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

JANE E. LEWIS
and
JAMES N. NORRIS
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Robert McC. Adams
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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.
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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 Molucca 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-

*Throughout this text, Chinese place names and words not enclosed in quotation marks are spelled according to the Pin Yin romanization system.*
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 *Geidium* and *Pterocladia* (Okamura, 1934a), *Galaxaurora* (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 effect 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 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 Kōtōshō, 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 studies of the 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 of *Carpopeltis formosana*, *Laurencia sp.*, *Acanthophora orientalis*, *Halymeria duralii* var. *formosa*, *Hypnea seticulosa*, *Nemalion pulvinatum*, *Chondria armata*, and *Demonomia dichotoma*), also giving a Japanese translation 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) in-
cluded 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 Kōtōshō by Y. Yamamoto, which resulted in a list of 62 green, 50 brown, and 142 red taxa. Locations were given as "Taiwan," "Kōtōshō" (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 occurring 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 phytoecogeographic 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 Bometella 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; and Chiang 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 monospor 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 phycol­ogy of literary are those of Taiwan (= Formosa) (21°53'–25°18'N, 120°1'–122°0'E), Orchid Island (= Kōto sho 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, 1976:397–398, 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.

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Benthic Marine Algae from Taiwan

**CHLOROPHYTA**

**ULOTRICHALES**

**Ulotrichaceae**


**CHAETOPHORALES**

**Chaetophoraceae**


**ULVALES**

**Ulvaeeae**

_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, 1956; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939.
_Enteromorpha compressa_ (Linnaeus) Greville, 1830:180.
_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.
_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.

As "_E. crinita_": Ariga, 1920; Chiang, 1960; Chihara, 1970; De Toni, 1895; Fan, 1953a; Heydrich, 1894; Okamura, 1956; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939.
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.

Ulva conglobata Kjellman, 1897b: 10.

Ulva fasciata Delile, 1813:155.


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.

Ulva reticulata Forsskal, 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.

CAULERPALES

CODIACEAE

Codium adhaerens (Cabrera) C. Agardh, 1823:457.

Codium arabicum Kützing, 1856:35.
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a.

Codium contractum Kjellman, 1897b:35.

Codium cylindricum Holmes, 1896:250.
Shen and Fan, 1950.

Codium dichotomum (Hudson) S.F. Gray, 1821:293.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950.

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, 1975b; Fan, 1953a; Higashi, 1934; Horikawa, 1919; Shen and Fan, 1950; Yamada, 1950.

Chiang, 1973a.

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.

Udotheaceae

Chlorodesmis caespitosa J. Agardh, 1887:49.
Remarks: Ducker et al. (1965) and Ducker (1967) provide evidence for reducing C. formosana into synonymy 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; Shen and Fan, 1950; Segawa, 1974; Yoshikawa and Yoshikawa, 1977. As "C. freycinetii var. typica": Okamura, 1931.

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.

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

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


Caulerpaceae

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

Caulerpa freycinetii var. freycinetii f. lata Weber-van Bosse, 1898:313.

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; Tseng, 1983; Yamada, 1926.

Caulerpa racemosa var. occidentalis (J. Agardh) Börgesen, 1907:379.

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. turbinate (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, 1956; Chihara, 1975.

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

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

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.

*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; Shen and Fan, 1950.

**DERBESIACEAE**

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

**SIPHONOCLADALES**

**SIPHONOCLADACEAE**

*Boergesenia forbesii* (Harvey) Feldmann, 1938:584.

*Boodlea coacta* (Dickie) Murray et De Toni in Murray, 1889:245.

*Boodlea composita* (Harvey et J. Hooker) Brand, 1904:187.

*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”.
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.

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

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

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

**Okamura, 1931, 1932, 1935; Shen and Fan, 1950.**

Shen and Fan, 1950.

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

*Cladophoropsis zollingeri* (Kützing) Reinbold, 1905:147.
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.


Okamura, 1936; Shen and Fan, 1950; Fan, 1974; Yamada, 1950. As “Rhipidiphyllon nigrescens”: Yamada, 1925a.

*Microdictyon okamurae* Setchell, 1925:107, “okamuraei”.
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.
mura, 1930, 1931, 1936; Shen and Fan, 1950; Yamada, 1925b, 1926.

**Valonia aegagropila** C. Agardh, 1823:429.

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

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

**Valonia aegagropila** C. Agardh, 1823:429.

**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** Kutzing, 1849:508.
Okamura, 1930.

**Valoniopsis pachynema** (Martens) Borgesen, 1934:10.

**ANADYOMENACEAE**

**Anadyomene wrightii** Harvey in Gray, 1866:48.
Ariga, 1920; Chiang, 1973b; Okamura, 1936; Shen and Fan, 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.

