-	-	-	-	-	X
Avrainvillea com	-	-	X	-	-	-	-	-	-	X	-	-	-
Avrainvillea ere	-	X	X	-	X	-	X	X	-	-	X	X	X
Avrainvillea lac	-	X	X	-	X	X	X	-	-	-	-	X	X
Avrainvillea lon	-	-	X	-	-	-	-	-	-	-	-	X	-
Avrainvillea nig	-	-	X	-	-	-	-	-	-	-	-	X	-
Avrainvillea obs	-	-	X	-	-	-	-	-	-	-	-	X	-
Avrainvillea pap	-	-	X	-	-	-	-	-	-	X	-	-	-
Avrainvillea rid	-	-	X	-	-	-	-	-	-	-	-	-	X
Avrainvillea sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Blastophysa rhiz	-	-	X	-	-	-	-	-	-	-	-	-	X
Blidingia minima	-	-	X	-	-	-	-	-	-	-	-	-	X
Boergesenia forb	-	X	X	-	X	X	X	-	-	-	X	X	X
Boergesenia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Boodlea coacta	-	-	X	-	-	-	-	-	-	X	X	X	X
Boodlea composit	-	X	X	X	-	-	X	X	-	-	X	X	X
Boodlea montagne	-	-	X	-	-	-	-	-	-	-	X	X	X
Boodlea siamensi	-	X	X	-	-	-	X	-	-	-	X	-	-
Boodlea sp.	X	-	X	-	-	-	-	-	-	-	-	X	-
Boodlea struveoi	-	X	X	-	-	-	X	-	-	-	-	X	-
Boodlea vanbosse	-	-	X	-	-	-	-	-	-	-	X	-	X
Boodleopsis pusi	-	-	X	-	-	-	-	-	-	-	-	X	X
Boodleopsis sp	X	-	-	-	-	-	-	-	-	-	-	-	-
Boodleopsis vert	-	-	X	-	-	-	-	-	-	-	-	X	-
Bornetella capit	-	-	X	-	-	-	-	-	-	-	-	-	X
Bornetella nitid	-	X	X	-	-	X	-	-	-	-	X	X	X
Bornetella oligo	X	X	X	-	-	-	X	-	-	-	-	X	X
Bornetella ovali	-	-	X	-	-	-	-	-	-	-	-	X	-
Bornetella sp.	-	X	-	-	X	X	-	-	-	-	-	-	-
Bornetella sphae	-	X	X	-	X	-	X	-	X	-	X	X	-
Bryopsis corticu	-	-	X	-	-	-	-	-	-	-	-	X	-
Bryopsis foliosa	-	-	X	-	-	-	-	-	-	-	-	-	X
Bryopsis harveya	-	X	X	-	-	-	-	-	-	X	X	-	-
Bryopsis hypnoid	-	-	X	-	-	-	-	-	-	-	-	-	X
Bryopsis indica	-	X	X	-	-	-	X	-	-	-	X	X	X

	Summary			South China Sea					WWWP			
Green	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Bryopsis mucosa	-	-	X	-	-	-	-	-	-	-	X	-	-
Bryopsis muscosa	-	X	X	X	-	-	-	-	-	-	-	-	X
Bryopsis myura	-	-	X	-	-	-	-	-	-	-	-	-	X
Bryopsis pennata	-	X	X	-	-	-	X	X	-	-	-	X	X
Bryopsis plumosa	-	X	X	X	-	-	X	X	-	-	X	X	X
Bryopsis sp	X	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa ambigua	X	X	X	-	-	-	X	-	-	-	-	X	X
Caulerpa arenico	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa biserru	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa brachyp	-	X	X	-	-	-	X	-	-	-	-	X	X
Caulerpa brownii	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa byssoid	-	X	-	X	-	-	-	-	-	-	-	-	-
Caulerpa cactoid	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa chemnit	-	X	-	-	-	-	-	X	-	-	-	-	-
Caulerpa clavife	-	-	X	-	-	-	-	-	-	X	-	-	X
Caulerpa crassif	-	X	X	-	-	-	-	X	-	X	-	-	-
Caulerpa crassum	-	X	-	X	-	-	-	-	-	-	-	-	-
Caulerpa cupress	X	X	X	X	X	X	-	-	X	X	X	X	X
Caulerpa elongat	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa falcifo	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa fastigi	-	X	X	-	-	-	X	-	-	-	-	X	X
Caulerpa ferguso	-	X	X	-	-	-	-	X	-	-	-	X	-
Caulerpa filicoi	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa flexili	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa freycin	-	-	X	-	-	-	-	-	-	X	X	X	-
Caulerpa geminat	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa lentill	-	X	X	-	-	-	X	X	-	-	-	X	X
Caulerpa lessoni	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa macrodi	-	X	-	-	-	-	X	-	-	-	-	-	-
Caulerpa mexican	-	X	X	-	-	-	X	-	-	-	-	X	-
Caulerpa microph	-	X	X	-	-	-	X	-	-	-	-	X	-
Caulerpa nummula	-	X	-	-	X	X	-	-	-	-	-	-	-
Caulerpa papillo	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa parvifo	-	-	X	-	-	-	-	-	-	-	X	-	-
Caulerpa peltata	-	X	X	X	-	-	-	X	X	X	X	X	X
Caulerpa prolife	-	X	X	-	-	-	-	X	-	-	-	X	-
Caulerpa racemos	X	X	X	-	-	X	X	X	X	-	X	X	X
Caulerpa reyesii	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa scalpel	-	X	-	-	-	-	-	X	-	-	-	-	-
Caulerpa selago	-	-	X	-	-	-	-	-	-	-	-	X	X
Caulerpa serrula	X	X	X	-	X	-	X	X	X	-	X	X	X
Caulerpa sertula	-	X	X	X	X	X	X	X	X	-	X	X	-
Caulerpa sertulo	X	-	X	-	-	-	-	-	-	-	X	-	-
Caulerpa simplic	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa sp.	X	X	-	-	X	X	-	-	-	-	-	-	-
Caulerpa subserr	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa taxifol	X	X	X	X	X	X	X	X	X	-	X	X	X
Caulerpa urville	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulerpa urvilli	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa vertici	X	X	X	-	X	-	X	X	-	-	-	X	X
Caulerpa vesicul	-	-	X	-	-	-	-	-	-	-	-	X	-
Caulerpa vickers	-	X	X	-	-	-	X	-	-	-	-	-	X
Caulerpa webbian	X	-	X	-	-	-	-	-	-	X	X	X	X
Chaetomorpha aer	-	X	X	-	-	-	X	-	-	-	X	-	X
Chaetomorpha ant	X	X	X	X	-	-	X	X	-	-	X	X	X
Chaetomorpha bas	-	-	X	-	-	-	-	-	-	-	X	-	-
Chaetomorpha bra	-	X	X	X	-	-	-	-	-	-	X	X	X
Chaetomorpha cap	-	X	-	-	-	-	X	-	-	-	-	-	-
Chaetomorpha col	-	-	X	-	-	-	-	-	-	-	-	-	X
Chaetomorpha cra	-	X	X	-	-	-	X	-	-	-	X	X	X
Chaetomorpha exp	-	-	X	-	-	-	-	-	-	-	-	-	X
Chaetomorpha gra	-	X	X	-	-	-	X	-	-	-	-	X	-
Chaetomorpha ind	-	X	X	-	-	-	X	-	-	-	-	-	X
Chaetomorpha inf	-	-	X	-	-	-	-	-	-	-	-	X	-

	Summary			South China Sea					WWWP				
Green	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Chaetomorpha jap	-	-	X	-	-	-	-	-	-	-	-	-	X
Chaetomorpha jav	-	X	-	-	-	-	X	-	-	-	-	-	-
Chaetomorpha kel	-	-	X	-	-	-	-	-	-	-	-	X	-
Chaetomorpha lig	-	-	X	-	-	-	-	-	-	-	-	X	-
Chaetomorpha lin	X	X	X	-	-	-	X	-	-	-	X	X	X
Chaetomorpha sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Chaetomorpha sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Chaetomorpha spi	X	X	X	-	X	-	-	X	-	-	X	X	X
Chaetomorpha tor	-	-	X	-	-	-	-	-	-	-	-	-	X
Chamaedoris orie	-	-	X	-	-	-	-	-	-	-	X	X	-
Chlorocladus aus	-	-	X	-	-	-	-	-	-	-	-	X	X
Chlorocladus phi	-	-	X	-	-	-	-	-	-	-	-	X	-
Chlorodesmis cae	-	-	X	-	-	-	-	-	-	-	X	X	X
Chlorodesmis com	-	-	X	-	-	-	-	-	-	-	X	-	-
Chlorodesmis fas	-	-	X	-	-	-	-	-	-	-	X	X	X
Chlorodesmis hil	-	X	X	-	X	-	X	-	-	-	-	X	X
Chlorodesmis maj	-	-	X	-	-	-	-	-	-	-	-	X	X
Chlorodesmis sin	-	X	-	-	-	X	-	-	-	-	-	-	-
Chlorodesmis sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Chroodactylon or	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora Xaete	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora aegic	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora albid	-	X	X	-	-	-	X	-	-	-	-	-	X
Cladophora aniso	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora aokii	X	X	X	-	X	-	-	-	-	-	X	X	X
Cladophora caten	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora coelo	-	X	X	-	-	-	X	-	-	-	-	-	X
Cladophora confe	-	-	X	-	-	-	-	-	-	-	-	X	-
Cladophora crina	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora crisp	-	X	X	-	-	-	X	-	-	-	-	X	-
Cladophora cruci	-	-	X	-	-	-	-	-	-	-	-	X	-
Cladophora cryst	-	-	X	-	-	-	-	-	-	-	-	X	-
Cladophora cymop	-	-	X	-	-	-	-	-	-	-	-	X	-
Cladophora dalma	-	-	X	-	-	-	-	-	-	-	-	X	X
Cladophora delic	-	X	-	X	-	-	-	-	-	-	-	-	-
Cladophora diver	-	X	-	X	-	-	-	-	-	-	-	-	-
Cladophora fasci	-	X	-	-	-	-	X	X	-	-	-	-	-
Cladophora ferti	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora filip	-	-	X	-	-	-	-	-	-	-	-	X	-
Cladophora fract	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora fulig	-	X	X	-	X	X	X	-	-	-	X	-	-
Cladophora fusca	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora glauc	-	X	-	-	-	-	X	-	-	-	-	-	-
Cladophora glome	-	X	X	-	-	-	X	-	-	-	-	-	X
Cladophora gower	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora graci	-	X	-	-	-	-	X	-	-	-	-	-	-
Cladophora herpe	-	-	X	-	-	-	-	-	-	X	-	-	-
Cladophora inser	-	X	X	-	-	-	X	X	-	-	-	X	-
Cladophora japon	-	-	X	-	-	-	-	-	-	-	-	X	-
Cladophora kilne	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora laete	-	X	X	-	-	-	X	-	-	-	-	X	-
Cladophora liebe	-	-	X	-	-	-	-	-	-	-	-	X	X
Cladophora mauri	-	X	-	-	-	-	-	X	-	-	-	-	-
Cladophora merid	-	-	X	-	-	-	-	-	-	-	X	-	-
Cladophora monta	-	-	X	-	-	-	-	-	-	-	X	-	-
Cladophora papen	-	X	-	-	-	-	X	-	-	-	-	-	-
Cladophora parvu	-	-	X	-	-	-	-	-	-	-	-	-	X
Cladophora paten	-	X	X	-	-	X	X	-	-	-	X	-	-
Cladophora pellu	-	-	X	-	-	-	-	-	-	-	-	X	X
Cladophora perpu	-	X	X	-	-	-	X	-	-	-	-	-	X
Cladophora proli	-	-	X	-	-	-	-	-	-	-	-	X	X
Cladophora quisu	-	-	X	-	-	-	-	-	-	-	-	X	-
Derbesia marina	-	-	X	-	-	-	-	-	-	-	-	X	-
Derbesia ryukyue	-	-	X	-	-	-	-	-	-	-	-	X	X
Derbesia tenuiss	-	-	X	-	-	-	-	-	-	-	-	X	-

	Summary			South China Sea						WWWP			
Green	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aus
Dictyosphaeria b	-	-	X	-	-	-	-	-	-	-	X	-	-
Dictyosphaeria c	-	X	X	X	-	-	X	-	-	-	X	X	X
Dictyosphaeria f	-	X	X	-	-	-	-	X	-	X	-	-	-
Dictyosphaeria i	-	-	X	-	-	-	-	-	-	-	-	X	X
Dictyosphaeria o	-	-	X	-	-	-	-	-	-	-	-	X	-
Dictyosphaeria s	X	X	X	-	-	X	X	-	-	-	-	X	X
Dictyosphaeria v	X	X	X	-	-	-	X	-	-	-	-	X	X
Endophyton ramos	-	-	X	-	-	-	-	-	-	-	X	-	-
Enteromorpha ara	-	-	X	-	-	-	-	-	-	-	-	X	-
Enteromorpha cha	-	X	X	-	-	-	X	-	-	-	-	X	-
Enteromorpha cla	X	X	X	-	-	-	X	-	-	-	X	X	X
Enteromorpha com	-	X	X	X	-	-	-	X	-	-	X	X	X
Enteromorpha fas	-	-	X	-	-	-	-	-	-	X	-	-	-
Enteromorpha fle	X	X	X	-	-	-	X	X	-	-	-	X	X
Enteromorpha gun	-	-	X	-	-	-	-	-	-	-	-	-	X
Enteromorpha int	X	X	X	-	-	-	X	X	-	-	X	X	X
Enteromorpha kyl	-	X	X	-	-	-	X	-	-	-	-	X	X
Enteromorpha lin	X	X	X	X	-	-	-	-	-	-	X	X	-
Enteromorpha pro	X	X	X	-	-	-	-	X	-	-	X	X	-
Enteromorpha ral	-	X	X	-	-	-	X	-	-	-	-	-	X
Enteromorpha ram	-	-	X	-	-	-	-	-	-	-	-	X	-
Enteromorpha sp	-	-	X	-	-	-	-	-	-	-	X	X	-
Enteromorpha sp.	X	X	-	X	-	-	-	-	-	-	-	-	-
Enteromorpha tub	X	X	-	X	-	-	X	-	-	-	-	-	-
Entocladia virid	-	X	-	-	-	-	X	-	-	-	-	-	-
Ernodesmis verti	-	-	X	-	-	-	-	-	-	-	-	X	-
Erytyrotrichia c	-	-	X	-	-	-	-	-	-	-	-	-	X
Gepella prolifer	-	X	-	-	-	X	-	-	-	-	-	-	-
Gomontia arrhiza	-	X	-	-	-	-	X	-	-	-	-	-	-
Goniotrichum als	-	-	X	-	-	-	-	-	-	-	-	-	X
Goniotrichum cor	-	-	X	-	-	-	-	-	-	-	-	-	X
Halicoryne spica	-	-	X	-	-	-	-	-	-	-	-	-	X
Halicoryne wrigh	-	-	X	-	-	-	-	-	-	-	-	X	-
Halicystis pyrif	-	X	-	-	-	-	X	-	-	-	-	-	-
Halimeda batanen	-	-	X	-	-	-	-	-	-	-	-	X	-
Halimeda bikinen	-	-	X	-	-	-	-	-	-	-	-	X	-
Halimeda copiosa	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda cuneața	-	X	X	-	-	-	X	-	-	-	X	X	X
Halimeda cylindr	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda discoid	-	X	X	-	-	X	X	X	-	-	X	X	X
Halimeda distort	-	-	X	-	-	-	-	-	-	-	-	-	X
Halimeda dura	-	X	-	-	-	-	-	X	-	-	-	-	-
Halimeda fragili	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda gigas	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda gracili	-	X	X	-	-	-	X	-	-	-	-	X	X
Halimeda incrass	-	X	X	-	X	X	X	-	-	-	X	X	X
Halimeda lacunal	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda macrolo	X	X	X	-	X	X	-	-	-	-	X	X	X
Halimeda macroph	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda magnidi	-	-	X	-	-	-	-	-	-	-	-	-	X
Halimeda melanes	-	-	X	-	-	-	-	-	-	-	-	-	X
Halimeda microne	-	X	X	-	-	X	-	-	-	-	-	X	X
Halimeda minima	-	-	X	-	-	-	-	-	-	-	-	-	X
Halimeda opuntia	-	X	X	-	X	X	X	X	-	-	X	X	X
Halimeda papyrac	-	-	X	-	-	-	-	-	-	-	-	-	X
Halimeda renschi	-	-	X	-	-	-	-	-	-	X	X	X	X
Halimeda simulan	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Halimeda stuposa	-	-	X	-	-	-	-	-	-	-	-	X	X
Halimeda taenico	-	X	X	-	-	X	-	-	-	-	-	X	X
Halimeda tuna	-	X	X	-	-	-	X	X	-	-	-	X	X
Halimeda velasqu	-	X	X	-	-	X	-	-	-	-	X	X	X
Halimeda xishaen	-	X	-	-	-	-	-	-	-	-	-	-	-

