Floristic Account of the Marine Benthic Algae from Jarvis Island and Kingman Reef, Line Islands, Central Pacific

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Abstract—The marine benthic algae from Jarvis Island and Kingman Reef were identified from collections obtained from the Whippoorwill Expedition in 1924, the Itasca Expedition in 1935, the U.S. Coast Guard Cutter Taney in 1938, the Smithsonian Institution’s Pacific Ocean Biological Survey Program in 1964 and the U.S. National Oceanic and Atmospheric Administration’s Reef Assessment and Monitoring Program (RAMP) in 2000, 2001, 2002, 2004 and 2006. A total of 124 species, representing 8 Cyanobacteria (blue-green algae), 82 Rhodophyta (red algae), 6 Heterokontophyta (brown algae) and 28 Chlorophyta (green algae), are reported from both islands. Seventy-nine and 95 species of marine benthic algae are recorded from Jarvis Island and Kingman Reef, respectively. Of the 124 species, 77 species or 62% (4 blue-green algae, 57 red algae, 2 brown algae and 14 green algae) have never before been reported from the 11 remote reefs, atolls and low islands comprising the Line Islands in the Central Pacific.

Introduction

The Line Islands are located approximately 1600 kilometers south of the main Hawaiian Islands and consist of 11 remote reefs, atolls and low islands that lie between 7° N and 12° S latitude, and 150° W and 164° W longitude (Fig. 1). Three of the Line Islands, i.e., Jarvis Island, Kingman Reef and Palmyra Atoll, are presently components of the seven-island Pacific Remote Islands Marine National Monument established on 6 January 2009 by Presidential Proclamation. The history, geology, oceanography and biology of the three U.S. islands are described by Maragos et al. (2008). Marine and terrestrial organisms on these remote islands are managed by the U.S. Fish and Wildlife Service and are protected by U.S. Presidential executive order.

JRF passed away on 4 July 2010.
The only published records of marine benthic algae from Jarvis Island were included in taxonomic studies of Pacific *Polysiphonia* (Hollenberg 1968a) and Pacific *Herposiphonia* (Hollenberg 1968c). Two species of the red algal genus *Polysiphonia*, *P. poko* Hollenberg [now *Neosiphonia poko* (Hollenberg) Abbott] and *P. scopulorum* Harvey, and three species of the red algal genus *Herposiphonia*, *H. parca* Setchell, *H. secunda* (C. Agardh) Ambronn [= *H. tenella* f. *secunda* (C. Agardh) Hollenberg] and *H. variabilis* Hollenberg, were reported from Jarvis Island. There is no published record of any alga from Kingman Reef.

Our knowledge of the marine benthic algae from Palmyra Atoll, located 67 km southeast of Kingman Reef, is based on published studies by Howe & Lyon (1916), Dawson et al. (1955), Dawson (1959), and Braun et al. (2009). Howe & Lyon (1916) reported 12 species of marine benthic algae, including two species of blue-green algae, seven species of green algae of which *Cladophora sabulosa* Lyon was described as a new species, and three species of crustose coralline red algae. Dawson et al. (1955) reexamined Howe & Lyon (1916) specimens and two other collections made by Joseph E. King on 1 January 1953 and by Bruce W. Halstead and assistants on 27 April 1953. Dawson et al. (1955) provided a listing of algae from the field, as well as algae found in the alimentary tract of herbivorous fish. This study also relegated the new species *Cladophora sabulosa* under *Cladophoropsis sundanensis* Reinbold, and *Halimeda macroloba* Decaisne, reported by Howe & Lyon (1916), was identified as *H. discoidea* Decaisne.
Dawson (1959) provided a general comparative observation of the terrestrial and marine vegetation of Palmyra Atoll in 1913 and 1958, and described four new species of red algae, i.e., \textit{Alsidium pacificum} Dawson, \textit{Cryptonemia umbraticola} Dawson, \textit{Antithamnion palmyrense} Dawson and \textit{Pterocladiella tropica} Dawson. The latter two species are now recognized as synonyms of \textit{Antithamnion lherminieri} (P. Crouan & H. Crouan) Bornet ex Nasr and \textit{Pterocladiella caerulescens} (Kützing) Santelices & Hommersand, respectively. Hollenberg (1968a) recorded \textit{Polysiphonia flaccidissima} Hollenberg [now \textit{Polysiphonia sertularioides} (Grateloup) J. Agardh] and \textit{P. upolensis} (Grunow) Hollenberg from Palmyra Atoll in his Pacific taxonomic treatment of the genus \textit{Polysiphonia}. Skelton & South (2007) lists \textit{Jania adhaerens} Lamouroux from Palmyra Atoll as an incidental specimen examined during the study of Samoan algae. Although Braun et al. (2009) did not provide a comprehensive list of algal species found, their examination of benthic percent cover specifically discussed five species, two of which, \textit{Dichotomaria marginata} (J. Ellis & Solander) Lamarck and \textit{Galaxaura filamentosa} Chou, were new records for both Palmyra Atoll and the Line Islands.