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

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

**Ectocarpales**

**Ectocarpaceae**

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

**Ectocarpus laurenciae** Yamada, 1941:66.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1931a.

**Ectocarpus spinosus** Kutzing, 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**

**Corynophilaecae**

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

**Dictyotales**

**Dictyotaceae**

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

**Dictyopteris repens** (Okamura) Borgesen, 1920a:265.

**Dictyopteris undulata** Holmes, 1896:251.

**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.
Dictyota ceylanica var. anastomosans Yamada, 1950:186.

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 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.


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

Remarks: Fan (1953b) considers this name to be in need of synonymy since he believes Dilophus radicans may be the prostrate form of Padina commersonii (see also Lewis et al., 1987).


Pachydictyon coriaceum (Holmes) Okamura, 1899:39.
Ariga, 1920; Chiång, 1976; Chihara, 1970; Okamura, 1936; Rho, 1958; Shen and Fan, 1950.

Higashi, 1934.

Padina australis Hauck, 1887:44.

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.

Padina durvillaei Bory, 1827:591.
Ariga, 1920; Chiång, 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.

Padina tenuis Bory, 1827:590.
As “Padina commersonii”: Okamura, 1931, 1936; Shen and Fan, 1950; Yamada, 1925b, 1931a.


Spatoglossum pacificum Yendo, 1920:2.
Chiång, 1973a.

Zonaria coriacea Yamada, 1925b:249.
Chiång, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

Zonaria diesingiana J. Agardh, 1841:443.
Ariga, 1920; Chiång, 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”: Chiång, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

Zonaria nigrescens Sonder, 1845:50.
Heydrich, 1894; Shen and Fan, 1950.

Chiång and Chou, 1980.

Zonaria sp.
Su et al., 1982.

SCYTOSIPHONALES

ISHIGEACEAE

Ishige okamurae Yendo, 1907:154, ‘okamurai’.
Chiång, 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.
SCYTOSIPHONACEAE

*Chnoospora implexa* (Hering) J. Agardh, 1848:172.

  Chiang, 1960; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1939; Tseng, 1983; Yamada, 1950.

*Colpomenia sinuosa* (Mertens et Roth) Derbes et Solier in Castagne, 1851:95.

*Endarachne binghamiae* J. Agardh, 1896:27.

*Hydroclathrus clathratus* (Bory) Howe, 1920:590.

  Okamura, 1936; Shen and Fan, 1950; Tseng, 1983. As *"Hydroclathrus orientalis":* De Toni, 1895; Heydrich, 1894.

*Scolodiscus lomentaria* (Lyngbye) J. Agardh, 1848:126, *lomentarium*.

FUCALES

CYSTOSEIRACEAE

*Cystoseira prolifera* J. Agardh, 1848:215.
  Chiang, 1976.

*Cystoseira* sp.
  Nizamuddin, 1970.

  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.

*Sargassum coriifolium* J. Agardh, 1839:86.
  Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

*Sargassum crassifolium* (Agardh) Agardh, 1848:326.

*Sargassum crispifolium* J. Agardh, 1848:304.

*Sargassum cristaefolium* C. Agardh, 1820:13.

*Sargassum duplicatum* (Agardh) 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* (Agardh) Agardh, 1848:327.
  Yamada, 1950.

*Sargassum fulvellum* (Turner) C. Agardh, 1820:34.
  Ariga, 1920.

*Sargassum glaucescens* J. Agardh, 1848:306.

*Sargassum hemiphyllum* (Turner) C. Agardh, 1820:39.

*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.

*Sargassum ilicifolium* J. Agardh, 1848:337.
  Okamura, 1936; Shen and Fan, 1950; 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.
Chou and Chiang, 1981.
Sargassum kuetzingii Setchell, 1931:249.
Chou and Chiang, 1981.
Chou and Chiang, 1981.
Sargassum muriocystum C. 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.
As "S. microphyllum": Chiang, 1976; Yamada, 1925b.
Sargassum rostratum C. Agardh, 1896:55.
Sargassum sandei Reinbold in Weber-van Bosse, 1913a: 158.
As "S. microphyllum": Chiang, 1976; Yamada, 1925b.
Sargassum serratifolium C. Agardh, 1820:16.
Chiang, 1973a.
Sargassum siliquosum C. Agardh, 1848:316.
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.
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 sp.
Ariga, 1919; Horikawa, 1919.

RHODOPHYTA

GONIOTRICHALES

GONIOTRICHACEAE

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.