Green	Summary			South China Sea						WWWP			
	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aus
Hormidium subtil	-	-	X	-	-	-	-	-	-	-	-	-	X
Microdictyon aga	-	-	X	-	-	-	-	-	-	-	-	X	-
Microdictyon boe	-	-	X	-	-	-	-	-	-	-	-	X	-
Microdictyon cla	-	-	X	-	-	-	-	-	-	-	-	X	-
Microdictyon cur	-	-	X	-	-	-	-	-	-	-	-	X	-
Microdictyon jap	-	X	X	-	-	-	-	-	-	-	X	X	-
Microdictyon mon	-	X	-	-	-	-	-	X	-	-	-	-	-
Microdictyon nig	X	-	X	-	-	-	-	-	-	-	X	-	-
Microdictyon obs	-	-	X	-	-	-	-	-	-	-	-	-	X
Microdictyon oka	-	X	X	-	-	-	X	-	-	-	X	X	X
Microdictyon pse	-	X	-	-	-	-	-	-	-	-	-	-	-
Microdictyon sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Monostroma latis	-	-	X	-	-	-	-	-	-	-	X	X	-
Monostroma nitid	X	X	X	X	-	-	X	-	-	-	X	X	-
Monostroma sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Monostroma sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Neomeris annulat	X	X	X	-	-	-	X	X	X	-	X	X	X
Neomeris bilimba	-	X	-	-	-	X	X	-	-	-	-	-	-
Neomeris sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Neomeris vanboss	-	X	X	-	-	-	X	-	-	-	X	X	X
Ochlochaete hyst	-	-	X	-	-	-	-	-	-	-	-	-	X
Ostreobium reine	-	X	X	-	-	-	X	-	-	-	-	-	X
Palmophyllum cra	-	-	X	-	-	-	-	-	-	-	-	-	X
Pedobesia clavae	-	-	X	-	-	-	-	-	-	-	-	-	X
Penicillus nodul	-	-	X	-	-	-	-	-	-	-	-	-	X
Penicillus sibog	-	X	X	-	-	-	X	-	-	-	-	-	X
Percursaria perc	-	-	X	-	-	-	-	-	-	-	-	-	X
Phaeophila dendr	-	-	X	-	-	-	-	-	-	-	-	X	X
Polyphysa clavat	-	-	X	-	-	-	-	-	-	-	-	-	X
Polyphysa parvul	-	-	X	-	-	-	-	-	-	-	-	-	X
Pseudobryopsis h	-	X	-	-	X	-	-	-	-	-	-	-	-
Pseudobryopsis m	-	X	X	-	-	-	X	-	-	-	X	-	-
Pseudobryopsis p	-	X	-	-	-	-	X	-	-	-	-	-	-
Pseudobryopsis s	-	X	-	X	-	-	X	-	-	-	-	-	-
Pseudochlorodesm	-	X	X	-	-	-	X	-	-	-	-	-	X
Pseudoendocloniu	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhipilia orienta	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhipiliella vert	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhipiliopsis ech	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhipiliopsis gra	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhipiliopsis how	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhipiliopsis mil	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhipiliopsis pel	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhizoclonium afr	-	-	X	-	-	-	-	-	-	-	-	X	X
Rhizoclonium cap	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhizoclonium cra	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhizoclonium gra	-	X	X	-	-	-	X	X	-	-	-	X	-
Rhizoclonium hie	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhizoclonium imp	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhizoclonium ker	-	X	X	-	-	-	X	-	-	-	-	X	-
Rhizoclonium koc	-	X	X	-	-	-	X	-	-	-	-	X	-
Rhizoclonium rip	-	X	X	-	-	-	X	-	-	-	-	X	X
Rhizoclonium set	-	-	X	-	-	-	-	-	-	-	-	X	-
Rudicularia peni	-	-	X	-	-	-	-	-	-	X	-	-	-
Siphonocladus tr	-	-	X	-	-	-	-	-	-	-	-	-	X
Siphonocladus xi	-	X	-	-	-	-	-	-	-	-	-	-	-
Spongocladia pau	-	-	X	-	-	-	-	-	-	-	-	-	X
Spongocladia vau	-	X	-	-	-	X	-	-	-	-	-	-	-
Spongomorpha sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Struvea anastomo	X	X	X	-	X	X	X	X	X	-	X	X	X
Struvea delicatu	-	X	X	-	-	-	X	X	-	-	X	-	-
Struvea intermed	-	X	-	-	-	X	-	-	-	-	-	-	-
Struvea ramosa	-	-	X	-	-	-	-	-	-	-	-	X	-

Green	*Summary* FLD	SCS	WP	*South China Sea* HK	HN	XS	VN	Mly	*WWWP* LZ	Ryu	TW	Phil	Aus
Struvea sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Trichosolen parv	-	-	X	-	-	-	-	-	-	-	-	-	X
Tydemania expedi	-	X	X	-	-	X	-	-	-	-	-	X	X
Udotea argentea	-	X	X	-	-	-	X	-	-	-	-	X	X
Udotea flabellum	-	X	X	-	X	-	-	-	-	-	-	X	X
Udotea fragiligo	-	X	-	-	-	X	-	-	-	-	-	-	-
Udotea geppii	-	-	X	-	-	-	-	-	-	-	-	X	-
Udotea glaucesce	-	-	X	-	-	-	-	-	-	-	-	X	X
Udotea halimeda	-	-	X	-	-	-	-	-	-	-	-	-	X
Udotea indica	-	-	X	-	-	-	-	-	-	-	-	X	-
Udotea javensis	X	X	X	-	X	X	X	X	-	-	X	X	X
Udotea occidenta	-	-	X	-	-	-	-	-	-	-	-	X	-
Udotea orientali	-	-	X	-	-	-	-	-	-	-	-	X	X
Udotea palmetta	-	-	X	-	-	-	-	-	-	-	-	-	X
Udotea reniformi	-	X	-	-	-	X	-	-	-	-	-	-	-
Udotea tenax	-	X	-	-	-	X	-	-	-	-	-	-	-
Udotea tenuifoli	-	X	-	-	-	X	-	-	-	-	-	-	-
Udotea velutina	-	X	-	-	-	X	-	-	-	-	-	-	-
Udotea xishaensi	-	X	-	-	-	X	-	-	-	-	-	-	-
Ulothrix flaccid	-	-	X	-	-	-	-	-	-	-	X	-	-
Ulothrix subflac	-	X	X	-	-	-	X	-	-	-	-	-	X
Ulva angusta	-	-	X	-	-	-	-	-	-	-	X	-	-
Ulva conglobata	X	X	X	X	-	-	-	X	-	-	X	-	-
Ulva fasciata	-	X	X	X	-	-	X	-	-	-	X	X	X
Ulva japonica	-	-	X	-	-	-	-	-	-	-	X	-	-
Ulva lactuca	-	X	X	X	-	-	X	X	-	X	X	X	X
Ulva latissima	-	X	X	-	-	-	-	X	-	-	-	X	-
Ulva papenfussii	-	X	-	-	-	-	X	-	-	-	-	-	-
Ulva pertusa	-	X	X	-	-	-	-	X	-	-	X	X	-
Ulva reticulata	-	X	X	X	X	X	X	X	-	-	X	X	X
Ulva rigida	-	-	X	-	-	-	-	-	-	-	X	X	X
Ulva sp	-	-	X	-	-	-	-	-	-	-	X	X	-
Ulva sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Ulvaria oxysperm	-	-	X	-	-	-	-	-	-	-	-	-	X
Ulvella lens	-	X	-	-	-	-	X	-	-	-	-	-	-
Valonia aegagrop	X	X	X	-	-	-	X	-	X	-	X	X	X
Valonia confervo	-	-	X	-	-	-	-	-	-	X	-	X	-
Valonia fastigia	-	X	X	-	-	-	X	-	-	-	X	X	X
Valonia macrophy	-	-	X	-	-	-	-	-	-	-	-	X	X
Valonia ragtigia	-	X	-	-	-	-	-	X	-	-	-	-	-
Valonia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Valonia utricula	-	X	X	-	-	-	X	X	-	X	X	X	-
Valonia ventrico	X	X	X	-	-	-	X	X	-	-	-	X	X
Valonia verticil	-	-	X	-	-	-	-	-	-	-	X	-	-
Valoniopsis pach	X	X	X	-	X	X	X	X	-	-	X	X	X

Table C.2. Comparison of field with publication records (Phaeophyta) from the warm water western Pacific.

	Summary			*South ChinaSea*							*WWWP*			
Brown	FLD	SCS	WP	HK	HN	XS	VN	Mly	QW	LZ	Ryu	TW	Phil	Aust
Bachelotia antil	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Bellotia eriopho	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Carpomitra scopa	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Caulocystis uvif	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Chilionema ocell	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Chlanidophora re	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Chnoospora imple	-	-	X	-	-	-	-	-	-	-	-	X	X	X
Chnoospora minim	-	X	X	-	-	-	-	X	-	-	-	X	X	X
Chnoospora panno	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Cladostephus ver	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Colpomenia pereg	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Colpomenia sinou	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Colpomenia sinuo	-	-	X	-	-	-	-	-	-	-	-	X	X	X
Colpomenia sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Cutleria adspers	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Cutleria cylindr	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Cutleria sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Cylindrocarpus r	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Cystoseira hakod	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Cystoseira proli	-	X	X	-	-	-	-	X	-	-	-	X	-	-
Cystoseira sp	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Cystoseira trino	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyopteris acr	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyopteris aus	X	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyopteris cam	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyopteris cra	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyopteris del	-	X	X	-	-	-	X	-	-	-	-	X	X	X
Dictyopteris div	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyopteris jam	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyopteris lat	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Dictyopteris mem	X	X	-	-	-	-	X	-	-	-	-	-	-	-
Dictyopteris muę	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyopteris pla	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyopteris pol	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyopteris rep	X	X	X	-	-	-	-	-	-	-	-	X	X	X
Dictyopteris sp	-	X	X	-	-	-	-	X	-	-	-	-	X	-
Dictyopteris und	-	X	X	-	-	-	-	-	-	-	-	X	X	-
Dictyopteris woo	-	X	X	-	-	-	X	-	-	-	-	-	-	X
Dictyota acutilo	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyota adnata	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyota alterni	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyota apicula	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Dictyota atomari	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Dictyota bartayr	X	X	X	-	-	-	X	X	-	-	-	X	X	X
Dictyota beaccar	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Dictyota beccari	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Dictyota bidenta	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyota bifurca	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyota cervico	X	X	X	-	X	X	-	-	-	-	-	X	X	-
Dictyota ceylani	-	X	X	-	-	-	X	-	-	-	-	X	X	-
Dictyota ciliola	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Dictyota dentata	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Dictyota dichoto	X	X	X	-	-	-	X	X	-	-	X	X	X	X
Dictyota dilata	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Dictyota divaric	-	X	X	-	-	-	X	-	-	-	-	X	X	X
Dictyota friabil	-	X	X	-	X	X	X	-	-	-	-	-	X	-
Dictyota furcell	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyota hamifer	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Dictyota indica	-	X	X	-	-	-	X	X	-	-	-	-	X	X

	Summary			*South ChinaSea*							*WWWP*			
Brown	FLD	SCS	WP	HK	HN	XS	VN	Mly	QW	LZ	Ryu	TW	Phil	Aust
Dictyota lata	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Dictyota lineari	X	X	X	-	X	-	-	X	-	X	-	X	X	-
Dictyota major	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyota mertens	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyota pardali	-	X	X	-	-	-	-	X	-	-	-	-	-	X
Dictyota patens	-	X	X	X	-	-	X	-	-	-	-	X	X	-
Dictyota prolife	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyota sandwic	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyota sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Dictyota sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Dictyota spinulo	-	-	X	-	-	-	-	-	-	-	X	X	-	-
Dictyota submari	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Dictyota volubil	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dictyotopsis pro	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dilophus fastigi	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dilophus interme	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dilophus margina	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Dilophus okamura	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Dilophus radican	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Distromium didym	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Durvillaea potat	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Ecklonia radiata	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Ectocarpus brevi	-	X	X	-	-	-	X	-	-	-	-	X	-	X
Ectocarpus confe	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Ectocarpus elach	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Ectocarpus formo	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Ectocarpus indic	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Ectocarpus irreg	-	X	X	-	-	-	X	-	-	-	-	-	X	-
Ectocarpus laure	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Ectocarpus mitch	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Ectocarpus rhodo	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Ectocarpus silic	-	X	X	X	-	-	-	-	-	-	-	-	-	X
Ectocarpus sp	-	X	X	-	-	-	-	X	-	-	-	X	X	-
Ectocarpus sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Ectocarpus spino	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Ectocarpus tamar	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Ectocarpus vanbo	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Ectocarpus varia	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Ectocarpus vungt	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Endarachne bingh	-	-	X	-	-	-	-	-	-	-	-	X	-	X
Eudesne harveyan	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Feldmannia brevi	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Feldmannia colum	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Feldmannia elach	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Feldmannia enhal	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Feldmannia filif	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Feldmannia formo	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Feldmannia globi	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Feldmannia indic	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Feldmannia irreg	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Feldmannia sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Fucus fungiformi	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Fucus vesiculosu	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Giffordia irregu	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Giffordia mitche	-	X	X	-	-	-	X	-	-	-	-	X	-	X
Giffordia sordid	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Giffordia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Glossophora kunt	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Glossophora nigr	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Haliseris polypo	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Haliseris sp.	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Halopteris graci	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Hincksia breviar	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Hincksia mitchel	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Hincksia rallsia	-	-	X	-	-	-	-	-	-	-	-	-	X	-

	Summary			*South ChinaSea*						*WWWP*				
Brown	FLD	SCS	WP	HK	HN	XS	VN	Mly	QW	LZ	Ryu	TW	Phil	Aust
Hizikia fusiform	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Homeostrichus mu	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Hormophysa artic	-	X	-	-	X	X	X	-	-	-	-	-	-	-
Hormophysa cunei	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Hormophysa sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Hormophysa triqu	-	X	X	-	-	-	-	X	-	-	-	X	-	X
Hormosira articu	-	X	-	-	X	X	-	-	-	-	-	-	-	-
Hormosira banksi	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Hydroclathrus ca	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Hydroclathrus cl	-	-	X	-	-	-	-	-	-	-	-	X	X	X
Hydroclathrus sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Ishige foliacea	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Ishige okamurae	-	X	X	X	-	-	-	-	-	-	-	X	-	-
Ishige sinicola	-	X	X	-	-	-	-	-	-	-	-	X	-	-
Leathesia diffor	-	X	X	X	-	-	-	-	-	-	-	X	X	-
Lobophora sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobophora varieg	-	X	X	X	X	X	X	-	-	-	-	X	X	X
Macrocystis angu	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Mesopora schmidt	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Mesospora schmid	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Myagropsis myagr	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Myrionema strang	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Nemacystus decip	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Pachydictyon aeg	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Pachydictyon cor	-	X	X	X	-	-	-	-	-	-	-	X	-	-
Pachydictyon sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Padina arboresce	-	X	X	X	-	-	-	-	-	-	-	X	X	-
Padina australis	X	X	X	X	-	-	X	-	-	-	-	X	X	X
Padina boergesen	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Padina boryana	-	X	X	-	-	-	X	-	-	-	-	X	X	-
Padina commerson	X	X	-	-	-	-	X	X	-	-	-	-	-	-
Padina crassa	-	X	X	X	-	-	-	-	-	-	-	-	X	X
Padina distromat	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Padina durvillae	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Padina durvillei	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Padina fraseri	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Padina gymnospor	-	X	X	-	-	-	X	X	-	-	-	-	X	-
Padina japonica	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Padina jonesii	-	X	-	-	-	X	-	-	-	-	-	-	-	-
Padina minor	X	X	X	-	-	-	-	-	-	-	-	X	X	-
Padina pavonia	-	-	-	-	-	-	-	-	-	X	-	-	-	X
Padina pavonica	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Padina sanctae-c	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Padina sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Padina sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Padina tenuis	-	X	-	-	-	-	-	X	-	X	-	X	-	X
Padina tetrastro	-	X	X	X	X	-	-	X	-	-	-	-	X	X
Perithalia cauda	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Petalonia fascia	-	-	X	-	-	-	-	-	-	-	-	X	-	X
Petroderma vietn	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Pockockiella pap	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Pocockiella vari	-	X	-	-	-	-	X	-	-	X	-	-	-	-
Punctaria sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Pylaiella littor	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Ralfsia expansa	-	X	X	-	-	-	X	-	-	-	-	-	-	X
Ralfsia sp	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Ralfsia sp.	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Rosenvingea intr	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Rosenvingea orie	-	-	X	-	-	-	-	-	-	-	-	X	X	X
Sargassum acicul	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum acinar	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum aemulu	-	X	X	X	-	-	X	-	-	-	-	-	X	X
Sargassum agardh	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum amabil	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Sargassum amalla	-	-	X	-	-	-	-	-	-	-	-	-	-	X