The other eight islands and atolls in the Line Islands are administered by the Republic of Kiribati. Except for Tabuaeran (Fanning Atoll), the existing knowledge of the marine benthic algae from the other non-U.S. islands in the Line Islands is almost nonexistent. The information on the marine benthic algae of Tabuaeran (DeWreede & Doty 1970, Russell 1973, Tsuda 1973 and Tsuda et al. 1973) is based on two expeditions in January 1970 and August 1972, organized by the University of Hawai’i’s Hawaii Institute of Geophysics and reported in two technical reports. Hollenberg (1968a, 1968c) reported \textit{Polysiphonia herpa} Hollenberg, \textit{P. pokos} [now \textit{Neosiphonia poko}], \textit{P. scopulorum}, \textit{Herposiphonia obscura} Hollenberg, \textit{H. secunda} and \textit{H. variabilis} from Kiritimati (Christmas Island). There are no published records of marine benthic algae from any of the other six Line Islands.

The present paper is the first floristic account of the marine benthic algae from Jarvis Island and Kingman Reef in the Line Islands. It represents the fifth publication on the diversity of marine benthic algae based on collections made by U.S. Fish and Wildlife Service personnel or during NOAA expeditions over the past decade to six of the seven U.S. islands and atolls of the Pacific Remote Islands Marine National Monument. The four recent studies reported algal species from Wake Atoll (Tsuda et al. 2006, 2010a), Howland Island and Baker Island (Tsuda et al. 2008) and Johnston Atoll (Tsuda et al. 2010b). NOAA phycologists are currently studying the algae of Palmyra Atoll (Line Islands), the seventh island or atoll within this Marine National Monument. This paper also summarizes all reported algal species (Appendix 1) from the 11 reefs, atolls and low islands within the Line Islands in the Central Pacific.

\section*{Materials and Methods}

Major collections of marine benthic algae in subtidal habitats were obtained by SCUBA during four expeditions to Jarvis Island and Kingman Reef (Figs. 2 and 3) and conducted by either (1) the Honolulu Laboratory’s Coral Reef Ecosys-
tem Investigation (CREI), Southwest Fisheries Science Center, National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA) in February 2001 and March 2002, or (2) the Pacific Islands Fisheries Science Center (PIFSC), Coral Reef Ecosystem Division (CRED), NMFS, NOAA, in March and April 2004 and 2006. CRED evolved from CREI when the Honolulu Laboratory became PIFSC in 2003. The majority of algae were placed in plastic bags, labeled and frozen immediately after each dive. Selected macroalgae were dried in plant presses aboard the research vessel. See Preskitt et al. (2004) for sampling method performed during the algal collections.

Prior to examination, the frozen algae in plastic bags from each station were thawed in tap water. Thawed seawater was poured carefully out of the bag and replaced with 4% formalin in seawater to prevent the delicate turf and epiphytes from decomposing. The collections were examined using a dissecting microscope, and all epiphytes and turf were separated. The majority of the small specimens were mounted on glass slides, i.e., specimens were decalcified with 10% hydrochloric acid, stained with aniline blue and mounted with 30% corn syrup (Karo) with phenol. Larger specimens were typically mounted on segments of herbarium paper, although some specimens were preserved in vials with 4% formalin in seawater for further sectioning. The small quantity of replicate unprocessed specimens from
each station were consolidated into separate jars and preserved in 4% formalin in seawater. The retention of these specimens was to allow us to revisit the site collection, if needed, during our critical taxonomic reexaminations of the specimens.