As "Goniotrichum alsidii": Tanaka, 1944, 1944, 1952. As "Goniotrichum alsidii": Tanaka, 1944.
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 Bangiophy- cidae.

BANGIALES

ERYTHROPELTIDACEAE

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

BANGIACEAE

Bangia atropurpurea (Roth) C. Agardh, 1824:76.
Bangia yamadae Tanaka, 1944:84, "yamadaei".

Porphyra angusta Okamura and Ueda in Ueda, 1932:28.

Porphyra crispata Kjellman, 1897a:15.
Porphyra dentata Kjellman, 1897a:13.

Porphyra suborbiculata Kjellman, 1897a:10.

Porphyra sp.

NEMALIALES

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

ACROCHAEIACEAE

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

DERMONEMATACEAE

Dermoma frappieri (Montagne et Millardet) Børge sen, 1942:42.

Dermoma 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, 1985; Fan, 1974; Heydrich, 1894.

Dermoma pulvinata (Grunow in Holmes) Fan, 1962:337.
Chen and Chiang, 1982; Chihara, 1975; Fan, 1953a; Tseng, 1983; Umezaki, 1974. 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 type­locality for the genus is therefore Taiwan (see also Fan 1974:249, 253).

Chiang and Chen, 1983.

Liagoropsis schrammi (P. et H. Crouan in Maze et Schramm)
Fan, 1974. As "L. maxima": Shen and Fan, 1950; Yamada, 1944c.

Chiang, 1973b. As "L. annulata": Okamura, 1931, 1936. As "L. cernomyce": Chihara, 1975; Segawa, 1974; Shen and Fan, 1950; Tseng, 1941a; Yamada, 1938a.

LIAGORACEAE

Helminthocladius australis Harvey, 1863, pl. 272.
Chen et al., 1981.

Liagora borgesenii Yamada, 1938a:11.

Liagora ceranoides Lamouroux, 1816:239.

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.

Ariga, 1920; Chiang and Chen, 1982; Fan, 1974; Oka­mura, 1936; Shen and Fan, 1950; Yamada, 1932b. As "L. formosana": Yamada, 1938a.


Liagora rugosa Zanardini, 1851:56.
Ariga, 1920.

Liagora segawai Yamada, 1938a:1.

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) Børge sen, 1932:6.

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., Børge sen, 1920b; Chou, 1945, 1947; Dawson, 1953;
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 canalicularata** 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 canaliculata** Kutzing, 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.

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

**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 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.

**Scinaia pseudojaponica** Yamada et Tanaka in Yamada, 1938b:127.

**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.
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.

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.

Gelidium latiusculum Okamura, 1935b:443.
Chiang, 1962a; Fan, 1951, 1953a; Okamura, 1935b, 1936; Shen and Fan, 1950.

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.

Gelidium pusillum f. foliaceum Okamura, 1934a:51.

Ariga, 1919; Horikawa, 1919.

Gelidium yamadae (Okamura) Fan, 1951:10.

Remarks: Fan (1951) considers G. densum invalid on the basis of an earlier homonym.
Gelidium sp.
Ariga, 1920.

Pterocladia nana Okamura, 1934a:64.

Pterocladia tenuis Okamura, 1934a:62.

GELIDIACEAE

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 (1973) 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, 'hornemannii'.

Rhodopeltis borealis Yamada, 1935a:75.
Arasaki, 1964; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950. As "Rhodopeltis borealis": Yamada, 1935a.


Rhodopeltis setchelliae Yamada, 1935:33, 'setchellii'.
PEYSSONNELIACEAE

Peyssonelia caulifera Okamura, 1899:8.
Ariga, 1920.

Peyssonelia distenta (Harvey) Yamada, 1930:29.

Peyssonelia rubra (Greville) J. Agardh, 1852:502.
De Toni, 1895; Heydrich, 1894; Okamura, 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. exilis*; Heydrich, 1894; Yendo, 1902. Remarks: Recently Norris and Johansen (1981:6) considered *A. exilis* 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, 1956; Rho, 1958; Segawa, 1974; Shen and Fan, 1950. As *A. exilis*; Heydrich, 1894; Yendo, 1902. As *A. zonata*; Chiang, 1962a.

Amphiroa fragilissima (Linnaeus) Lamouroux, 1816:298.

Amphiroa multifida Kutzing, 1858:27.
De Toni, 1895; Heydrich, 1894; Shen and Fan, 1950.

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.

Jania tenella Kützing, 1858:41.
Chiang, 1962a.

Lithophyllum perulatum Foslie, 1900:18.
De Toni, 1895; Okamura, 1956; 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 membranacea*; 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. 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. Melobesia spp.
Ariga, 1920.