	Summary			*South ChinaSea*							*WWWP*			
Brown	FLD	SCS	WP	HK	HN	XS	VN	Mly	QW	LZ	Ryu	TW	Phil	Aust
Sargassum angust	-	X	X	X	X	-	-	-	-	X	-	-	-	X
Sargassum aquifo	-	-	X	-	-	-	-	-	-	-	-	X	-	X
Sargassum armatu	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum assimi	-	X	X	X	-	-	X	-	-	-	X	-	-	-
Sargassum baccif	-	X	X	-	-	-	X	-	-	-	-	-	-	X
Sargassum baccul	-	X	X	-	-	-	X	-	-	-	-	X	X	X
Sargassum belang	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum berber	-	-	X	-	-	-	-	-	-	-	-	X	X	X
Sargassum bicorn	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum biform	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum binder	-	X	X	-	-	-	X	X	-	-	-	X	-	-
Sargassum biserr	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum brachy	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum brevif	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum carpop	X	X	X	X	X	-	X	-	-	X	-	X	-	X
Sargassum cervic	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Sargassum cinctu	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Sargassum cinere	-	X	X	X	-	-	-	X	-	X	-	-	-	X
Sargassum clavif	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum confus	-	X	X	-	-	-	X	-	-	-	-	-	X	-
Sargassum congki	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum coriif	X	-	X	-	-	-	-	-	-	-	-	X	-	X
Sargassum crassi	-	X	X	-	-	-	X	X	-	-	-	X	-	X
Sargassum crispi	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Sargassum crista	-	X	X	-	-	-	X	X	-	-	X	X	X	X
Sargassum cystoc	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Sargassum cystop	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum dasyph	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum decurr	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum desvau	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum droser	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum duplic	-	X	X	-	X	X	X	X	-	-	-	X	X	-
Sargassum echino	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Sargassum elonga	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum emargi	-	X	-	-	-	X	-	-	-	-	-	-	-	-
Sargassum enerve	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Sargassum esperi	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum fallax	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum feldma	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum filici	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum filifo	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Sargassum filipe	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Sargassum fissif	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum flavic	-	X	X	-	-	-	X	-	-	-	-	-	-	X
Sargassum fluita	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum fragil	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum fulvel	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Sargassum furcat	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum fusifo	X	X	-	X	-	-	-	-	-	-	-	-	-	-
Sargassum gaudic	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum gigant	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum glauce	X	X	X	X	X	X	X	-	-	-	-	X	-	-
Sargassum godeff	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum gracil	X	X	X	-	X	X	X	-	-	-	-	-	X	X
Sargassum gramin	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Sargassum granul	-	X	X	-	-	-	-	X	-	-	-	-	X	X
Sargassum grevil	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Sargassum hemiph	X	X	X	X	-	-	X	-	-	-	-	X	X	-
Sargassum henslo	X	X	X	X	-	-	X	-	-	-	-	X	-	-
Sargassum herkla	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Sargassum herklo	-	X	-	X	X	-	-	-	-	X	-	-	-	-
Sargassum hetero	-	X	X	-	-	-	X	-	-	-	-	X	X	-
Sargassum hombro	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum horner	X	X	X	X	-	-	X	-	-	-	-	X	-	-
Sargassum howean	-	-	X	-	-	-	-	-	-	-	-	-	-	X

	Summary			*South China Sea*						*WWWP*				
Brown	FLD	SCS	WP	HK	HN	XS	VN	Mly	QW	LZ	Ryu	TW	Phi	Aus
Sargassum ilicif	X	X	X	-	X	X	X	X	-	-	-	X	X	X
Sargassum incanu	-	X	-	X	-	-	-	-	-	X	-	-	-	-
Sargassum kasyot	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Sargassum kjellm	-	X	-	X	-	-	X	-	-	-	-	-	-	-
Sargassum kuetzi	X	X	X	X	-	-	X	-	-	-	-	X	-	-
Sargassum kushim	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Sargassum lanceo	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum latifo	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Sargassum laxifo	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Sargassum leptop	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum linear	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum longif	X	X	-	-	-	-	-	-	-	X	-	-	-	-
Sargassum lophoc	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum maclur	-	X	-	X	X	-	X	-	-	X	-	-	-	-
Sargassum macrop	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum mangar	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum merrif	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum microc	-	X	X	-	-	-	X	-	-	-	-	-	X	X
Sargassum microp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum miyabe	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum myrioc	X	X	X	-	-	-	-	X	-	-	-	X	X	X
Sargassum natans	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum nigrif	X	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum nippon	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum nozhou	-	X	-	-	-	-	-	-	-	X	-	-	-	-
Sargassum oligoc	-	X	X	X	X	-	-	-	-	X	-	-	X	X
Sargassum oocyst	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum opacum	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum panicu	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum parvif	-	X	X	-	-	-	X	-	-	-	-	-	X	X
Sargassum parviv	-	X	-	-	-	X	-	-	-	-	-	-	-	-
Sargassum patens	-	X	X	X	-	-	-	-	-	-	-	-	X	-
Sargassum peroni	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum philip	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum phyllo	-	X	-	X	-	X	-	-	-	-	-	-	-	-
Sargassum piluli	-	X	X	-	-	-	X	-	-	-	-	-	X	-
Sargassum pinati	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Sargassum plagio	X	-	X	-	-	-	-	-	-	-	-	X	-	X
Sargassum polyce	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum polycy	X	X	X	-	X	X	X	X	-	-	X	X	X	X
Sargassum pterop	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum rostra	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Sargassum sagami	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum sandei	-	X	X	-	-	-	X	X	-	-	-	X	X	-
Sargassum serrat	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Sargassum siliqu	-	X	X	X	-	-	-	X	-	-	X	X	X	X
Sargassum sp	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Sargassum sp.	X	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum spinif	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Sargassum spinul	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum stenop	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum subspa	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sargassum subtil	-	X	-	-	-	X	-	-	-	-	-	-	-	-
Sargassum swartz	X	X	X	X	-	-	X	-	-	-	-	X	-	X
Sargassum teleph	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Sargassum teneri	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Sargassum tenerr	X	X	X	X	X	-	X	-	-	X	-	-	X	-
Sargassum tenue	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Sargassum tenuif	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Sargassum thunbe	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Sargassum tortil	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sargassum torvum	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sargassum tosaen	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Sargassum turbin	-	X	-	-	-	X	X	-	-	-	-	-	-	-
Sargassum vachel	-	X	-	X	-	-	-	-	-	X	-	-	-	-

	Summary			*South China Sea*							*WWWP*			
Brown	FLD	SCS	WP	HK	HN	XS	VN	Mly	QW	LZ	Ryu	TW	Phi	Aus
Sargassum vauchi	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Sargassum virgat	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Sargassum vulgar	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Sargassum wighti	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Sargassum xishae	-	X	-	-	-	X	-	-	-	-	-	-	-	-
Sargassum yendoi	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Scytosiphon lome	-	-	X	-	-	-	-	-	-	-	-	X	-	X
Spatoglossum asp	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Spatoglossum dic	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Spatoglossum mac	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Spatoglossum pac	X	X	X	X	-	-	-	-	-	-	-	X	-	-
Spatoglossum shr	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Spatoglossum sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Spatoglossum var	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Spatoglossum vie	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sphacelaria bira	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sphacelaria ceyl	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Sphacelaria diva	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Sphacelaria furc	-	X	X	-	-	-	X	X	-	-	-	X	-	-
Sphacelaria fusc	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Sphacelaria muci	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sphacelaria nova	-	X	X	-	-	-	X	-	-	-	-	-	X	X
Sphacelaria rigi	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Sphacelaria sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Sphacelaria sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Sphacelaria trib	-	X	X	-	-	-	X	-	-	-	-	X	X	X
Sporochnus comos	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Stilophora rhizo	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Stypopodium aust	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Stypopodium flab	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Stypopodium loba	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Stypopodium zona	-	X	X	-	-	-	X	-	-	-	-	-	-	X
Taonia australas	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Tomaculopsis her	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Turbinaria conde	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Turbinaria conoi	-	X	X	-	X	X	X	X	-	-	-	X	X	X
Turbinaria decur	-	X	X	-	-	-	X	-	-	-	-	-	X	X
Turbinaria denud	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Turbinaria filam	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Turbinaria graci	-	X	-	-	-	-	X	-	-	-	-	-	-	-
Turbinaria luzon	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Turbinaria murra	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Turbinaria ornat	X	X	X	-	X	X	X	X	-	-	X	X	X	X
Turbinaria parvi	-	X	-	-	-	X	-	-	-	-	-	-	-	-
Turbinaria sp	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Turbinaria sp.	-	X	-	-	X	X	X	-	-	-	-	-	-	-
Turbinaria trial	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Turbinaria turbi	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Turbinaria vulga	-	-	X	-	-	-	-	-	-	-	-	-	X	-
Zonaria coriacea	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Zonaria crenata	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Zonaria diesingi	-	X	X	-	-	-	-	-	-	-	-	X	X	X
Zonaria flabella	-	-	X	-	-	-	-	-	-	-	-	X	X	-
Zonaria harveyan	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Zonaria nigresce	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Zonaria sp	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Zonaria sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Zonaria stipitat	-	X	X	-	-	-	X	-	-	-	-	X	-	-
binghamiae	-													
bullosa	-													
clathratus	X													
implexa	X													
intricata	-													
lomentarius	-													
minima	-													

	Summary			*South China Sea*							*WWWP*			
Brown	FLD	SCS	WP	HK	HN	XS	VN	Mly	QW	LZ	Ryu	TW	Phi	Aus
nhatrangense	-	X	-	-	-	-	X	-	-	-	-	-	-	-
orientalis	X	X	X	-	X	-	X	-	X	X	-	X	-	-
pacifica	-	X	-	-	-	-	X	-	-	-	-	-	-	-
sinuosa	X	X	X	X	-	-	X	-	-	-	-	X	-	-
sp.	X	-	-	-	-	-	-	-	-	-	-	-	-	-
tenuis	-	X	-	-	-	X	-	-	-	-	-	-	-	-

Table C.3. Comparison of field with publication records (Rhodophyta) from the warm water western Pacific.

Red	*Summary* FLD	SCS	WP	*South China Sea* HK	HN	XS	VN	Mly	LZ	*WWWP* Ryu	TW	Phil	Aust
Acanthophora aok	-	-	X	-	-	-	-	-	-	-	X	X	-
Acanthophora den	-	-	X	-	-	-	-	-	-	-	-	-	X
Acanthophora mus	X	X	X	-	-	-	-	-	-	-	X	X	X
Acanthophora ori	X	X	X	-	-	-	-	X	X	-	X	-	-
Acanthophora sp	-	X	-	-	-	-	-	X	-	-	-	-	-
Acanthophora spi	-	X	X	X	X	-	X	X	-	-	X	X	X
Acrochaetium arc	-	X	-	X	-	-	-	-	-	-	-	-	-
Acrochaetium cat	-	X	-	-	-	-	X	-	-	-	-	-	-
Acrochaetium col	-	X	-	-	-	-	X	-	-	-	-	-	-
Acrochaetium cra	-	X	-	X	-	-	X	-	-	-	-	-	-
Acrochaetium eff	-	-	X	-	-	-	-	-	-	-	-	-	X
Acrochaetium gra	-	X	X	-	-	-	X	-	-	-	-	X	-
Acrochaetium han	-	-	X	-	-	-	-	-	-	-	-	X	-
Acrochaetium nit	-	-	X	-	-	-	-	-	-	-	-	X	-
Acrochaetium occ	-	X	-	-	-	-	X	-	-	-	-	-	-
Acrochaetium pap	-	-	X	-	-	-	-	-	-	-	-	X	-
Acrochaetium phu	-	X	-	-	-	-	X	-	-	-	-	-	-
Acrochaetium pse	-	X	-	-	-	-	X	-	-	-	-	-	-
Acrochaetium pul	-	X	X	-	-	-	X	-	-	-	-	-	X
Acrochaetium rob	-	X	X	X	-	-	X	-	-	-	-	X	-
Acrochaetium san	-	X	-	-	-	-	X	-	-	-	-	-	-
Acrochaetium sar	-	-	X	-	-	-	-	-	-	-	-	X	-
Acrochaetium ser	-	X	X	-	-	-	X	-	-	-	-	X	-
Acrochaetium sin	-	-	X	-	-	-	-	-	-	-	-	X	-
Acrochaetium sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Acrochaetium sub	-	X	X	-	-	-	X	-	-	-	-	-	X
Acrochaetium tri	-	-	X	-	-	-	-	-	-	-	-	X	-
Acrochaetium vir	-	X	-	-	-	-	X	-	-	-	-	-	-
Acrocystis nana	-	X	X	-	X	X	X	-	-	-	X	X	X
Acrosorium sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Acrosorium uncin	-	-	X	-	-	-	-	-	-	-	-	-	X
Acrosorium yendo	-	X	-	X	-	-	-	-	-	-	-	-	-
Acrosymphyton ta	-	-	X	-	-	-	-	-	-	-	-	-	X
Actinotrichia fr	-	X	X	X	X	X	X	-	-	-	X	X	X
Actinotrichia ri	X	-	X	-	-	-	-	-	-	X	-	-	-
Actinotrichia ro	-	-	X	-	-	-	-	-	-	X	-	-	-
Agardhiella sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Agardhiella tene	-	X	-	-	-	-	-	X	-	-	-	-	-
Aglaothamnion co	-	-	X	-	-	-	-	-	-	-	-	-	X
Ahnfeltia concin	-	-	X	-	-	-	-	-	-	-	-	X	-
Ahnfeltia furcel	-	X	X	-	-	-	-	-	-	-	-	X	-
Ahnfeltia parado	-	-	X	-	-	-	-	-	-	-	X	-	-
Ahnfeltia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Alsidium pusillu	-	-	X	-	-	-	-	-	-	-	-	X	-
Amansia daemelii	-	-	X	-	-	-	-	-	-	-	-	-	X
Amansia dietrich	-	-	X	-	-	-	-	-	-	-	-	-	X
Amansia glomerat	-	X	X	-	X	X	X	-	-	X	X	X	X
Amansia pumila	-	-	X	-	-	-	-	-	-	-	-	-	X
Amansia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Amphiroa anastom	-	X	X	-	X	-	-	-	-	-	-	X	X
Amphiroa anceps	-	-	X	-	-	-	-	-	-	-	-	X	X
Amphiroa annulat	-	-	X	-	-	-	-	-	-	-	-	X	-
Amphiroa beauvoi	-	-	X	-	-	-	-	-	-	-	X	X	-
Amphiroa bowerba	-	-	X	-	-	-	-	-	-	-	X	-	-
Amphiroa crassa	-	-	X	-	-	-	-	-	-	-	-	-	X
Amphiroa cumingi	-	-	X	-	-	-	-	-	-	-	-	X	-
Amphiroa dilatat	X	X	-	-	-	-	X	-	-	-	-	-	-
Amphiroa ephedra	-	X	X	X	-	-	-	-	-	-	X	X	-
Amphiroa foliace	X	X	X	-	-	-	X	-	-	-	X	X	X