NOAA stations were designated by a code system, e.g., JAR-04P-04, which signifies Jarvis Island (JAR), permanent station or site number (04P), and the year 2004 when the specimens were collected (04). A brief description of each station is presented in Appendix 2. Specimens of only three species, *Neosiphonia apiculata* (Hollenberg) Masuda & Kogame, *Polysiphonia scopulorum* Harvey and *Valonia macrophysa* Kützing, collected by Robin Newbold during the first Pacific Reef Assessment and Monitoring Program (RAMP) cruise in March 2000 were found in the Bishop Museum and included here.

Other specimens from Jarvis Island previously deposited in the *Herbarium Pacificum* of the Bishop Museum were also examined and included in this floristic study; no specimens from Kingman Reef were found in *Herbarium Pacificum*. The Jarvis collections consisted of six species collected by H. F. Bergman during the Whippoorwill Expedition in August 1924, four species collected by F. S. Collins and anonymous collectors during the Itasca Expeditions in March, April and June 1935, one specimen of *Turbinaria ornata* (Turner) J. Agardh collected by Edwin
H. Bryan Jr. on 8 August 1938 aboard the U.S. Coast Guard Cutter Taney, and three species collected by Charles R. Long during the Smithsonian Institution’s Pacific Ocean Biological Survey Program in November 1964.

The following higher level classification systems were used: Cyanobacteria (Anagnostidis and Komárek 1988, Komárek and Anagnostidis 1989, Silva et al. 1996); Rhodophyta (Abbott 1999, Yoon et al. 2006, Choi et al. 2008); Heterokontophyta (Abbott and Huisman 2004); and Chlorophyta (Abbott and Huisman 2004, Cocquyt et al. 2010). Guiry & Guiry (2011) was consulted for current names and synonyms. Citations listed after the species represent references that provide descriptions and illustrations of the species. Brief annotations were included for the Cyanobacteria to show what characters were used in the identification. Annotations for the other algae were provided only when specimens differed from the norm or were uncommon in the central equatorial Pacific. A few species were represented by as many as 40 specimens, i.e., *Heterosiphonia crispella* (C. Agardh) Wynne; voucher specimens, however, were limited to a maximum of five specimens per island or atoll.

Genera and species are listed alphabetically under their respective families. Except for a limited number of species retained by NOAA (assigned accession numbers beginning with PSV), the majority of specimens were assigned Bishop Museum (BISH) numbers. All BISH numbered specimens listed here are deposited and are maintained in the data base of the Herbarium Pacificum at the Bishop Museum; PSV numbered specimens are deposited at the NOAA Fisheries' PIFSC CRED. New species records for the Line Islands are preceded by asterisks.

### Floristic Account

**Phylum Cyanobacteria**

**Class Cyanophyceae**

**Order Oscillatoriales**

**Family Oscillatoriaceae**


Trichomes, enclosed in distinct sheaths, are 20–32 µm diam. with cells 2 – 3 µm long, with distinct indentation at cross walls.

Specimen examined: Kingman. KIN-08-04, *BISH* 725664.

*Lyngbya confervoides* C. Agardh; Desikachary 1959: 315, pl. 49 (fig. 8), pl. 52 (fig. 1).

Trichomes are 10–16 µm diam. with cells 2–4 µm long; cross walls are not constricted. Sheaths are clear and do not appear striated contrary to a characteristic of this species.


*Lyngbya penicilliformis* P. Silva; Littler & Littler 2000: 452.
Trichomes are 4–6 µm diam. and cells 5 µm long; cross walls are not constricted. Numerous empty sheaths are present.

Specimen examined: Kingman. KIN-10P-01, BISH 725536.

*Lyngbya sordida* Gomont [= *Lyngbya polychroa* (Meneghini) Rabenhorst]; Tilden 1910: 118, pl. 5 (fig. 37); Engene et al. 2010: 593, figs. 1A, 1D.