As *Dermatolithon tumidulum*; Chiang, 1973a; Okamura, 1935b.

ENDOCLADIACEAE

Gloiopeltis complanata (Harvey) Yamada, 1932a:117.
As *Endocladium complanata*; Ariga, 1920. As *Gloiopeltis cervicornis*; Ariga, 1921.

Gloiopeltis furcata (Postels et Ruprecht) J. Agardh, 1851:235.
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.

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.
**Gigartinales**

**Solieriales**

*Eucheuma arnoldii* Weber-van Bosse, 1928:421.

*Eucheuma "audialis"*
Remarks: This species name is apparently a nomen nudum (fide M.S. Doty).

*Eucheuma cottonii* Weber-van Bosse, 1913b:115.

*Eucheuma crassum* Zanardini, 1878:36.
Shen and Fan, 1950; Yamada, 1936a.

Shen and Fan, 1950; Yamada, 1936a; Chen, 1977.

*Eucheuma gelatinae* (Esper) J. Agardh, 1852:628.

*Eucheuma muricatum* (Gmelin) Weber-van Bosse, 1928:413.
Higashi, 1934; Shen and Fan, 1950.


*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, 1876:584.
Arasaki, 1964; Chihara, 1975; Fan, 1953a; Okamura, 1936; Segawa, 1974; Tseng, 1983.

*Eucheuma spp.*
Ariga, 1920.

**Meristotheca caoxa** Okamura, 1930:97.

**Meristotheca papulosa** (Montagne) J. Agardh, 1876:584.
Arasaki, 1964; Chihara, 1975; Fan, 1953a; Okamura, 1936; Segawa, 1974; Tseng, 1983.

**Hypneaeae**

*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 chordacea* Lamouroux, 1813:131.
Chiang, 1973b; Fan, 1953a; Shen and Fan, 1950; Tseng, 1983.

*Hypnea chordacea f. simpliciuscula* (Okamura) Tanaka, 1941:232.
Chiang, 1962a; Chihara, 1975; Shen and Fan, 1950; Tanaka, 1941.

Shen and Fan, 1950; Tanaka, 1941.

Shen and Fan, 1950; Tanaka, 1941.

*Hypnea serra* J. Agardh, 1852:447.
Chiang, 1962b; Fan, 1953a; Shen and Fan, 1950; Tseng, 1983.

*Hypnea crassum* Zanardini, 1878:36.
Shen and Fan, 1950; Yamada, 1936a.

Shen and Fan, 1950; Yamada, 1936a.

*Hypnea gelatinae* (Esper) J. Agardh, 1852:628.

*Hypnea muricatum* (Gmelin) Weber-van Bosse, 1928:413.
Higashi, 1934; Shen and Fan, 1950.


*Hypnea okamurae* Yamada, 1936a:125, 'okamurai'.
Shen and Fan, 1950.

*Hypnea papulosa* Cotton et Yendo in Cotton, 1914:220.
Cotton, 1915; Tilden, 1929.

*Eucheuma serra* J. Agardh, 1852:452.
Shen and Fan, 1950; Tanaka, 1941.

*Meristotheca coacta* Okamura, 1930:97.

*Meristotheca papulosa* (Montagne) J. Agardh, 1876:584.
Arasaki, 1964; Chiang, 1962a; Fan, 1953a; Okamura, 1936; Segawa, 1974; Tseng, 1983.
cited “Montagne 1850:n.16 (page 9)” as the original place of publication.

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

*Hypnea nidulans* Setchell, 1924:161.  
Chiara, 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* Agardh, 1852:446.  
Ariga, 1920; Okamura, 1931, 1936; Tokida, 1939.

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

*PLOCAMIACEAE*

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

*Plocamium serratum* 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.  

*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.  


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

*Gracilaria arcuata* Zanardini, 1858:265.  

*Gracilaria blodgettii* Harvey, 1853:111.  

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.  

*Gracilaria canaliculata* (Kützing) Sonder, 1871:56.  
As “Corallipsis opuntia”: Arasaki, 1964; Segawa, 1974.


*Gracilaria comnopolis* J. Agardh, 1852:592.  
As “G. lichenoides f. comnopolis”: 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.  

*Gracilaria edulis* (Gmelin) Silva, 1952:293.  

*Gracilaria eucheumoides* Harvey, 1859:331.  

*Gracilaria gigas* Harvey, 1859:330.  

*Gracilaria incurvata* Okamura, 1931:41.  

*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 verrucosa*.


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.


**Sphaerococcaceae**

*Caulacanthus okamurae* Yamada, 1933:278, 'okamurai'.