	Summary			*South China Sea*				*WWWP*					
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Amphiroa fragili	X	X	X	-	X	X	X	-	-	-	X	X	-
Amphiroa fragill	-	X	X	-	-	-	-	X	-	-	-	-	X
Amphiroa gracili	-	-	X	-	-	-	-	-	-	-	-	-	X
Amphiroa hancock	-	-	X	-	-	-	-	-	-	-	-	X	-
Amphiroa howensi	-	-	X	-	-	-	-	-	-	-	-	-	X
Amphiroa multifi	-	-	X	-	-	-	-	-	-	-	X	-	-
Amphiroa pacific	-	-	X	-	-	-	-	-	-	-	-	X	-
Amphiroa pusilla	-	-	X	-	-	-	-	-	-	-	X	-	-
Amphiroa rigida	-	-	X	-	-	-	-	-	-	-	-	X	-
Amphiroa sp.	X	X	X	X	-	-	-	X	-	-	X	X	-
Amphiroa subcyli	-	-	X	-	-	-	-	-	-	-	X	X	-
Amphiroa tribulu	-	-	X	-	-	-	-	-	-	-	-	X	-
Amphiroa valonio	-	X	X	X	-	-	-	-	-	-	-	X	-
Amphiroa zonata	X	-	X	-	-	-	-	-	-	-	-	X	-
Anotrichium tenu	-	X	X	-	X	X	-	-	-	-	-	X	X
Antithamnion ant	-	-	X	-	-	-	-	-	-	-	-	X	X
Antithamnion bas	-	X	-	-	-	-	X	-	-	-	-	-	-
Antithamnion lhe	-	-	X	-	-	-	-	-	-	-	-	X	X
Antithamnion neg	-	X	-	-	-	-	X	-	-	-	-	-	-
Antithamnion per	-	-	X	-	-	-	-	-	-	-	-	-	X
Antithamnion sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Antithamnion sp.	-	X	X	-	-	-	X	-	-	-	-	-	-
Antithamnion spi	-	X	-	-	-	-	X	-	-	-	-	-	-
Antrocentrum nig	-	-	X	-	-	-	-	-	-	-	-	-	X
Archaeolithotham	-	-	X	-	-	-	-	-	-	-	-	X	-
Areschougia cong	-	-	X	-	-	-	-	-	-	-	-	-	X
Asparagopsis arm	-	-	X	-	-	-	-	-	-	-	-	-	X
Asparagopsis san	-	X	X	X	-	-	-	-	-	X	-	-	-
Asparagopsis tax	X	X	X	X	-	-	X	-	X	-	X	X	X
Asterocystis orn	-	X	-	X	-	-	X	-	-	-	-	-	-
Asterocytis sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Audouinella dasy	-	-	X	-	-	-	-	-	-	-	-	-	X
Audouinella davi	-	-	X	-	-	-	-	-	-	-	-	-	X
Audouinella euge	-	-	X	-	-	-	-	-	-	-	-	-	X
Audouinella micr	-	-	X	-	-	-	-	-	-	-	-	-	X
Audouinella sapi	-	-	X	-	-	-	-	-	-	-	-	-	X
Audouinella secu	-	-	X	-	-	-	-	-	-	-	-	-	X
Balliella amphig	-	-	X	-	-	-	-	-	-	-	-	-	X
Balliella grandi	-	-	X	-	-	-	-	-	-	-	-	-	X
Balliella repens	-	-	X	-	-	-	-	-	-	-	-	-	X
Balliella subcor	-	-	X	-	-	-	-	-	-	-	-	X	-
Bangia atropurpu	-	-	X	-	-	-	-	-	-	-	X	X	X
Bangia breviarti	-	X	-	X	-	-	-	-	-	-	-	-	-
Bangia fuscopurp	-	X	-	X	-	-	X	-	-	-	-	-	-
Bangia simplex	-	-	X	-	-	-	-	-	-	-	-	-	X
Bangia sp	-	-	X	-	-	-	-	-	-	-	X	-	-
Bangia tanakai	-	X	-	-	-	-	X	-	-	-	-	-	-
Bangia yamadae	-	-	X	-	-	-	-	-	-	-	X	X	-
Bangiopsis humph	-	X	-	-	-	-	X	-	-	-	-	-	-
Beckerella scala	-	-	X	-	-	-	-	-	-	-	-	X	-
Bertholdia japon	-	X	-	-	-	-	X	-	-	-	-	-	-
Bostrychia binde	-	X	X	X	X	-	X	-	-	-	-	X	X
Bostrychia calli	-	-	X	-	-	-	-	-	-	-	-	X	-
Bostrychia flage	-	-	X	-	-	-	-	-	-	-	-	-	X
Bostrychia hongk	-	X	X	X	-	-	-	-	-	-	-	-	X
Bostrychia intri	-	X	X	X	-	-	-	-	-	-	-	X	X
Bostrychia kelan	-	X	X	X	-	-	-	-	-	-	-	X	X
Bostrychia morit	-	-	X	-	-	-	-	-	-	-	-	X	X
Bostrychia radic	-	X	X	X	-	-	X	-	-	-	-	X	X
Bostrychia simpl	-	X	X	X	-	-	-	-	-	-	-	X	X
Bostrychia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Bostrychia tenel	-	X	X	X	X	-	X	-	-	-	X	X	X
Botryocarpa prol	-	-	X	-	-	-	-	-	-	-	-	X	-
Botryocladia bot	-	-	X	-	-	-	-	-	-	-	-	X	-
Botryocladia kuc	-	-	X	-	-	-	-	-	-	-	-	X	-

Red	*Summary* FLD	SCS	WP	*South China Sea* HK	HN	XS	VN	Mly	LZ	*WWWP* Ryu	TW	Phil	Aust
Botryocladia lep	-	X	X	-	-	-	X	-	-	-	-	-	X
Botryocladia pyr	-	-	X	-	-	-	-	-	-	-	-	X	-
Botryocladia sko	-	X	-	-	-	X	-	-	-	-	-	-	-
Botryocladia uva	-	-	X	-	-	-	-	-	-	-	-	X	-
Bryocladia cervi	-	X	-	-	-	-	X	-	-	-	-	-	-
Calliarthron sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Callithamnion by	-	-	X	-	-	-	-	-	-	-	-	-	X
Callithamnion co	-	-	X	-	-	-	-	-	-	-	-	-	X
Callithamnion sp	-	X	X	-	-	-	X	-	-	-	-	X	-
Callophycus serr	-	-	X	-	-	-	-	-	-	-	-	X	-
Callophycus trid	-	-	X	-	-	-	-	-	-	-	-	-	X
Callophyllis adh	-	-	X	-	-	-	-	-	-	-	-	X	-
Callophyllis adn	-	-	X	-	-	-	-	-	-	-	-	X	-
Callophyllis oka	-	-	X	-	-	-	-	-	-	-	-	X	-
Callophyllis sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Callothamnion sp	X	-	-	-	-	-	-	-	-	-	-	-	-
Calòglossa adnat	-	X	X	-	-	-	X	X	-	-	-	X	X
Caloglossa bomba	-	-	X	-	-	-	-	-	-	-	X	-	X
Caloglossa lepri	-	X	X	X	-	-	X	-	-	-	-	X	X
Caloglossa ogasa	-	X	X	X	-	-	X	-	-	-	-	X	X
Caloglossa saigo	-	X	-	-	-	-	X	-	-	-	-	-	-
Caloglossa sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Caloglossa stipi	-	X	-	-	-	-	X	-	-	-	-	-	-
Campylaephora cr	-	X	-	X	-	-	-	-	-	-	-	-	-
Carpoblepharis s	-	-	X	-	-	-	-	-	-	-	X	-	-
Carpoblepharis w	-	-	X	-	-	-	-	-	-	-	X	-	-
Carpopeltis affi	-	-	X	-	-	-	-	-	-	-	-	X	-
Carpopeltis angu	-	-	X	-	-	-	-	-	-	-	X	X	-
Carpopeltis arti	-	-	X	-	-	-	-	-	-	-	-	X	-
Carpopeltis capi	-	-	X	-	-	-	-	-	-	-	-	X	X
Carpopeltis corn	-	-	X	-	-	-	-	-	-	-	X	-	-
Carpopeltis cris	-	-	X	-	-	-	-	-	-	-	-	X	-
Carpopeltis diva	-	-	X	-	-	-	-	-	-	-	-	X	-
Carpopeltis flab	-	-	X	-	-	-	-	-	-	-	X	X	-
Carpopeltis form	-	X	X	-	-	-	X	-	-	-	X	X	-
Carpopeltis mail	-	-	X	-	-	-	-	-	-	-	X	X	-
Carpopeltis phyl	-	-	X	-	-	-	-	-	-	-	-	-	X
Carpopeltis rigi	-	-	X	-	-	-	-	-	-	X	X	-	-
Carpopeltis sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Carpopeltis sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Catanella nipae	-	-	X	-	-	-	-	-	-	-	-	-	X
Catanella subumb	-	-	X	-	-	-	-	-	-	-	-	-	X
Catenella caespi	-	-	X	-	-	-	-	-	-	-	-	X	-
Catenella impudi	-	X	X	X	-	-	X	-	-	-	-	X	-
Catenella nipae	-	X	X	X	-	-	X	X	-	-	-	X	-
Catenella sp.	X	-	-	-	-		-	-	-	-	-	-	-
Catenella subumb	-	X	-	X	-	-	-	-	-	-	-	-	-
Caulacanthus hor	-	X	-	-	-	-	X	-	-	-	-	-	-
Caulacanthus ind	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulacanthus oka	-	X	X	X	-	-	-	-	-	-	X	-	X
Caulacanthus sal	-	-	X	-	-	-	-	-	-	-	-	-	X
Caulacanthus sp.	X	X	-	-	-	-	X	-	-	-	-	-	-
Caulacanthus spi	-	-	X	-	-	-	-	-	-	-	X	-	-
Caulacanthus ust	-	-	X	-	-	-	-	-	-	-	X	-	X
Centroceras apic	-	-	X	-	-	-	-	-	-	-	-	X	X
Centroceras clav	-	X	X	X	X	X	X	X	-	-	X	X	X
Centroceras iner	-	X	-	-	-	-	X	-	-	-	-	-	-
Centroceras mini	-	X	-	-	-	X	-	-	-	-	-	-	-
Centroceras minu	-	-	X	-	-	-	-	-	-	-	X	X	X
Centroceras sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Centroceras sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Ceramiella procu	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium aduncum	-	-	X	-	-	-	-	-	-	-	X	-	-
Ceramium affine	-	-	X	-	-	-	-	-	-	-	-	X	-

Red	*Summary*		*South China Sea*						*WWWP*				
	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Ceramium camouii	-	-	X	-	-	-	-	-	-	-	-	-	X
Ceramium ciliatu	-	-	X	-	-	-	-	-	-	-	X	-	-
Ceramium cingula	-	X	-	-	-	-	X	-	-	-	-	-	-
Ceramium clarion	-	X	X	-	-	-	X	-	-	-	-	-	X
Ceramium clifton	-	-	X	-	-	-	-	-	-	-	-	-	X
Ceramium codii	-	-	X	-	-	-	-	-	-	-	-	-	X
Ceramium cruciat	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium equiset	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium fastigi	-	X	-	-	-	-	X	-	-	-	-	-	-
Ceramium fimbria	-	X	-	-	-	-	X	-	-	-	-	-	-
Ceramium flaccid	-	-	X	-	-	-	-	-	-	-	X	X	X
Ceramium gracill	-	X	X	-	-	-	X	-	-	-	X	X	-
Ceramium howei	-	X	-	-	-	-	X	-	-	-	-	-	-
Ceramium huysman	-	X	X	-	-	-	X	-	-	-	-	-	X
Ceramium loureir	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium luetzel	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium marshal	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium maryae	-	X	X	-	-	-	X	-	-	-	-	X	X
Ceramium mazatla	-	X	X	-	-	-	X	-	-	-	-	X	X
Ceramium multiju	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium nakamur	-	-	X	-	-	-	-	-	-	-	X	-	-
Ceramium panicul	-	-	X	-	-	-	-	-	-	-	X	-	-
Ceramium persona	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium procumb	-	X	X	-	-	-	X	-	-	-	-	-	X
Ceramium punctif	-	-	X	-	-	-	-	-	-	-	-	-	X
Ceramium rubrum	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium serpens	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium setchel	-	-	X	-	-	-	-	-	-	-	-	-	X
Ceramium sinicol	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Ceramium sp.	X	X	-	-	-	-	X	-	-	-	-	-	-
Ceramium taylori	-	X	X	-	-	-	X	-	-	-	-	X	-
Ceramium tenerri	-	X	X	-	-	-	-	-	-	-	X	X	-
Ceramium tenuiss	-	X	X	-	-	X	-	-	-	-	X	X	X
Ceramium vagabun	-	-	X	-	-	-	-	-	-	-	-	-	X
Ceramium vagans	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceramium vietnam	-	X	-	-	-	-	X	-	-	-	-	-	-
Ceramium zacae	-	-	X	-	-	-	-	-	-	-	-	X	-
Ceratodictyon sp	X	X	X	X	-	-	X	X	X	-	X	X	X
Champia bifida	-	-	X	-	-	-	-	-	-	-	X	X	-
Champia caespito	-	-	X	-	-	-	-	-	-	-	-	X	-
Champia compress	-	-	X	-	-	-	-	-	-	-	-	X	-
Champia disticha	-	-	X	-	-	-	-	-	-	-	-	X	-
Champia japonica	-	-	X	-	-	-	-	-	-	-	-	X	-
Champia parvula	X	X	X	X	-	-	X	X	-	-	X	X	X
Champia salicorn	-	X	X	-	-	-	X	-	-	-	-	X	-
Champia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Champia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Champia spathula	-	-	X	-	-	-	-	-	-	-	-	X	-
Champia vieillar	-	X	X	-	-	-	X	-	-	-	-	-	X
Cheilosporum anc	-	-	X	-	-	-	-	-	-	-	X	-	-
Cheilosporum cul	-	-	X	-	-	-	-	-	-	-	-	X	-
Cheilosporum jun	X	X	X	-	X	-	-	-	-	-	X	X	-
Cheilosporum sag	-	-	X	-	-	-	-	-	-	-	-	X	X
Cheilosporum spe	-	X	X	-	-	-	X	-	-	-	-	-	X
Cheilosporum war	-	-	X	-	-	-	-	-	-	-	-	-	X
Chondria armata	X	X	X	-	X	-	-	X	-	-	X	X	X
Chondria baileya	-	X	-	-	-	-	X	-	-	-	-	-	-
Chondria crassic	-	X	X	-	-	-	-	-	-	-	-	X	-
Chondria curvili	-	-	X	-	-	-	-	-	-	-	-	X	-
Chondria dangear	-	X	X	-	-	-	X	-	-	-	-	-	X
Chondria dasyphy	-	-	X	-	-	-	-	-	-	-	X	X	X
Chondria haptero	-	X	-	X	-	-	-	-	-	-	-	-	-
Chondria lancifo	-	X	X	X	-	-	-	-	-	-	-	-	X
Chondria minutul	-	-	X	-	-	-	-	-	-	-	-	-	X