Trichomes are 16–24 µm diam. with cells 4–8 µm long; cross walls are slightly constricted. Sheaths are clear and not striated.

Specimens examined: Jarvis. JAR-02-06, BISH 723788; JAR-04P-01, BISH 724120; JAR-07P-04, BISH 723828; JAR-09-01, BISH 724136. Kingman. KIN-03-04, BISH 724705; KIN-10P-06, BISH 724784; KIN-13-02, BISH 725786; KIN-18-06, BISH 726270; KIN-19-06, BISH 725505.

**Family Phormidiaceae**

*Blennothrix* *cf.* *comoides* (Gomont) Anagnostidis & Komárková [= *Hydrocoleum comoides* Gomont]; Humm & Wicks 1980: 143.

Trichomes are 10–14 µm diam. and cells 2–4 µm long, and possess distinct constricted cross walls. Apices, however, are blunt and not tapering through several cells.

Specimens examined: Kingman. KIN-10P-04, BISH 725730; KIN-11-04, BISH 726395.

*Phormidium laysanense* Lemmermann; Tilden 1910: 104, pl. 5 (figs. 7, 8).

Thalli consist of fascicles with trichomes 3–4 µm diam. and cells 4–12 µm long. Cross walls in BISH 725527 are very faint.

Specimens examined: Jarvis. JAR-11P-04, BISH 724045. Kingman. KIN-03-01, BISH 725519; KIN-05P-01, BISH 725828; KIN-08-01, BISH 725727; KIN-12-01, BISH 725724; KIN-15-06, BISH 725563.

**Family Pseudoanabaenaceae**

*Spirocoleus* *cf.* *fragilis* (Meneghini) P. Silva; Littler & Littler 2000: 462.

Thallus consist of fascicles with trichomes 1 µm diam. and cells 1 µm long. Sheaths are obscure.

Specimen examined: Kingman. KIN-13-06, BISH 726442.

**Order Nostocales**

**Family Rivulariaceae**

Calothrix confervicola (Dillwyn) C. Agardh; Fan 1956: 169, fig. 6.

Specimens are only 50 µm long with round basal heterocysts, 6 µm diam.

Specimen examined: Kingman. KIN-05P-04, BISH 725815 on Neomeris vanbosseae.
Phylum Rhodophyta
Class Stylonematophyceae
Order Stylonematales
Family Stylonemataceae

Stylonema alsidii (Zanardini) Drew; Skelton & South 2007: 12, figs. 9, 10.
Specimens examined: Kingman. KIN-07-04, BISH 726366 with Lyngbya confervoides; KIN-13-02, BISH 725782.

*Stylonema cornu-cervi* Reinsch; Abbott 1999: 44, fig. 1D.
Specimen examined: Jarvis: JAR-02-06, BISH 723795 on Pterocladilla caloglossoides.

Class Compsopogonophyceae
Order Erythropeltidales
Family Erythrotrichiaceae

Erythrotrichia carnea (Dillwyn) J. Agardh; Abbott 1999: 45, fig. 1E.
Specimens examined: Jarvis: JAR-08-06, BISH 724010; JAR-09-06, BISH 724071.

Class Rhodophyceae
Order Nemaliales
Family Acrochaetiaceae

*Acrochaetium hypneae* (Børgesen) Børgesen [= Acrochaetium seriatum Børge-
sen]; Abbott 1999: 56, fig. 3J.
Specimen examined: Jarvis. JAR-04P-06, BISH 723907.

Family Liagoraceae

*Liagora ceranoides* Lamouroux; Abbott 1999: 84, figs. 13I–M; N’Yeurt & Payri 2010: 24, figs. 29, 30.
Specimen examined: Kingman. KIN-19-04, BISH 724748 with benthic dia-
tom Licmorma.

Order Gelidiales
Family Gelidiaceae

Pterocladiella caeruleascens (Kützing) Santelices & Hommersand [= Pterocladia tropica Dawson]; Abbott 1999: 197, fig. 51E.