*Caulacanthus spinellus* (Hooker et Harvey) Kützing, 1849:753.

Chiang, 1973b; Shen and Fan, 1950; Yamada, 1933.

*Caulacanthus ustulatus* var. *fastigiatus* (Kutzing) Pilger, 1920:5.

As "C. fastigiatus": Martens, 1866.

*Phacelocarpus japonicus* Okamura, 1902:79.

Chiang, 1962a; Shen and Fan, 1950.

**Sarcodiacaeae**

*Sarcodia ceylanica* Harvey ex Kutzing, 1869, pi. 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.


Shen and Fan, 1950.

*Gigartina intermedia* Suringar, 1870:30.

Ariga, 1921; Chiang, 1962a; Fan, 1953a; Shen and Fan, 1950; Taniguti, 1976.


Ariga, 1920.

*Gigartina tenella* Harvey, 1859:331.


*Rhodoglossum affine* (Harvey) Kylin, 1928:49.

As "Chondrus affinis": Heydrich, 1894.

**Rhodymeniales**

**Rhodymeniaceae**


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


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.


As "Ceramium clavulatum": Heydrich, 1894.

*Centroceras minutum* Yamada, 1944c:42.

Chiang, 1962a.

*Ceramium aduncum* Nakamura, 1950:159.


*Ceramium flaccidium* (Kützing) Ardissone, 1971:40.

As "C. gracillimum var. byssoidem": Itono, 1972, 1977b.
Remarks: See Womersley (1978:234–238) for discussion on the nomenclature and taxonomy of this taxon.

*Ceramium gracillimum* (Kützing) Griffiths et Harvey in Harvey, 1848b, pl. 206.


Remarks: Womersley (1979:234) considers *C. gracillimum* to be a synonym of *C. flaccidium* (Kützing) Ardisone.


*Ceramium paniculatum* Okamura, 1896:36.


*Ceramium tenerrimum* (Martius) Okamura, 1921:112.


*C. 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.


Fan, 1974; Itono, 1977b. As "*Spermothamnion cladophorae*": Okamura 1936, 1937; Shen and Fan, 1950; Yamada and Tanaka, 1934.

*Reinholdiella schmitziana* (Reinbold) De Toni, 1895:35.

Ariga, 1920.

*Sphyridia filamentosa* (Wulffen) Harvey ex Hooker, 1833:337.

Ariga, 1920; Chihara, 1975; Heydrich, 1894; Okamura, 1913, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950.

*Acrocystis nana* Zanardini, 1872:145.

Chiang, 1962b; Chihara, 1975; Okamura, 1930, 1931, 1936; Shimmen, 1938; Shen and Fan, 1950; Tseng, 1983.

*Amansia glomerata* C. Agardh, 1822:194.

Ariga, 1920; Chiang, 1962a, 1975b; Chihara, 1975; Fan, 1953a; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977.


*Brachydrina armata* (Kützing) Okamura, 1907:69.

Ariga, 1919, 1920; Chiang, 1962a, 1975b; Chihara, 1975; Fan, 1953a; Okamura, 1930, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983.

*Chondria dasyphylla* (Woodward) C. Agardh, 1822:350.

Chiang, 1962a; De Toni, 1895; Yoshikawa and Yoshikawa, 1977. As "*Laurencia dasyphylla*": Martens, 1866.

*Chondria simplex* (Wulffen) C. Agardh, 1822:350.

Chiang, 1962a; De Toni, 1895; Yoshikawa and Yoshikawa, 1977.

*Cladocera sp.*

Chiang, 1962a.


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.

**Laurencia glandulifera** Kützing, 1849:855.

**Laurencia grevilleana** Harvey, 1854:545.

**Laurencia obtusa** var. *densa* Yamada, 1931b:226.

**Laurencia palisada** Yamada, 1931b:196.

**Laurencia papillosa** (Forsskål) Greville, 1830:lii.

**Laurencia perforata** (Montagne) J. Agardh, 1876:648.

**Laurencia tropica** Yamada, 1931b:223.

**Laurencia venusta** Yamada, 1931b:203.

**Laurencia sp.**

**Leveillea jungermannioides** (Martius et Hering) Harvey,
1854:539.

**Murrayella periclados** (C. Agardh) Schmitz, 1899:227.

**Murrayella squarrosa** (Harvey) Schmitz, 1893:228.

**Murrayella jungermannioides**: Okamura, 1897.

**Neurymenia fraxinifolia** (Mertens ex Turner) J. Agardh,
1863:1135.

**Wurdemannia setacea** Harvey, 1853:246.

**Wurdemannia sp.**

**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.

**Wurdemannia sp.**

**Okamura, 1931**.
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