Red	*Summary* FLD	SCS	WP	*South China Sea* HK	HN	XS	VN	Mly	*WWWP* LZ	Ryu	TW	Phil	Aust
Chondria polyrhi	-	-	X	-	-	-	-	-	-	-	-	X	-
Chondria rainfor	-	-	X	-	-	-	-	-	-	-	-	-	X
Chondria repens	-	X	X	-	-	-	X	-	-	-	-	X	X
Chondria sedifol	-	-	X	-	-	-	-	-	-	-	-	X	-
Chondria seticul	-	-	X	-	-	-	-	-	-	-	-	X	-
Chondria sibogae	-	-	X	-	-	-	-	-	-	-	-	X	-
Chondria sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Chondria sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Chondrococcus ho	-	X	X	-	-	X	-	-	-	-	X	-	X
Chondrus crispus	-	-	X	-	-	-	-	-	-	-	X	-	-
Chondrus ocellat	-	-	X	-	-	-	-	-	-	-	X	-	-
Chondrus sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Chromastrum liag	-	-	X	-	-	-	-	-	-	-	-	X	-
Chromastrum tuti	-	-	X	-	-	-	-	-	-	-	-	X	-
Chroodactylon or	-	-	X	-	-	-	-	-	-	-	X	X	-
Chrysymenia kaer	-	-	X	-	-	-	-	-	-	-	-	-	X
Chrysymenia proc	-	-	X	-	-	-	-	-	-	-	X	-	-
Chrysymenia sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Claudea batanens	-	X	X	-	-	X	-	-	-	-	X	X	-
Claudea multifid	-	-	X	-	-	-	-	-	-	-	-	X	-
Coelarthrum boer	-	-	X	-	-	-	-	-	-	-	X	-	X
Coelarthrum coac	-	X	-	-	-	X	-	-	-	-	-	-	-
Coelothrix irreg	-	-	X	-	-	-	-	-	-	-	-	X	X
Coelothrix sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Conferva fastigi	-	-	X	-	-	-	-	-	-	-	-	X	-
Corallina fronde	-	-	X	-	-	-	-	-	-	-	-	X	-
Corallina granif	-	-	X	-	-	-	-	-	-	-	-	-	X
Corallina offici	X	-	X	-	-	-	-	-	-	-	-	-	X
Corallina piluli	-	X	-	X	-	-	-	-	-	-	-	-	-
Corallina sessil	-	X	-	X	-	-	-	-	-	-	-	-	-
Corallina sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Corallopsis cere	-	-	X	-	-	-	-	-	-	-	-	-	X
Corallopsis cras	-	X	-	-	-	-	X	-	-	-	-	-	-
Corallopsis sali	-	X	-	-	-	-	-	X	-	-	-	-	-
Corallopsis urvi	-	-	X	-	-	-	-	-	-	-	-	-	X
Coriophyllum set	-	-	X	-	-	-	-	-	-	-	-	-	X
Corynecladia umb	-	-	X	-	-	-	-	-	-	-	-	-	X
Corynomorpha pri	-	-	X	-	-	-	-	-	-	-	-	-	X
Cottoniella fila	-	-	X	-	-	-	-	-	-	-	-	X	-
Crouania attenua	-	-	X	-	-	-	-	-	-	-	-	X	-
Crouania caprico	-	-	X	-	-	-	-	-	-	-	-	-	X
Crouania minutis	-	-	X	-	-	-	-	-	-	-	-	X	-
Crouania sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Cruoriella armor	-	-	X	-	-	-	-	-	-	-	-	-	X
Cryptarachne oka	-	X	-	-	-	X	-	-	-	-	-	-	-
Cryptarachne pro	-	-	X	-	-	-	-	-	-	-	X	-	-
Cryptonemia bail	-	-	X	-	-	-	-	-	-	-	-	-	X
Cryptonemia cali	-	-	X	-	-	-	-	-	-	-	-	-	X
Cryptonemia cren	-	-	X	-	-	-	-	-	-	-	-	X	-
Cryptonemia luxu	-	-	X	-	-	-	-	-	-	-	-	X	-
Cryptonemia schm	-	-	X	-	-	-	-	-	-	-	-	X	-
Cryptonemia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Cryptonemia undo	-	-	X	-	-	-	-	-	-	-	-	-	X
Cryptopleura sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Cubiculosporum k	-	-	X	-	-	-	-	-	-	-	-	-	X
Cyrtymenia spars	-	X	-	X	-	-	-	-	-	-	-	-	-
Dasya adhaerens	-	-	X	-	-	-	-	-	-	-	-	X	-
Dasya baillouvia	-	-	X	-	-	-	-	-	-	-	-	X	X
Dasya caraibica	-	-	X	-	-	-	-	-	-	-	-	-	X
Dasya cuspidifer	-	-	X	-	-	-	-	-	-	-	-	-	X
Dasya elongata	-	-	X	-	-	-	-	-	-	-	-	-	X
Dasya fruticulos	-	-	X	-	-	-	-	-	-	-	-	-	X
Dasya iyengarii	-	-	X	-	-	-	-	-	-	-	-	-	X
Dasya mollis	-	-	X	-	-	-	-	-	-	-	-	X	-
Dasya ocellata	-	-	X	-	-	-	-	-	-	-	-	X	-

	Summary			*South China Sea*					*WWWP*				
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Dasya pacifica	-	-	X	-	-	-	-	-	-	-	-	-	X
Dasya pedicellat	-	X	-	-	-	-	X	-	-	-	-	-	-
Dasya pilosa	-	X	-	-	-	-	X	-	-	-	-	-	-
Dasya punicea	-	-	X	-	-	-	-	-	-	-	-	X	-
Dasya scoparia	-	X	-	-	-	-	-	-	-	-	-	-	-
Dasya sessilis	-	-	X	-	-	-	-	-	-	-	-	X	-
Dasya sp	-	-	X	-	-	-	-	-	-	-	X	-	-
Dasya sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Dasyclonium flac	-	-	X	-	-	-	-	-	-	-	-	-	X
Dasyopsis pilosa	-	X	-	-	-	-	X	-	-	-	-	-	-
Dasyphila plumar	-	-	X	-	-	-	-	-	-	-	X	X	-
Delesseria lepri	-	-	X	-	-	-	-	-	-	-	-	X	-
Delesseria sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Delisea fimbriat	-	-	X	-	-	-	-	-	-	-	X	-	X
Dermatolithon pu	-	X	X	-	-	-	X	-	-	-	-	-	X
Dermonema frappi	-	-	X	-	-	-	-	-	-	-	X	X	-
Dermonema gracil	-	-	X	-	-	-	-	-	-	-	X	-	-
Dermonema pulvin	-	-	X	-	-	-	-	-	-	-	X	-	-
Desmia hornemann	-	X	-	-	X	X	X	-	-	-	-	-	-
Desmia pulvinata	-	-	X	-	-	-	-	-	-	X	-	-	-
Dicranema rosali	-	-	X	-	-	-	-	-	-	-	-	-	X
Dicranema sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Dictymenia sonde	-	-	X	-	-	-	-	-	-	-	-	-	X
Dictymenia tride	-	-	X	-	-	-	-	-	-	-	-	-	X
Dictyurus purpur	-	-	X	-	-	-	-	-	-	-	X	-	X
Digenea simplex	-	-	X	-	-	-	-	-	-	-	X	X	X
Dotyophycus yama	-	-	X	-	-	-	-	-	-	-	X	-	-
Dudresnaya japon	-	-	X	-	-	-	-	-	-	-	X	-	-
Echinothamnion h	-	-	X	-	-	-	-	-	-	-	-	-	X
Enantiocladia ok	-	-	X	-	-	-	-	-	-	-	-	X	-
Enantiocladia ro	-	-	X	-	-	-	-	-	-	-	-	-	X
Endosiphonia cla	-	X	-	-	-	X	-	-	-	-	-	-	-
Endosiphonia spi	-	-	X	-	-	-	-	-	-	-	-	X	X
Epymenia cuneata	-	-	X	-	-	-	-	-	-	-	-	-	X
Erythrocladia ir	-	-	X	-	-	-	-	-	-	-	-	X	-
Erythrocladia pi	-	-	X	-	-	-	-	-	-	-	-	X	-
Erythroclonium m	-	-	X	-	-	-	-	-	-	-	-	-	X
Erythroclonium s	-	-	X	-	-	-	-	-	-	-	-	-	X
Erythrocolon pod	-	X	X	-	-	X	-	-	-	-	X	X	-
Erythrotrichia b	-	-	X	-	-	-	-	-	-	-	X	X	-
Erythrotrichia c	-	X	X	-	-	-	X	-	-	-	X	-	-
Erythrotrichia p	-	X	X	-	-	-	X	-	-	-	-	X	-
Erythrotrichia s	-	X	X	X	-	-	-	-	-	-	-	X	-
Eucheuma alvarez	-	-	X	-	-	-	-	-	-	-	-	X	-
Eucheuma amakusa	-	-	X	-	-	-	-	-	-	X	X	-	-
Eucheuma arnoldi	-	-	X	-	-	-	-	-	-	X	X	X	X
Eucheuma audioli	-	-	X	-	-	-	-	-	-	-	X	-	-
Eucheuma cervico	-	-	X	-	-	-	-	-	-	-	-	-	X
Eucheuma cottoni	-	-	X	-	-	-	-	-	-	-	X	X	-
Eucheuma crassum	-	-	X	-	-	-	-	-	-	-	X	X	X
Eucheuma crustae	-	-	X	-	-	-	-	-	-	-	X	X	-
Eucheuma cupress	-	X	-	-	-	-	-	X	-	-	-	-	-
Eucheuma deforma	-	-	X	-	-	-	-	-	-	-	-	-	X
Eucheuma denticu	-	X	X	-	-	-	-	X	-	-	-	X	X
Eucheuma edule	-	-	X	-	-	-	-	-	-	-	-	X	-
Eucheuma gelatin	-	X	X	-	X	-	-	-	-	X	X	X	X
Eucheuma horridu	-	X	X	-	-	-	-	X	-	-	-	X	-
Eucheuma isiform	-	-	X	-	-	-	-	-	-	-	-	X	-
Eucheuma leeuwen	-	-	X	-	-	-	-	-	-	-	-	X	-
Eucheuma muricat	-	X	X	-	-	-	-	X	-	-	X	X	-
Eucheuma okamura	-	-	X	-	-	-	-	-	-	-	X	X	-
Eucheuma papulos	-	-	X	-	-	-	-	-	-	-	X	-	-
Eucheuma procrus	-	-	X	-	-	-	-	-	-	-	-	X	-
Eucheuma serra	-	X	X	-	-	-	-	X	-	-	X	X	X
Eucheuma sonderi	-	-	X	-	-	-	-	-	-	-	-	-	X

Red	Summary			South China Sea					WWWP				
	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Eucheuma sp	-	X	X	-	-	-	-	X	-	-	X	X	-
Eucheuma sp.	-	X	-	-	X	X	-	-	-	-	-	-	-
Eucheuma specios	-	-	X	-	-	-	-	-	-	-	-	-	X
Eucheuma spinosu	-	X	-	-	-	-	-	X	-	-	-	-	-
Eucheuma striatu	-	-	X	-	-	-	-	-	-	-	-	X	-
Eupogodon antill	-	-	X	-	-	-	-	-	-	-	-	X	-
Eupogodon pilosu	-	-	X	-	-	-	-	-	-	-	-	X	-
Eupogodon sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Euptilota articu	-	-	X	-	-	-	-	-	-	-	-	-	X
Euptilota formos	-	-	X	-	-	-	-	-	-	-	-	-	X
Exophyllum wenti	-	X	X	-	-	-	X	-	-	-	-	X	-
Fauchea leptophy	-	-	X	-	-	-	-	-	-	-	-	X	-
Fauchea sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Fernandosiphonia	-	-	X	-	-	-	-	-	-	-	-	-	X
Fosliella farino	-	X	X	-	-	-	X	-	-	-	-	X	X
Fosliella lejoli	-	X	-	X	-	-	-	-	-	-	-	-	-
Galaxaura apicul	-	X	X	-	-	X	-	-	-	-	-	X	-
Galaxaura arbore	-	X	X	X	X	-	-	-	-	-	X	X	X
Galaxaura canali	-	-	X	-	-	-	-	-	-	-	X	-	-
Galaxaura clavig	-	X	X	-	-	-	X	-	-	-	X	-	-
Galaxaura contig	-	-	X	-	-	-	-	-	-	-	-	X	-
Galaxaura cylidr	-	X	-	-	-	-	-	X	-	-	-	-	-
Galaxaura disten	-	-	X	-	-	-	-	-	-	-	X	-	-
Galaxaura elegan	-	-	X	-	-	-	-	-	-	-	X	-	-
Galaxaura elonga	-	X	X	-	-	-	-	-	X	-	X	-	-
Galaxaura falcat	-	-	X	-	-	-	-	-	-	-	X	X	-
Galaxaura fascic	-	X	X	-	X	-	X	-	-	-	X	X	X
Galaxaura fastig	-	X	X	-	-	-	X	-	-	-	X	-	-
Galaxaura filame	-	X	X	-	-	X	X	-	-	-	X	X	X
Galaxaura frutes	-	-	X	-	-	-	-	-	-	X	-	-	-
Galaxaura glaber	-	-	X	-	-	-	-	-	-	-	-	-	X
Galaxaura glabri	-	X	-	-	X	X	X	-	-	-	-	-	-
Galaxaura kjellm	-	-	X	-	-	-	-	-	-	-	-	X	-
Galaxaura lapide	-	-	X	-	-	-	-	-	-	-	X	-	-
Galaxaura latifo	-	-	X	-	-	-	-	-	-	-	X	-	-
Galaxaura margin	-	-	X	-	-	-	-	-	-	-	X	X	X

	Siany			Shinh						WWW			
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phi	Aus
Galaxaura oblong	X	X	X	X	X	X	X	-	X	-	X	X	X
Galaxaura obtusa	-	X	X	-	-	-	X	-	-	-	X	X	X
Galaxaura pacifi	-	X	X	-	X	X	-	-	X	-	X	-	-
Galaxaura robust	-	X	X	-	-	-	-	-	X	X	X	-	-
Galaxaura rudis	-	X	X	-	-	-	X	-	-	-	X	-	-
Galaxaura rugosa	X	-	X	-	-	-	-	-	-	-	-	X	X
Galaxaura sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Galaxaura sp.	X	X	-	-	X	X	-	-	-	-	-	-	-
Galaxaura squali	-	X	-	-	-	-	-	X	X	-	-	-	-
Galaxaura striat	-	-	X	-	-	-	-	-	-	-	-	X	-
Galaxaura subfru	-	X	X	-	-	-	-	-	X	-	-	X	X
Galaxaura subver	-	-	X	-	-	-	-	-	-	-	-	X	-
Galaxaura tenera	-	-	X	-	-	-	-	-	-	-	X	-	-
Galaxaura umbell	-	X	-	-	-	-	-	-	X	-	-	-	-
Galaxaura ventri	-	X	-	-	X	X	-	-	-	-	-	-	-
Galaxaura veprec	-	X	X	-	-	X	-	-	-	-	X	-	-
Galaxaura vietna	-	X	-	-	-	-	X	-	-	-	-	-	-
Gastroclonium xi	-	X	-	-	-	X	-	-	-	-	-	-	-
Gelidiella acero	X	X	X	-	X	X	X	-	X	-	X	X	X
Gelidiella adnat	-	X	X	-	-	-	X	-	-	-	-	X	X
Gelidiella borne	-	-	X	-	-	-	-	-	-	-	-	-	X
Gelidiella lubri	-	X	-	-	-	-	X	-	-	-	-	-	-
Gelidiella myrio	-	X	-	-	-	-	X	-	-	-	-	-	-
Gelidiella panno	-	-	X	-	-	-	-	-	-	-	-	-	X
Gelidiella sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Gelidiella taylo	-	-	X	-	-	-	-	-	-	-	-	X	-
Gelidiella tenui	-	X	-	-	-	-	X	-	-	-	-	-	-
Gelidiopsis acro	-	-	X	-	-	-	-	-	-	-	-	-	X
Gelidiopsis grac	-	X	-	-	-	-	X	-	-	-	-	-	-
Gelidiopsis hach	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidiopsis intr	-	X	X	-	X	-	X	-	-	-	-	X	X
Gelidiopsis repe	-	X	X	-	-	-	X	-	-	-	X	X	-
Gelidiopsis rigi	-	X	-	-	-	-	-	X	-	-	-	-	-
Gelidiopsis scop	-	X	X	-	-	-	X	-	-	-	-	-	X
Gelidiopsis sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Gelidiopsis sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Gelidiopsis vari	-	X	X	-	-	-	X	-	-	X	X	-	X
Gelidium amansii	-	X	X	X	-	-	-	X	-	-	X	X	-
Gelidium austral	-	-	X	-	-	-	-	-	-	-	-	-	X
Gelidium cartila	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidium corneum	-	-	X	-	-	-	-	-	-	X	-	-	X
Gelidium coulter	-	-	X	-	-	-	-	-	-	-	-	X	-
Gelidium crinale	X	X	X	-	-	-	X	-	-	-	X	X	X
Gelidium divaric	-	X	X	X	X	-	X	-	-	-	X	X	-
Gelidium heterop	-	-	X	-	-	-	-	-	-	-	-	-	X
Gelidium isabela	-	-	X	-	-	-	-	-	-	-	-	X	-
Gelidium japonic	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidium johnsto	-	X	X	X	-	-	-	-	-	-	X	-	-
Gelidium kintaro	-	-	X	-	-	-	-	-	-	-	X	X	-
Gelidium latifol	-	X	X	-	-	-	-	X	-	-	-	-	X
Gelidium latiusc	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidium maideni	-	-	X	-	-	-	-	-	-	-	-	-	X
Gelidium pacific	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidium planius	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidium pulchel	-	X	X	-	-	-	X	-	-	-	-	X	-
Gelidium pusillu	X	X	X	X	-	-	X	X	-	-	X	X	X
Gelidium rigens	-	-	X	-	-	-	-	-	-	-	-	X	-
Gelidium sp	-	-	X	-	-	-	-	-	-	-	X	X	-
Gelidium sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Gelidium spathul	-	X	-	-	-	-	X	-	-	-	-	-	-
Gelidium subcost	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidium tsengii	-	X	-	X	-	-	-	-	-	-	-	-	-
Gelidium vagum	-	-	X	-	-	-	-	-	-	-	X	-	-
Gelidium vietnam	-	X	-	-	-	-	X	-	-	-	-	-	-
Gelidium yamadae	-	-	X	-	-	-	-	-	-	-	X	-	-