All dried plants were bright red and less than 3 cm tall. Prostrate axes were subcylindrical with erect axes flattened and less than 400 µm wide. As per Abbott (1999), the branchings were mostly irregular. One of four dried specimens (BISH 724112) possessed erect axis with two pairs of opposite subcylindrical lateral branchlets which were slightly swollen at the apices, similar to the tetrasporangial sori of *Pterocladiella bulbosa* (Loomis) Santelices. Rhizines were present in medulla only. *Pterocladia tropica* described as a new species from Palmyra Atoll, Line Islands, by Dawson (1959) is a synonym of *P. caeruleascens*. 

Tsuda et al.: Marine algae from Jarvis I. and Kingman Reef
Specimens examined: Jarvis. JAR-01-06, BISH 724112; JAR-11P-04, BISH 724047.

*Pterocladiella caloglossoides* (Howe) Santelices 1998: 243, fig. 3.

Specimens examined: Jarvis. JAR-02-06, BISH 723792; JAR-04P-06, BISH 723911; JAR-07P-04, BISH 723838; JAR-08-04, BISH 724020; JAR-09-02, BISH 724113.

**Family Gelidiellaceae**

*Parviphycus antipai* (Celán) Santelices [= *Gelidiella antipai* Celán]; Abbott 1999: 202, figs. 53D–F as *Gelidiella antipai* Celán; N’Yeurt & Payri 2010: 36, figs. 59-61.

Specimens examined: Jarvis. JAR-07P-02, BISH 723960; JAR-11P-04, BISH 724050; JAR-12-06, BISH 723815. Kingman. KIN-03-04, BISH 724721; KIN-08-04, BISH 725659; KIN-10P-04, BISH 725750; KIN-16P-02, BISH 724985; KIN-16P-04, BISH 725428.

**Order Corallinales**

**Family Corallinaceae**

*Jania pacifica* Areschoug [= *Jania mexicana* W. R. Taylor]; Taylor 1945: 197, pl. 60; Tsuda et al. 2008: 275, fig. 2A.

Segments, 160–240 µm diam. and about 3x long as broad, are constricted and possess rounded terminal segments.

Specimens examined: Jarvis. JAR-07P-02, BISH 723957; JAR-07P-06, BISH 723868; JAR-11P-02, BISH 724159; JAR-11P-06, BISH 723986. Kingman. KIN-04-06, BISH 726293; KIN-06-06, BISH 725484; KIN-07-04, BISH 726372; KIN-07-06, BISH 726329; KIN-10P-04, BISH 725746.

*Jania pumila* Lamouroux; Abbott 1999: 189, fig. 48C; N’Yeurt & Payri 2010: 56, fig. 98.


*Jania rubens* (Linnaeus) Lamouroux; Taylor 1950: 133.

Thallus of *BISH 725646* is similar to *Jania pacifica*; however, the terminal segments are acute. *BISH 725817* possesses both rounded and acute terminal segments.

Specimens examined: Kingman. KIN-05P-04, BISH 725817; KIN-08-04, BISH 725646, conceptacles.

**Order Gigartinales**

**Family Halymeniaceae**

*Carpopeltis bushiae* (Farlow) Kylin; Abbott 1999: 135, fig. 32A.

Specimen examined: Jarvis. JAR-01-04, BISH 732994.

*Cryptonemia umbraticola* Dawson 1959: 43, figs. 21F, 22A; Abbott 1999: 136, fig. 32B; N’Yeurt & Payri 2010: 42, figs. 74, 75.
Specimens examined: Jarvis. JAR-01-06, BISH 724151 (PSV 10858); JAR-04P-04, BISH 723939. Kingman. KIN-02-06, BISH 742963.

*Cryptonemia yendoi* Weber-van Bosse; Abbott 1999: 138, figs. 32C–E.

Specimens examined: Jarvis. JAR-08-06, BISH 723993. Kingman. KIN-02-06, BISH 724847; KIN-07-04, BISH 726345; KIN-08-04, BISH 725660; KIN-12-01, BISH 725721; KIN-15-06, BISH 725543.

*Halymenia cf. actinophysa* Howe; Abbott 1999: 143, fig. 34A.

Specimen examined: Jarvis. JAR-02-06, BISH 723799; JAR-07P-01, BISH 726467. Kingman. KIN-10P-01, BISH 725537.