Gigartina acicul	-	X	-	-	-	-	-	X	-	-	-	-	-
Gigartina brachi	-	-	X	-	-	-	-	-	-	-	-	-	X
Gigartina interm	-	X	X	-	-	-	X	-	-	-	X	-	-
Gigartina ochote	-	-	X	-	-	-	-	-	-	-	X	-	-
Gigartina sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Gigartina tenell	X	-	X	-	-	-	-	-	-	-	X	X	-
Gloiocladia rame	-	-	X	-	-	-	-	-	-	-	-	X	-
Gloiopeltis comp	-	-	X	-	-	-	-	-	-	-	X	X	-
Gloiopeltis furc	-	X	X	X	-	-	-	-	-	-	X	-	-
Gloiopeltis minu	-	X	-	-	-	-	X	-	-	-	-	-	-
Gloiopeltis tena	-	X	X	X	-	-	-	-	-	-	X	X	-
Gloiophloea chin	-	X	-	-	X	-	-	-	-	-	-	-	-
Goniotrichum als	-	X	X	-	-	-	X	-	-	-	-	X	-
Goniotrichum hum	-	X	-	-	-	-	X	-	-	-	-	-	-
Gordoniella yona	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria arcua	-	X	X	X	X	X	X	-	-	X	X	X	X
Gracilaria artic	-	X	-	-	X	-	-	-	-	-	-	-	-
Gracilaria asiat	X	-	-	-	-	-	-	-	-	-	-	-	-
Gracilaria blodg	X	X	X	X	X	-	-	X	-	X	X	X	-
Gracilaria bursa	-	X	X	-	X	-	-	-	-	-	X	X	-
Gracilaria cacal	-	-	X	-	-	-	-	-	-	-	-	-	X
Gracilaria canal	-	-	X	-	-	-	-	-	-	-	X	X	X
Gracilaria chord	-	X	X	-	X	-	-	-	-	-	X	-	-
Gracilaria confe	-	X	-	-	-	-	X	X	-	-	-	-	-
Gracilaria coron	X	X	X	-	X	-	X	-	-	-	X	X	-
Gracilaria crass	-	X	X	-	X	-	X	X	-	-	X	-	X
Gracilaria cylin	X	-	X	-	-	-	-	-	-	-	-	X	X
Gracilaria damae	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria denti	-	-	X	-	-	-	-	-	-	-	X	-	-
Gracilaria disti	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria dura	-	X	-	-	-	-	-	X	-	-	-	-	-
Gracilaria eduli	-	-	X	-	-	-	-	-	-	-	X	X	X
Gracilaria euche	X	X	X	-	X	X	X	X	-	X	X	X	-
Gracilaria firma	-	X	-	-	-	-	-	-	-	-	-	-	-
Gracilaria folii	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria furce	-	-	X	-	-	-	-	-	-	-	-	-	X
Gracilaria gigas	-	-	X	-	-	-	-	-	-	-	X	X	-
Gracilaria haina	-	X	-	-	X	-	-	-	-	-	-	-	-
Gracilaria heter	X	-	-	-	-	-	-	-	-	-	-	-	-
Gracilaria howen	-	-	X	-	-	-	-	-	-	-	-	-	X
Gracilaria incur	-	-	X	-	-	-	-	-	-	-	X	X	-
Gracilaria liche	-	X	-	-	-	-	-	X	-	-	-	-	-
Gracilaria minor	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria papen	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria preis	-	-	X	-	-	-	-	-	-	-	-	-	X
Gracilaria punct	-	-	X	-	-	-	-	-	-	-	X	-	-
Gracilaria purpu	X	-	X	-	-	-	-	-	-	-	X	-	X
Gracilaria rhodo	-	-	X	-	-	-	-	-	-	-	-	-	X
Gracilaria rubra	-	X	-	-	X	-	-	-	-	-	-	-	-
Gracilaria salic	X	X	X	-	X	-	-	X	-	-	X	X	-
Gracilaria secon	-	-	X	-	-	-	-	-	-	-	-	-	X
Gracilaria sp	-	X	X	-	-	-	-	X	-	-	X	X	-
Gracilaria sp.	X	X	-	-	X	X	X	-	-	-	-	-	-
Gracilaria spini	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria spinu	-	X	X	-	X	-	-	-	-	-	X	X	-
Gracilaria taeni	-	X	-	-	-	-	-	X	-	-	-	-	-
Gracilaria tenui	X	X	X	-	X	-	-	-	-	-	X	-	-
Gracilaria texto	-	-	X	-	-	-	-	-	-	X	-	X	X
Gracilaria turgi	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria venez	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilaria verru	-	X	X	-	-	-	X	-	-	X	X	X	X
Gracilaria vieil	-	-	X	-	-	-	-	-	-	-	-	X	-
Gracilariopsis n	-	X	-	-	-	-	X	-	-	-	-	-	-
Gracilariopsis p	-	X	-	-	-	-	X	-	-	-	-	-	-
Gracilariopsis r	-	X	-	-	-	-	X	-	-	-	-	-	-
Gracilariopsis s	-	X	-	-	-	-	X	-	-	-	-	-	-
Gracllaria coron	-	-	X	-	-	-	-	-	-	-	-	-	X
Gracllaria salic	-	-	X	-	-	-	-	-	-	-	-	-	X

Grateloupia carn	-	-	X	-	-	-	-	-	-	-	X	-	-
Grateloupia conf	-	-	X	-	-	-	-	-	-	-	-	X	-
Grateloupia dich	-	-	X	-	-	-	-	-	-	-	-	X	-
Grateloupia diva	-	X	X	-	-	-	X	-	-	-	-	X	X
Grateloupia dory	-	-	X	-	-	-	-	-	-	-	-	X	-
Grateloupia fili	X	X	X	-	-	-	X	-	-	-	X	X	-
Grateloupia frut	-	X	-	X	-	-	-	-	-	-	-	-	-
Grateloupia fuqu	X	-	-	-	-	-	-	-	-	-	-	-	-
Grateloupia ligu	-	X	-	X	-	-	-	-	-	-	-	-	-
Grateloupia livi	-	X	-	-	-	-	-	-	-	-	-	-	-
Grateloupia okam	-	-	X	-	-	-	-	-	-	-	X	-	-
Grateloupia phuq	-	X	-	-	-	-	X	-	-	-	-	-	-
Grateloupia ramo	X	X	X	-	-	-	X	-	-	-	X	X	-
Grateloupia sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Grateloupia sp.	X	X	-	X	-	-	-	-	-	-	-	-	-
Grateloupia subs	-	-	X	-	-	-	-	-	-	-	-	-	X
Griffithsia coac	-	-	X	-	-	-	-	-	-	-	X	-	-
Griffithsia hete	-	-	X	-	-	-	-	-	-	-	-	-	X
Griffithsia japo	-	X	-	-	-	-	X	-	-	-	-	-	-
Griffithsia metc	-	X	-	-	X	-	X	-	-	-	-	-	-
Griffithsia oval	-	-	X	-	-	-	-	-	-	-	-	X	-
Griffithsia rhiz	-	-	X	-	-	-	-	-	-	-	-	X	-
Griffithsia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Griffithsia subc	-	X	X	-	X	-	-	-	-	-	-	-	X
Griffithsia tenu	-	X	-	-	-	-	X	-	-	-	-	-	-
Grifflthsia cras	-	-	X	-	-	-	-	-	-	-	-	-	X
Gymnogongrus ass	-	-	X	-	-	-	-	-	-	-	-	-	X
Gymnogongrus chn	-	X	-	-	-	-	X	-	-	-	-	-	-
Gymnogongrus dil	-	-	X	-	-	-	-	-	-	-	-	X	-
Gymnogongrus div	-	X	X	X	-	-	-	-	-	-	-	X	-
Gymnogongrus fla	-	X	X	X	-	-	X	-	-	-	X	X	-
Gymnogongrus gri	-	X	X	-	-	-	X	-	-	-	-	-	X
Gymnogongrus irr	-	-	X	-	-	-	-	-	-	-	-	-	X
Gymnogongrus jap	-	X	-	-	-	-	X	-	-	-	-	-	-
Gymnogongrus met	-	X	-	-	-	-	X	-	-	-	-	-	-
Gymnogongrus pli	-	X	-	-	-	-	X	-	-	-	-	-	-
Gymnogongrus pyg	-	X	X	-	-	-	X	-	-	-	-	X	X
Gymnogongrus qui	-	X	-	-	-	-	X	-	-	-	-	-	-
Gymnogongrus ser	-	X	-	-	-	-	X	-	-	-	-	-	-
Gymnogongrus sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Gymnogongrus sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Gymnophycus haps	-	-	X	-	-	-	-	-	-	-	-	-	X
Gymnophycus hypi	-	-	X	-	-	-	-	-	-	-	-	-	X
Gymnothamnion el	-	X	X	-	-	-	X	-	-	-	X	X	-
Halichrysis mica	-	-	X	-	-	-	-	-	-	-	-	-	X
Haliptilon cuben	-	-	X	-	-	-	-	-	-	-	-	X	-
Haliptilon cupie	-	-	X	-	-	-	-	-	-	-	-	-	X
Haliptilon graci	-	-	X	-	-	-	-	-	-	-	-	-	X
Haliptilon rosea	-	-	X	-	-	-	-	-	-	-	-	-	X
Haloplegma duper	-	X	X	-	-	X	-	-	-	-	X	X	X
Haloplegma polys	-	X	-	-	-	X	-	-	-	-	-	-	-
Halymenia acumin	-	-	X	-	-	-	-	-	-	-	-	X	-
Halymenia ceylan	-	-	X	-	-	-	-	-	-	-	X	-	-
Halymenia dilata	-	X	X	-	-	-	X	-	-	-	-	X	-
Halymenia durvil	-	X	X	-	-	-	-	X	-	X	X	X	X
Halymenia fimbri	-	-	X	-	-	-	-	-	-	-	-	-	X
Halymenia flores	-	-	X	-	-	-	-	-	-	-	-	X	X
Halymenia formos	-	-	X	-	-	-	-	-	-	-	-	X	-
Halymenia harvey	-	-	X	-	-	-	-	-	-	-	-	X	-
Halymenia japoni	-	-	X	-	-	-	-	-	-	-	-	X	-
Halymenia lacera	-	-	X	-	-	-	-	-	-	-	-	-	X
Halymenia macula	-	X	X	-	-	-	X	-	-	-	-	X	-
Halymenia microc	-	-	X	-	-	-	-	-	-	-	-	X	-
Halymenia multif	-	-	X	-	-	-	-	-	-	-	-	-	X
Halymenia sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Halymenia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Halymenia ulvoid	-	X	X	-	-	-	X	-	-	-	-	-	X
Helminthocladia	-	-	X	-	-	-	-	-	-	-	X	X	X

Herposiphonia cr	-	-	X	-	-	-	-	-	-	-	-	X	-
Herposiphonia de	-	-	X	-	-	-	-	-	-	-	-	X	-
Herposiphonia in	-	X	X	-	-	-	X	-	-	-	-	-	X
Herposiphonia nu	-	-	X	-	-	-	-	-	-	-	-	X	-
Herposiphonia ob	-	-	X	-	-	-	-	-	-	-	-	X	X
Herposiphonia pa	-	-	X	-	-	-	-	-	-	-	-	X	X
Herposiphonia pe	-	X	-	X	-	-	-	-	-	-	-	-	-
Herposiphonia pl	-	-	X	-	-	-	-	-	-	-	-	X	-
Herposiphonia se	-	-	X	-	-	-	-	-	-	-	-	X	-

Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phi	Aus
	Summary			*South China Sea*					*WWWP*				
Herposiphonia sp	X	X	X	-	-	-	-	-	X	-	X	X	-
Herposiphonia su	-	-	X	-	-	-	-	-	-	-	X	X	X
Herposiphonia te	-	X	X	-	-	-	-	X	-	-	-	-	X
Herposiphonia tr	-	-	X	-	-	-	-	-	-	-	-	X	-
Herposiphonia vi	-	X	-	-	-	-	-	X	-	-	-	-	-
Heteroderma minu	-	X	-	-	-	-	-	X	-	-	-	-	-
Heteroderma sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Heterosiphonia m	-	-	X	-	-	-	-	-	-	-	-	X	X
Heterosiphonia s	X	-	-	-	-	-	-	-	-	-	-	-	-
Heterosiphonia w	-	-	X	-	-	-	-	-	-	-	-	X	X
Hildenbrandia pr	-	X	X	-	-	-	-	X	-	-	-	-	X
Hildenbrandia ru	-	-	X	-	-	-	-	-	-	-	X	-	-
Holmesia neuryme	-	-	X	-	-	-	-	-	-	-	X	-	-
Hydrolithon rein	-	X	X	-	-	X	X	X	-	-	-	X	-
Hymenocladia dac	-	-	X	-	-	-	-	-	-	-	-	X	-
Hymenocladia gra	-	-	X	-	-	-	-	-	-	-	-	-	X
Hypnea boergesen	-	X	X	-	-	-	-	X	-	-	X	X	X
Hypnea cenomyce	-	X	X	-	-	-	-	X	-	-	X	X	X
Hypnea cervicorn	X	X	X	-	X	-	-	X	-	-	X	X	X
Hypnea charoides	-	X	X	-	-	-	-	-	-	-	X	X	-
Hypnea chordacea	-	-	X	-	-	-	-	-	-	-	X	-	-
Hypnea coenomyce	-	X	-	-	-	-	-	-	X	-	-	-	-
Hypnea cornuta	-	X	X	-	-	-	-	X	-	-	X	X	X
Hypnea divaricat	-	-	X	-	-	-	-	-	-	-	-	X	X
Hypnea esperi	-	X	X	-	-	-	-	X	-	-	X	-	-
Hypnea hamulosa	-	-	X	-	-	-	-	-	-	-	X	-	-
Hypnea japonica	X	X	X	-	X	X	-	-	-	-	X	-	-
Hypnea musciform	-	X	X	X	-	-	-	-	X	-	-	X	-
Hypnea nidifica	X	-	X	-	-	-	-	-	-	-	-	-	X
Hypnea nidulans	-	X	X	-	-	-	-	X	-	-	X	X	-
Hypnea pannosa	-	X	X	-	-	X	X	X	-	-	X	X	X
Hypnea rugulosa	-	-	X	-	-	-	-	-	-	-	-	-	X
Hypnea saidana	-	-	X	-	-	-	-	-	-	-	X	X	-
Hypnea seticulos	-	-	X	-	-	-	-	-	-	-	X	-	-
Hypnea sp	-	X	X	-	-	-	-	-	X	-	X	X	-
Hypnea sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Hypnea spinella	-	X	X	-	-	-	-	X	-	-	X	X	X
Hypnea valentiae	-	X	X	-	-	-	-	X	-	-	-	X	X
Hypoglossum atte	-	X	X	-	-	-	X	X	-	-	-	X	-
Hypoglossum barb	-	-	X	-	-	-	-	-	-	-	-	-	X
Hypoglossum hypo	-	-	X	-	-	-	-	-	-	-	-	-	X
Hypoglossum serr	-	-	X	-	-	-	-	-	-	-	-	X	-
Hypoglossum spat	-	-	X	-	-	-	-	-	-	-	-	X	-
Implicaria retic	-	-	X	X	-	-	-	-	-	-	-	-	-
Jania adhaerens	X	X	X	-	-	-	-	X	-	-	X	X	X
Jania capillacea	-	X	X	-	-	-	-	X	-	-	-	X	-
Jania crassa	X	X	X	-	-	X	-	-	-	-	-	-	X
Jania decussato-	-	X	X	-	-	-	-	X	-	-	-	X	-
Jania fastigiata	-	-	X	-	-	-	-	-	-	-	-	-	X
Jania longiarthr	-	X	X	-	-	-	-	X	-	-	X	X	-
Jania mexicana	-	-	X	-	-	-	-	-	-	-	X	-	-
Jania micrarthro	-	-	X	-	-	-	-	-	-	-	-	X	X
Jania pacifica	-	-	X	-	-	-	-	-	-	-	-	X	-
Jania pumila	-	X	X	-	-	-	-	X	-	-	-	X	-
Jania radiata	-	-	X	-	-	-	-	-	-	-	X	-	-
Jania rosea	-	-	X	-	-	-	-	-	-	-	-	-	X
Jania rubens	X	X	X	-	-	-	-	X	-	-	-	X	X
Jania sp	-	X	X	-	-	-	-	-	X	-	-	X	-
Jania sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Jania tenella	-	-	X	-	-	-	-	-	-	-	X	X	-
Jania undulata	-	-	X	-	-	-	-	-	-	-	X	-	-
Jania ungulata	X	X	X	-	X	X	-	X	-	-	-	X	-
Jeannerettia lob	-	-	X	-	-	-	-	-	-	-	-	-	X
Jeannerettia ped	-	-	X	-	-	-	-	-	-	-	-	-	X
Kallymenia callo	-	-	X	-	-	-	-	-	-	-	-	X	-

Red	Summary FLD	SCS	WP	South China Sea HK	HN	XS	VN	Mly	WWWP LZ	Ryu	TW	Phi	Aus
Kallymenia pacif	-	-	X	-	-	-	-	-	-	-	-	X	-
Kallymenia sessi	-	-	X	-	-	-	-	-	-	-	-	X	-
Kallymenia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Kappaphycus alva	-	X	X	-	-	-	-	-	X	-	-	X	-
Kappaphycus cott	-	X	X	-	-	X	-	-	-	-	-	X	-
Kappaphycus proc	-	-	X	-	-	-	-	-	-	-	-	X	-
Kappaphycus stri	-	X	X	-	-	-	-	-	X	-	-	X	-
Laurencia articu	-	X	-	-	X	-	X	X	-	-	-	-	-
Laurencia botryo	-	X	X	-	-	-	-	-	X	-	-	-	X
Laurencia brachy	-	X	-	-	-	-	-	X	-	-	-	-	-
Laurencia brongn	-	-	X	-	-	-	-	-	-	-	X	X	X
Laurencia capitu	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia caraib	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia caroli	-	-	X	-	-	-	-	-	-	-	-	X	X
Laurencia cartil	-	X	X	-	X	-	X	X	-	-	-	X	-
Laurencia ceylan	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia chinen	-	X	X	-	X	-	-	-	-	-	-	-	X
Laurencia chondr	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia clavat	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia colume	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia compos	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia concin	-	-	X	X	-	-	-	-	-	-	-	-	-
Laurencia concre	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia corall	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia corymb	-	X	-	-	-	-	-	X	-	-	-	-	-
Laurencia crucia	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia decumb	-	X	X	-	-	-	X	-	-	-	-	X	-
Laurencia distic	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia dotyi	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia fascic	-	X	-	-	-	-	X	-	-	-	-	-	-
Laurencia filifo	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia flexil	-	X	X	-	-	X	-	-	-	-	X	-	X
Laurencia forste	-	-	X	-	-	-	-	-	-	-	X	X	X
Laurencia galtso	-	X	-	-	-	-	X	-	-	-	-	-	-
Laurencia glandu	-	X	X	-	-	-	-	-	X	-	X	X	-
Laurencia gracil	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia grevil	-	-	X	-	-	-	-	-	-	-	X	-	-
Laurencia hetero	-	X	-	-	-	-	-	X	-	-	-	-	-
Laurencia hongko	-	X	-	-	X	-	-	-	-	-	-	-	-
Laurencia humili	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia implic	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia interm	-	-	X	-	-	-	-	-	-	-	X	X	-
Laurencia intric	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia japoni	-	X	X	-	X	-	-	-	-	-	-	X	-
Laurencia jejuna	-	X	-	-	X	-	-	-	-	-	-	-	-
Laurencia longic	-	X	-	-	X	-	-	-	-	-	-	-	-
Laurencia majusc	X	X	X	X	X	-	X	-	-	-	-	X	X
Laurencia marian	-	X	X	-	-	-	X	-	-	-	-	X	X
Laurencia microc	-	X	-	-	-	-	-	X	-	-	-	-	-
Laurencia moreto	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia nidifi	-	X	X	-	-	-	-	X	-	-	-	X	X
Laurencia obtusa	X	X	X	-	-	-	-	X	X	-	X	X	X
Laurencia okamur	X	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia palisa	-	-	X	-	-	-	-	-	-	-	X	X	-
Laurencia panicu	-	X	X	-	X	-	-	X	-	-	-	X	-
Laurencia pannos	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia papill	-	X	X	-	-	-	-	X	-	-	X	X	X
Laurencia parvip	X	X	X	-	X	-	X	X	-	-	-	X	X
Laurencia patent	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia pedicu	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia penust	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia perfor	-	X	X	-	-	-	-	X	-	-	X	-	X
Laurencia pinnat	-	X	X	-	-	-	X	-	X	-	X	X	X
Laurencia poitea	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia poitii	-	-	X	-	-	-	-	-	-	-	-	-	X

Red	*Summary* FLD	SCS	WP	*South China Sea* HK	HN	XS	VN	Mly	*WWWP* LZ	Ryu	TW	Phi	Aus
Laurencia ptycho	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia pygmae	-	X	X	-	-	-	-	X	-	-	-	-	X
Laurencia rigida	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia silvai	-	X	-	-	-	-	X	-	-	-	-	-	-
Laurencia sp	-	X	X	-	-	-	-	-	X	-	X	X	-
Laurencia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Laurencia subsim	-	X	X	-	X	-	-	-	-	-	-	X	-
Laurencia succis	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia surcul	-	X	X	-	X	-	-	-	-	-	-	X	-
Laurencia tenera	-	X	X	-	X	-	-	X	-	-	-	-	X
Laurencia thuyoi	-	-	X	-	-	-	-	-	-	-	-	-	X
Laurencia tristi	-	X	-	-	X	-	-	-	-	-	-	-	-
Laurencia tronoi	-	-	X	-	-	-	-	-	-	-	-	X	-
Laurencia tropic	-	X	X	-	-	-	-	X	-	-	X	X	-
Laurencia undula	X	X	X	-	X	-	-	-	-	-	X	X	-
Laurencia venust	-	-	X	-	-	-	-	-	-	-	X	X	-
Laurencia vertic	-	X	-	-	-	-	X	-	-	-	-	-	-
Laurencia yamada	-	-	X	-	-	-	-	-	-	-	-	X	-
Lenormandia spec	-	-	X	-	-	-	-	-	-	-	-	-	X
Lenormandiopsis	-	-	X	-	-	-	-	-	-	-	-	-	X
Leptofauchea sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Leveillea junger	X	X	X	-	-	X	-	X	X	X	X	X	X
Liagora boergese	-	-	X	-	-	-	-	-	-	-	X	X	-
Liagora canarien	-	-	X	-	-	-	-	-	-	-	-	X	-
Liagora ceranoid	-	-	X	-	-	-	-	-	-	-	X	X	X
Liagora cladonio	-	-	X	-	-	-	-	-	-	-	-	-	X
Liagora decussat	-	-	X	-	-	-	-	-	-	-	X	-	-
Liagora divarica	-	-	X	-	-	-	-	-	-	-	-	X	-
Liagora farinosa	-	-	X	-	-	-	-	-	-	-	X	X	X
Liagora hawaiian	-	-	X	-	-	-	-	-	-	-	-	X	X
Liagora howensis	-	-	X	-	-	-	-	-	-	-	-	-	X
Liagora japonica	-	-	X	-	-	-	-	-	-	-	-	X	-
Liagora oriental	-	-	X	-	-	-	-	-	-	-	X	X	-
Liagora pinnata	-	-	X	-	-	-	-	-	-	-	-	-	X
Liagora robusta	-	-	X	-	-	-	-	-	-	-	-	X	-
Liagora rugosa	-	-	X	-	-	-	-	-	-	-	X	-	X
Liagora segawae	-	-	X	-	-	-	-	-	-	-	-	X	-
Liagora segawai	-	-	X	-	-	-	-	-	-	-	X	-	-
Liagora setchell	-	-	X	-	-	-	-	-	-	-	X	X	X
Liagora sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Liagora tenuis	-	-	X	-	-	-	-	-	-	-	-	X	-
Liagora valida	-	-	X	-	-	-	-	-	-	-	X	X	X
Liagorophila end	-	-	X	-	-	-	-	-	-	-	X	-	-
Liagoropsis schr	-	-	X	-	-	-	-	-	-	-	X	X	-
Litholepis indic	-	-	X	-	-	-	-	-	-	-	-	X	-
Lithophyllum bys	-	-	X	-	-	-	-	-	-	-	-	X	-
Lithophyllum kot	-	X	X	-	-	X	-	-	-	-	-	-	X
Lithophyllum mol	-	X	X	-	-	X	-	X	-	-	-	-	X
Lithophyllum oka	-	X	-	-	-	-	-	X	-	-	-	-	-
Lithophyllum pal	-	-	X	-	-	-	-	-	-	-	-	X	X
Lithophyllum per	-	-	X	-	-	-	-	-	-	-	X	-	-
Lithophyllum sam	-	X	-	-	-	-	-	X	-	-	-	-	-
Lithophyllum sp	-	-	X	-	-	-	-	-	-	-	X	X	-
Lithophyllum tri	-	X	-	-	-	-	-	X	-	-	-	-	-
Lithoporella mel	-	X	X	-	-	X	X	-	-	-	-	X	X
Lithoporella pac	-	X	-	-	-	X	X	X	-	-	-	-	-
Lithothamnion au	-	-	X	-	-	-	-	-	-	-	-	X	-
Lithothamnion er	-	X	-	-	-	-	-	X	X	-	-	-	-
Lithothamnion gl	-	-	X	-	-	-	-	-	-	-	-	-	X

Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
	Summary			*Sout China Sea*						*WWWP*			
Lithothamnion in	-	-	X	-	-	-	-	-	-	-	-	X	-
Lithothamnion mo	-	-	X	-	-	-	-	-	-	-	-	X	-
Lithothamnion si	-	X	X	-	-	-	-	X	-	-	-	-	X
Lithothamnium me	-	-	X	-	-	-	-	-	-	-	X	-	-
Lithothamnium sp	-	-	X	-	-	-	-	-	-	-	X	-	-
Lomentaria artic	-	-	X	-	-	-	-	-	-	-	-	X	-
Lomentaria baile	-	-	X	-	-	-	-	-	-	-	-	X	-
Lomentaria coral	-	-	X	-	-	-	-	-	-	-	-	-	X
Lomentaria hakod	-	-	X	-	-	-	-	-	-	-	-	X	-
Lomentaria pinna	-	-	X	-	-	-	-	-	-	-	-	X	-
Lomentaria sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Lophocladia harv	-	-	X	-	-	-	-	-	-	-	-	-	X
Lophocladia lall	-	-	X	-	-	-	-	-	-	-	-	X	-
Lophosiphonia cr	-	-	X	-	-	-	-	-	-	-	-	X	X
Lophosiphonia ob	-	X	-	-	-	-	X	-	-	-	-	-	-
Lophosiphonia pr	-	-	X	-	-	-	-	-	-	-	-	-	X
Lophosiphonia re	-	X	-	-	-	-	X	-	-	-	-	-	-
Lophosiphonia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Lophosiphonia su	-	-	X	-	-	-	-	-	-	-	-	-	X
Lophosiphonia vi	-	X	-	-	-	-	X	-	-	-	-	-	-
Martensia dentic	-	-	X	-	-	-	-	-	-	-	X	-	-
Martensia elegan	-	-	X	-	-	-	-	-	-	-	-	-	X
Martensia flabel	-	-	X	-	-	-	-	-	-	-	X	X	-
Martensia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Martensia specio	-	-	X	-	-	-	-	-	-	-	-	X	X
Mastophora affin	X	X	X	-	X	-	X	-	-	-	-	-	X
Mastophora macro	-	-	X	-	-	-	-	-	-	X	-	-	-
Mastophora pygma	-	-	X	-	-	-	-	-	-	-	X	-	-
Mastophora rosea	-	X	X	-	-	-	-	-	X	-	X	X	X
Mastophora sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Melobesia confer	-	X	-	-	-	-	X	-	-	-	-	-	-
Melobesia corona	-	-	X	-	-	-	-	-	-	-	-	-	X
Melobesia farino	-	X	X	-	-	-	X	-	-	-	X	-	-
Melobesia membra	-	-	X	-	-	-	-	-	-	-	-	-	X
Melobesia sp	-	X	X	-	-	-	-	X	-	-	X	X	-
Meristotheca coa	-	-	X	-	-	-	-	-	-	-	X	-	-
Meristotheca pap	-	-	X	-	-	-	-	-	-	-	X	X	X
Meristotheca pro	-	-	X	-	-	-	-	-	-	-	-	-	X
Mesophyllum erub	-	X	X	-	-	-	-	-	-	-	-	X	-
Mesophyllum imbr	-	-	X	-	-	-	-	-	-	-	-	X	-
Mesophyllum lich	-	-	X	-	-	-	-	-	-	-	-	-	X
Mesophyllum meso	-	-	X	-	-	-	-	-	-	-	X	-	X
Mesophyllum pulc	-	-	X	-	-	-	-	-	-	-	-	X	-
Mesophyllum siam	-	-	X	-	-	-	-	-	-	-	-	X	-
Mesophyllum simu	-	X	X	-	X	-	-	-	X	-	-	X	-
Mesothamnion car	-	X	-	-	-	-	X	-	-	-	-	-	-
Metagoniolithon	-	X	X	-	-	-	X	-	-	-	-	-	X
Microcladia eleg	-	-	X	-	-	-	-	-	-	-	X	X	-
Microcladia glan	-	-	X	-	-	-	-	-	-	-	-	X	-
Microcladia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Monosporus austr	-	-	X	-	-	-	-	-	-	-	-	-	X
Monosporus indic	-	-	X	-	-	-	-	-	-	-	-	-	X
Murrayella peric	-	-	X	-	-	-	-	-	-	-	X	X	X
Murrayella sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Murrayella squar	-	-	X	-	-	-	-	-	-	-	X	-	-
Mychodea zanardi	-	-	X	-	-	-	-	-	-	-	-	-	X
Myriogramme bomb	-	-	X	-	-	-	-	-	-	-	-	-	X
Myriogramme carn	-	-	X	-	-	-	-	-	-	-	-	-	X
Nemalion helmint	-	X	-	-	-	-	-	-	-	-	-	-	-
Nemalion pulvina	X	-	-	-	-	-	-	-	-	-	-	-	-
Neogoniolithon f	-	X	X	-	-	X	-	-	-	-	-	X	X
Neogoniolithon l	-	-	X	-	-	-	-	-	-	-	-	-	X
Neogoniolithon m	-	X	X	-	-	-	X	-	-	-	-	X	X
Neogoniolithon o	-	-	X	-	-	-	-	-	-	-	-	-	X

	Summary			*Sout China Sea*						*WWWP*			
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Neogoniolithon p	-	X	X	-	-	X	-	-	-	-	-	-	X
Neogoniolithon t	-	X	-	-	-	-	-	-	-	-	-	-	-
Neogoniolithon v	-	X	-	-	X	X	-	-	-	-	-	-	-
Neomonospora ped	-	X	-	-	-	-	X	-	-	-	-	-	-
Neurymenia fraxi	-	X	X	-	-	-	X	-	-	X	X	X	X
Nitophyllum sp	-	-	X	-	-	-	-	-	-	-	X	-	-
Nitophyllum tong	-	-	X	-	-	-	-	-	-	-	-	-	X
Opephyllum marte	-	-	X	-	-	-	-	-	-	-	-	X	-
Palmaria palmata	-	-	X	-	-	-	-	-	-	-	-	X	-
Peleroa elongata	-	-	X	-	-	-	-	-	-	-	-	-	X
Peysonnelia calc	-	X	-	-	-	-	X	-	-	-	-	-	-
Peysonnelia caul	-	-	X	-	-	-	-	-	-	X	-	-	-
Peysonnelia dist	-	-	X	-	-	-	-	-	-	-	X	-	-
Peysonnelia gunn	-	X	-	-	-	-	X	-	-	-	-	-	-
Peysonnelia rubr	X	X	X	-	X	-	X	-	-	-	X	-	-
Peyssonelia atro	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia calc	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia cape	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia cocc	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia conc	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia evae	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia hari	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia inam	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia mari	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonelia rubr	-	-	X	-	-	-	-	-	-	-	-	-	X
Peyssonnelia cal	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia cau	-	-	X	-	-	-	-	-	-	-	X	-	-
Peyssonnelia con	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia dis	-	-	X	-	-	-	-	-	-	-	X	X	-
Peyssonnelia eva	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia fov	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia ind	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia luz	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia mar	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia obs	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia rub	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Peyssonnelia squ	-	-	X	-	-	-	-	-	-	-	-	X	-
Phacelocarpus ja	-	-	X	-	-	-	-	-	-	-	X	-	-
Phyllophora subm	-	-	X	-	-	-	-	-	-	-	-	X	-
Phymatolithon ca	-	-	X	-	-	-	-	-	-	-	-	X	-
Phymatolithon po	-	-	X	-	-	-	-	-	-	-	-	X	-
Pilophora sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Platysiphonia ma	-	-	X	-	-	-	-	-	-	-	-	-	X
Platysiphonia mi	-	-	X	-	-	-	-	-	-	-	-	-	X
Pleonosporium gl	-	-	X	-	-	-	-	-	-	-	-	X	-
Pleonosporum bor	-	X	-	-	-	-	X	-	-	-	-	-	-
Plocamium angust	-	-	X	-	-	-	-	-	-	-	-	-	X
Plocamium botryo	-	-	X	-	-	-	-	-	-	X	-	-	-
Plocamium cartil	-	-	X	-	-	-	-	-	-	-	-	-	X
Plocamium costat	-	-	X	-	-	-	-	-	-	-	-	X	-
Plocamium hamatu	-	-	X	-	-	-	-	-	-	-	-	-	X
Plocamium merten	-	-	X	-	-	-	-	-	-	-	-	-	X
Plocamium patens	-	-	X	-	-	-	-	-	-	-	-	X	-
Plocamium preiss	-	-	X	-	-	-	-	-	-	-	-	-	X
Plocamium serrat	-	-	X	-	-	-	-	-	-	-	X	-	-
Plocamium serrul	-	-	X	-	-	-	-	-	-	-	-	X	-
Plocamium telfai	-	X	X	X	-	-	-	-	-	-	X	X	-
Polycavernosa de	-	-	X	-	-	-	-	-	-	-	-	X	-
Polycavernosa fa	X	X	X	-	X	X	-	X	-	-	-	X	-
Polycavernosa ra	-	X	-	-	X	-	-	-	-	-	-	-	-
Polycavernosa ur	-	X	-	-	-	-	-	X	-	-	-	-	-
Polyopes ligulat	-	X	-	-	-	-	X	-	-	-	-	-	-
Polyopes polyide	-	-	X	-	-	-	-	-	-	-	X	-	-