Family Hypneaceae

_Hypnea pannosa_ J. Agardh; Abbott 1999: 57, figs. 100–102.

Specimen examined: Kingman. KIN-21-06, BISH 726240.


Specimens examined: Jarvis. JAR-02-06, BISH 723786; JAR-04P-01, BISH 724118; JAR-04P-04, BISH 723938; JAR-04P-06, BISH 723898.

Family Nemastomataceae

*Predaea weldii* Kraft & Abbott; Abbott 1999: 153, fig. 37D–F.

Specimens examined: Kingman. KIN-07P-04, BISH 725820; KIN-07-01, BISH 724738; KIN-11-04, BISH 726399.

Family Peyssonneliaceae


Specimens examined: Jarvis. JAR-08-04, BISH 724024. Kingman. KIN-05P-04, BISH 725820; KIN-07-01, BISH 724738; KIN-11-04, BISH 726399.

Family Solieriaceae

_Wurdemannia miniata_ (Sprengel) Feldmann & Hamel; Abbott 1999: 238.

Specimens examined: Kingman. KIN-13-02, BISH 725781; KIN-13-04, BISH 725789.

Order Rhodymeniales

Family Champiaceae

*Champia parvula* (C. Agardh) Harvey; Skelton & South 2007: 68, figs. 126–133.

Specimens examined: Kingman. KIN-02-06, BISH 724836; KIN-05P-04, BISH 725797; KIN-07-04, BISH 726351; KIN-09-01, BISH 724691; KIN-16P-04, BISH 725438.

Family Lomentariaceae

_Lomentaria hakodatensis_ Yendo; Abbott 1999: 224, figs. 62A–D.
Specimens examined: Jarvis. JAR-02-06, BISH 723798; JAR-04P-01, BISH 724116; JAR-04P-04, BISH 723940; JAR-04P-06, BISH 723921; JAR-07P-06, BISH 723861. Kingman. KIN-21-06, BISH 726248.

**Family Rhodymeniaceae**

*Chrysymenia kaernbachii* Grunow; Abbott 1999: 230, fig. 64B.
Specimens examined: Jarvis. JAR-01-04, BISH 732996; JAR-07P-04, BISH 723842; JAR-08-04, BISH 724016.

*Coelothrix irregularis* (Harvey) Børgeesen; Abbott 1999: 233, figs. 65A–D.
Specimen examined: Jarvis. JAR-01-06, BISH 724113.

*Halichrysis coalescens* (Farlow) R. E. Norris & Millar; Abbott 1999: 235, figs. 66A–C.
Specimen examined: Jarvis. JAR-04P-06, BISH 723900; JAR-08-01, BISH 724086.

**Order Ceramiales**

**Family Callithamniaceae**

*Aglaothamnion boergesenii* (Aponte & Ballantine) L’Hardy-Halos & Rueness; Abbott 1999: 244, figs. 67C–F.
Specimens examined: Jarvis. JAR-07P-04, BISH 723855; JAR-09-06, BISH 724069; JAR-12-06, BISH 723809.

*Aglaothamnion cordatum* (Børgeesen) Feldmann-Mazoyer; Abbott 1999: 244, figs. 67G–H.
Specimen examined: Jarvis. JAR-07P-02, BISH 723973.

*Crouania mageshimensis* Itono; Abbott 1999: 293, figs. 82A–D.
Specimens examined: Kingman. KIN-10P-06, BISH 724795; KIN-12-04, BISH 725404; KIN-18-06, BISH 726272.

*Crouania minutissima* Yamada; Abbott 1999: 294, figs. 82E–G.
Specimens examined: Kingman. KIN-06-06, BISH 725473; KIN-07P-04, BISH 726349; KIN-07P-06, BISH 726340; KIN-12-06, BISH 726482.

**Family Ceramiaceae**

As per Skelton & South (2007) and N’Yeurt & Payri (2010), *A. lherminieri* is used over *A. antillanum* despite the brief four-word original description of the basionym *Callithamnion lherminieri* P. Crouan & H. Crouan. *A. palmyrense* was one of four new species described by Dawson (1959) from Palmyra Atoll.
Specimens examined: Jarvis. JAR-02-06, BISH 723789; JAR-04P-04, BISH 723937; JAR-07P-04, BISH 723853; JAR-10-04, BISH 723878. Kingman. KIN-16P-04, BISH 725431.