	Summary			*Sout China Sea*						*WWWP*			
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Polyopes sp	-	-	X	-	-	-	-	-	-	-	X	-	-
Polyopes sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Polysiphonia amp	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia api	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia bax	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia bea	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia bla	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia coa	-	X	X	-	-	-	X	-	-	-	-	-	X
Polysiphonia exi	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia fer	-	-	X	-	-	-	-	-	-	-	-	X	X
Polysiphonia fla	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia for	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia fra	-	X	X	-	-	-	X	-	-	-	-	X	X
Polysiphonia gor	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia gra	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia har	-	X	X	X	X	-	X	-	-	-	X	-	-
Polysiphonia haw	-	-	X	-	-	-	-	-	-	-	-	X	X
Polysiphonia her	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia how	-	-	X	-	-	-	-	-	-	-	-	X	X
Polysiphonia inf	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia iso	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia kam	-	-	X	-	-	-	-	-	-	-	X	-	-
Polysiphonia mac	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia mol	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia nha	-	X	-	-	-	-	X	-	-	-	-	-	-
Polysiphonia opa	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia pac	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia pla	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia pok	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia pul	-	-	X	-	-	-	-	-	-	-	X	-	-
Polysiphonia pur	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia sav	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia sco	-	X	X	-	-	-	X	-	-	-	-	X	X
Polysiphonia ser	-	-	X	-	-	-	-	-	-	-	-	-	X
Polysiphonia set	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Polysiphonia sp.	X	X	-	-	-	-	X	-	-	-	-	-	-
Polysiphonia spa	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia sph	-	-	X	-	-	-	-	-	-	-	-	X	X
Polysiphonia sub	-	X	X	-	-	-	X	-	-	-	-	X	X
Polysiphonia tep	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia ton	-	X	X	-	-	-	X	-	-	-	-	-	X
Polysiphonia tri	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia tsu	-	-	X	-	-	-	-	-	-	-	-	X	-
Polysiphonia upo	-	-	X	-	-	-	-	-	-	-	-	X	X
Polysiphonia var	-	-	X	-	-	-	-	-	-	-	-	-	X
Polystrata dura	-	-	X	-	-	-	-	-	-	-	-	X	-
Porolithon gardi	-	-	X	-	-	-	-	-	-	-	-	-	X
Porolithon onkod	-	X	X	-	X	X	-	-	-	-	-	X	X
Porphyra angusta	-	-	X	-	-	-	-	-	-	-	X	-	-
Porphyra atropur	-	-	X	-	-	-	-	-	-	-	-	X	-
Porphyra crispat	-	X	X	-	-	-	X	-	-	-	X	X	-
Porphyra dentata	-	X	X	X	-	-	-	-	-	-	X	-	-
Porphyra denticu	-	-	X	-	-	-	-	-	-	-	-	X	X
Porphyra guangdo	-	X	-	-	-	-	-	-	-	-	-	-	-
Porphyra marcosi	-	-	X	-	-	-	-	-	-	-	-	X	-
Porphyra sp	-	-	X	-	-	-	-	-	-	-	X	X	-
Porphyra sp.	X	X	X	X	-	-	-	-	-	-	X	-	-
Porphyra suborbi	-	X	X	X	-	-	-	-	-	-	X	X	-
Porphyra variega	-	-	X	-	-	-	-	-	-	-	-	X	-
Porphyra vietnam	-	X	-	-	-	-	X	-	-	-	-	-	-
Portieria hornem	-	-	X	-	-	-	-	-	-	-	-	X	-
Portieria japoni	-	-	X	-	-	-	-	-	-	-	-	X	-
Predaea incraspe	-	-	X	-	-	-	-	-	-	-	-	-	X

	Summary			*South China Sea*						*WWWP*			
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Predaea lacinios	-	-	X	-	-	-	-	-	-	-	-	-	X
Predaea weldii	-	-	X	-	-	-	-	-	-	-	-	-	X
Prionitis cornea	-	-	X	-	-	-	-	-	-	-	-	X	-
Prionitis elata	-	-	X	-	-	-	-	-	-	X	-	-	-
Prionitis obtusa	-	-	X	-	-	-	-	-	-	-	-	-	X
Prionitis sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Prionitis vietna	-	X	-	-	-	-	X	-	-	-	-	-	-
Pseudolithophyll	-	X	-	-	-	-	-	-	-	-	-	-	-
Pterocladia caer	-	-	X	-	-	-	-	-	-	-	-	-	X
Pterocladia calo	X	X	X	-	-	-	X	-	-	-	-	X	X
Pterocladia capi	-	X	X	-	-	-	-	-	-	-	X	X	X
Pterocladia cerr	X	-	-	-	-	-	-	-	-	-	-	-	-
Pterocladia dens	-	-	X	-	-	-	-	-	-	-	-	X	-
Pterocladia luci	-	-	X	-	-	-	-	-	-	-	-	-	X
Pterocladia nana	-	-	X	-	-	-	-	-	-	-	X	X	-
Pterocladia parv	-	X	-	-	-	-	X	-	-	-	-	-	-
Pterocladia pinn	-	X	-	-	-	-	X	-	-	-	-	-	-
Pterocladia sp	-	-	X	-	-	-	-	-	-	-	-	X	-

	Summary			South China Sea					WWWP				
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Pterocladia tenu	-	X	X	-	-	-	-	-	-	-	X	-	-
Ptilocladia aust	-	-	X	-	-	-	-	-	-	-	-	-	X
Ptilothamnion cl	-	-	X	-	-	-	-	-	-	-	X	X	-
Ramicrusta nanha	-	X	-	-	-	X	-	-	-	-	-	-	-
Reinboldiella sc	-	-	X	-	-	-	-	-	-	-	X	-	-
Reptataxis rhizo	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhodoglossum aff	-	-	X	-	-	-	-	-	-	-	X	-	-
Rhodopeltis bore	-	-	X	-	-	-	-	-	-	-	X	X	-
Rhodopeltis grac	-	-	X	-	-	-	-	-	-	-	X	X	-
Rhodopeltis setc	-	-	X	-	-	-	-	-	-	-	X	-	-
Rhodopeltis sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhodophyllis pel	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhodymenia anast	-	X	X	-	-	-	X	-	-	-	-	-	X
Rhodymenia calif	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhodymenia coact	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhodymenia decum	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhodymenia intri	X	X	X	X	-	-	-	-	-	-	-	X	-
Rhodymenia lepto	-	-	X	-	-	-	-	-	-	-	-	-	X
Rhodymenia palme	-	-	X	-	-	-	-	-	-	X	-	-	-
Rhodymenia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Rhodymenia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Rhodymenia spinu	-	-	X	-	-	-	-	-	-	-	X	-	-
Rodriguezella ho	-	X	-	-	-	-	X	-	-	-	-	-	-
Sarcodia ceylani	-	-	X	-	-	-	-	-	-	-	X	-	-
Sarcodia ciliata	-	-	X	-	-	-	-	-	-	-	-	-	X
Sarcodia montagn	-	-	X	-	-	-	-	-	-	-	-	X	X
Sarcodia sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Sarconema filifo	-	X	X	-	X	-	-	-	-	-	-	-	X
Sarconema gracil	-	X	-	-	X	-	-	-	-	-	-	-	-
Scinaia boergese	-	X	X	-	X	-	-	-	-	-	X	-	-
Scinaia cottonii	-	X	X	-	X	-	-	-	-	-	X	-	-
Scinaia hormoide	-	-	X	-	-	-	-	-	-	-	-	X	-
Scinaia latifron	-	-	X	-	-	-	-	-	-	-	-	X	-
Scinaia monilifo	-	-	X	-	-	-	-	-	-	-	X	X	X
Scinaia moretone	-	-	X	-	-	-	-	-	-	-	-	-	X
Scinaia pseudoja	-	-	X	-	-	-	-	-	-	-	X	-	-
Scinaia sp	-	-	X	-	-	-	-	-	X	-	-	X	
Scinaia tsenglan	X	X	-	-	X	-	-	-	-	-	-	-	-
Sebdenia ceylani	-	-	X	-	-	-	-	-	-	-	-	-	X
Sebdenia limensi	-	-	X	-	-	-	-	-	-	-	-	X	-
Sebdenia maculat	-	-	X	-	-	-	-	-	-	-	-	-	X
Sebdenia yamadae	-	-	X	-	-	-	-	-	-	-	-	X	-
Seirospora occid	-	-	X	-	-	-	-	-	-	-	-	-	X
Sinocladia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Soliera mollis	-	X	-	-	-	-	X	-	-	-	-	-	-
Solieria anastom	-	-	X	-	-	-	-	-	-	-	-	-	X
Solieria dura	-	-	X	-	-	-	-	-	-	-	-	X	-
Solieria robusra	-	-	X	-	-	-	-	-	-	-	-	-	X
Solieria robusta	-	X	X	-	X	-	-	-	-	-	-	-	X
Solieria sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Solieria tenuis	-	X	-	-	-	-	-	-	-	-	-	-	-
Sonderopelta cor	-	-	X	-	-	-	-	-	-	-	-	-	X
Spermothamnion s	X	-	X	-	-	-	-	-	-	-	-	X	-
Sphaerococcus de	-	-	X	-	-	-	-	-	-	X	-	-	-
Sporolithon eryt	-	-	X	-	-	-	-	-	-	-	-	X	-
Sporolithon schm	-	-	X	-	-	-	-	-	-	-	-	X	-
Sporolithon sibo	-	-	X	-	-	-	-	-	-	-	-	X	-
Sporolithon timo	-	-	X	-	-	-	-	-	-	-	-	X	-
Spyridia filamen	-	X	X	-	-	-	X	-	-	X	X	X	X
Spyridia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Spyridia velasqu	-	-	X	-	-	-	-	-	-	-	-	X	-
Stylonema alsidi	-	-	X	-	-	-	-	-	-	-	X	-	-
Symphiocladia ma	-	-	X	-	-	-	-	-	-	-	X	-	X
Symphiocladia sp	X	-	-	-	-	-	-	-	-	-	-	-	-
Taenioma nanum	-	-	X	-	-	-	-	-	-	-	-	-	X

	Summary			*South China Sea*				*WWWP*					
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
Taenioma perpusi	-	X	X	-	-	-	X	-	-	-	-	X	X
Tapeinodasya bor	-	-	X	-	-	-	-	-	-	-	-	X	-
Tenarea tumidulu	-	-	X	-	-	-	-	-	-	-	X	-	-
Thamnoclonium pr	-	-	X	-	-	-	-	-	-	-	-	X	-
Thamnoclonium se	-	-	X	-	-	-	-	-	-	-	-	-	X
Thamnoclonium ti	-	-	X	-	-	-	-	-	-	-	-	-	X
Thamnoclonium tr	-	-	X	-	-	-	-	-	-	-	-	X	-
Thuretia austral	-	-	X	-	-	-	-	-	-	-	-	-	X
Tiffaniella codi	-	-	X	-	-	-	-	-	-	-	X	-	-
Titanophora incr	-	-	X	-	-	-	-	-	-	-	-	X	-
Titanophora pulc	-	X	-	-	-	-	X	-	-	-	-	-	-
Titanophora sp	-	X	X	-	-	-	-	X	-	-	-	X	-
Titanophora webe	-	-	X	-	-	-	-	-	-	-	-	X	-
Tolypiocladia ca	-	X	X	-	-	-	X	-	-	-	-	X	-
Tolypiocladia co	-	-	X	-	-	-	-	-	-	-	-	X	-
Tolypiocladia gl	X	X	X	-	X	X	X	-	-	-	-	X	X
Tolypiocladia sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Trematocarpus py	-	X	-	-	-	X	-	-	-	-	-	-	-
Trichogloea regu	-	-	X	-	-	-	-	-	-	-	-	-	X
Trichogloea requ	-	-	X	-	-	-	-	-	-	-	X	X	-
Trichogloea sp	-	-	X	-	-	-	-	-	-	-	-	X	-
Tylotus lichenoi	-	X	-	-	-	X	-	-	-	-	-	-	-
Tylotus obtusatu	-	-	X	-	-	-	-	-	-	-	-	-	X
Vanvoorstia cocc	-	-	X	-	-	-	-	-	-	-	X	-	-
Vanvoorstia spec	-	-	X	-	-	-	-	-	-	-	-	X	X
Vidalia fimbriat	-	-	X	-	-	-	-	-	-	-	-	-	X
Vidalia obtusilo	-	-	X	-	-	-	-	-	-	-	X	X	-
Vidalia spiralis	-	-	X	-	-	-	-	-	-	-	-	-	X
Weberella micans	-	X	X	-	-	-	X	-	-	-	X	-	-
Wrangelia argus	-	X	X	-	-	X	X	-	-	-	-	X	X
Wrangelia bicusp	-	-	X	-	-	-	-	-	-	-	-	X	-
Wrangelia hainan	-	X	-	-	X	-	-	-	-	-	-	-	-
Wrangelia penici	-	-	X	-	-	-	-	-	-	-	-	X	X
Wrangelia plumos	-	-	X	-	-	-	-	-	-	-	-	-	X
Wrangelia sp.	X	-	-	-	-	-	-	-	-	-	-	-	-
Wrangelia tagoi	-	X	-	-	-	X	-	-	-	-	-	-	-
Wrangelia veluti	-	-	X	-	-	-	-	-	-	-	X	-	-
Wurdemannia mini	-	X	X	-	-	-	X	-	-	-	-	X	X
Wurdemannia seta	-	-	X	-	-	-	-	-	-	X	-	-	-
Wurdemannia sp	-	-	X	-	-	-	-	-	-	-	X	-	-
Yamadaella caeno	-	-	X	-	-	-	-	-	-	-	-	X	-
Yamadaella cenom	-	-	X	-	-	-	-	-	-	-	X	-	X
Zellera tawallin	-	-	X	-	-	-	-	-	-	-	-	X	-
abbottiae	-												
amplectens	-												
australis	-												
boergesenii	-												
capricornica	-												
ceranoides	X												
chaetomorphae	-	X	-	-	-	-	-	-	-	-	-	-	-
cheyneana	-												
divaricata	X												
farinosa	X												
filaformis	-												
fragilis	-												
frappierii	-												
hainanensis	-												
hawaiiana	-												
irregularis	-												
japonica	-												
orientalis	-												
pinnata	-	X	-	-	-	X	X	-	-	-	-	-	-
pulvinata		-	X	-	-	-	-	-	-	X	-	X	-
pulvinatum		-	-	-	-	-	-	-	-	X	-	X	-
robusta	-	-	X	-	-	-	-	-	-	-	X	-	-

	Summary			*South China Sea*					*WWWP*				
Red	FLD	SCS	WP	HK	HN	XS	VN	Mly	LZ	Ryu	TW	Phil	Aust
rubra	-												
samoensis	X												
segawai	-												
setchellii	-	-	X	-	-	-	-	-	-	-	X	-	-
sinensis	-	X	-	-	-	X	-	-	-	-	-	-	-
sp.	X	X	X	-	-	-	-	-	X	-	X	-	-
subintegra	-	X	-	-	-	-	X	-	-	-	-	-	-
valida	X	-	X	-	-	-	-	-	-	-	X	-	-
viscida	-	-	X	-	-	-	-	-	-	X	-	-	-
yamadae	-	-	X	-	-	-	-	-	-	-	X	-	-

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