Axial cells are 68–120 µm long and apical cells are rounded.

Specimens examined: Jarvis. JAR-02-06, BISH 723785; JAR-04P-06, BISH 723923; JAR-07P-04, BISH 723847. Kingman. KIN-12-02, BISH 726318; KIN-13-02, BISH 725780; KIN-21-06, BISH 726245.

*Antithamnionella graeffei* (Grunow) Athanasiadis; Skelton & South 2007: 87, figs. 186–188.

Main axis consists of short barrow-shaped cells at the apex.

Specimens examined: Kingman. KIN-05P-04, BISH 725796; KIN-08-04, BISH 725656; KIN-08-06, BISH 724816; KIN-13-04, BISH 726433; KIN-18-06, BISH 726261.

*Ceramium affine* Setchell & Gardner; South & Skelton 2000: 54, figs. 1–10.

Specimens examined: Kingman. KIN-07-02, PSV 10171; KIN-07-04, BISH 726374; KIN-11-04, BISH 726405; KIN-12-06, BISH 726484.

*Ceramium clarionense* Setchell & Gardner; Abbott 1999: 269, figs. 75A–C.

Specimens examined: Kingman. KIN-04-06, BISH 726296; KIN-08-04, BISH 725573, 725671; KIN-13-04, BISH 726415.


Specimens examined: Kingman. KIN-03-04, BISH 724723; KIN-10P-04, BISH 725736.

*Ceramium krameri* South & Skelton; South & Skelton 2000: 69, figs. 45–51.

Specimens examined: Kingman. KIN-03-06, BISH 724758; KIN-05P-04, BISH 725803; KIN-06-06, BISH 725490; KIN-07-04, BISH 726367; KIN-13-04, BISH 726428.

*Ceramium macilentum* J. Agardh [= *Ceramium mazatlanense* Dawson]; South & Skelton 2000: 71, figs. 52–62.

Specimens examined: Jarvis. JAR-07P-06, BISH 723866; JAR-08-04, BISH 724022; JAR-08-06, BISH 724006; JAR-12-06, BISH 723803. Kingman. KIN-03-04, BISH 724708; KIN-08-04, BISH 725645; KIN-10P-06, BISH 724785; KIN-12-04, BISH 725379; KIN-13-06, BISH 726445.

*Ceramium punctiforme* Setchell; South & Skelton 2000: 59, figs. 15–19.

Specimens examined: Jarvis. JAR-07P-04, BISH 723845; JAR-07P-06, BISH 723863.

*Ceramium vagans* P. Silva; South & Skelton 2000: 85, figs. 89–93.

Specimens examined: Jarvis. JAR-04P-06, BISH 723913; JAR-10-04, BISH 723936.


Specimens examined: Kingman. KIN-03-06, BISH 734922; KIN-08-01, BISH 725685; KIN-10P-04, BISH 725752; KIN-11-02, BISH 725464; KIN-13-04, BISH 726431.

**BISH 724035** possesses a prostrate axis, 240 µm diam., and narrower 140 µm diam. erect axes.

Specimens examined: Jarvis. JAR-04P-04, BISH 723935; JAR-04P-06, BISH 723894; JAR-11P-02, BISH 724155; JAR-11P-04, BISH 724036. Kingman. KIN-10P-06, BISH 724794; KIN-11-01, BISH 725757; KIN-11-04, BISH 726383; KIN-15-02, BISH 725371; KIN-16P-02, BISH 724980.

**Gayliella transversalis** (Collins & Hervey) T. O. Cho & Fredericq; Cho & Fredericq 2006: 727, figs. 5a–n, 6a–e; N’Yeurt & Payri 2010: 117, figs. 228, 229.

As per N’Yeurt & Payri (2010), most Pacific island specimens have been mistakenly reported as *Gayliella flaccida* (Kützing) T. O. Cho & L. McIvor [= *Ceramium flaccidum* (Harvey ex Kützing) Ardissone].

Specimens examined: Jarvis. JAR-04P-06, BISH 723893; JAR-07P-02, BISH 723956; JAR-07P-04, BISH 723848; JAR-11P-04, BISH 724039. Kingman. KIN-03-04, BISH 724713; KIN-11-02, BISH 725467; KIN-19-04, BISH 724749.

**Family Dasyaceae**

  Specimens examined: Kingman. KIN-04-06, BISH 726286; KIN-08-04, BISH 725570; KIN-10P-06, BISH 724789; KIN-11-02, BISH 725455; KIN-13-06, BISH 726440.

* **Dasya iridescens** (Schlech) Millar & Abbott; Abbott 1999: 321, figs. 91A–G.
  Specimens examined: Jarvis. JAR-07P-02, BISH 723965; JAR-08-01, BISH 724087; JAR-08-06, BISH 723995; JAR-09-06, BISH 724072; JAR-12-06, BISH 723808. Kingman. KIN-07-04, BISH 726355; KIN-12-02, BISH 726322; KIN-19-06, BISH 725498.

* **Dasya iyengarii** Børgesen; Skelton & South 2007: 145, figs. 386–391.
  Specimens examined: Kingman. KIN-03-04, BISH 724722; KIN-18-06, BISH 726273.

**Heterosiphonia crispella** (C. Agardh) Wynne; Skelton & South 2007: 149, figs. 398–405.

  Specimens examined: Jarvis. JAR-04P-04, BISH 723932; JAR-07P-04, BISH 723837; JAR-12-06, BISH 723821. Kingman. KIN-02-06, BISH 724837; KIN-03-04, BISH 724704; KIN-03-06, BISH 724770; KIN-10P-06, BISH 726304; KIN-20-06, BISH 724967.

**Family Delesseriaceae**

* **Branchioglossum prostratum** Schneider; Abbott 1999: 331, figs. 95C, D.
  Specimen examined: Kingman. KIN-04-06, BISH 742956.

* **Hypoglossum caloglossoides** Wynne & Kraft 1985: 9, figs. 1–19.
  Specimens examined: Kingman. KIN-04-06, BISH 726287; KIN-05P-04, BISH 725816; KIN-08-04, BISH 725572; KIN-08-06, BISH 724829.

* **Hypoglossum minimum** Yamada; Wynne et al. 1989: 31, figs. 7–11.
Specimens examined: Jarvis. JAR-04P-06, BISH 723914; JAR-07P-02, BISH 723962; JAR-07P-04, BISH 723835; JAR-07P-06, BISH 723862; JAR-09-06, BISH 724070.

*Hypoglossum sp.*

A single sterile specimen consists of four narrow prostrate blades, 5 mm long. One blade consists of distinctly undulating margins as depicted in *Hypoglossum wynnei* Abbott by Abbott (1996); the other three blades lack undulating margins. New bladelets appear at the distal damaged section, at the apex of the midrib and at the base. An examination of the holotype (*BISH 634741*) of *H. wynnei* shows that the second-order and third-order cells are larger and longer, 72 x 16 µm, than the cells of our Jarvis specimen.

Specimen examined: Jarvis. JAR-04P-04, BISH 723951.

*Taenioma perpusillum* (J. Agardh) J. Agardh; Abbott 1999: 348, figs. 101A–E.

Specimen examined: Kingman. KIN-21-06, BISH 726250.

**Family Rhodomelaceae**

*Chondria polyrhiza* Collins & Hervey; Abbott 1999: 360, figs. 103G–H.

Specimens examined: Jarvis. JAR-07P-04, BISH 723841; JAR-09-01, BISH 724140; JAR-09-02, BISH 724100; JAR-09-06, BISH 724065. Kingman. KIN-02-06, BISH 724853; KIN-12-04, BISH 725390; KIN-19-06, BISH 725504.

*Chondria simpliciuscula* Weber-van Bosse; Abbott 1999: 361, figs. 104A–F.

Specimens examined: Jarvis. JAR-07P-02, BISH 723966; JAR-08-01, BISH 724092; JAR-08-06, BISH 723997; JAR-11P-04, BISH 724035; JAR-12-06, BISH 723818. Kingman. KIN-02-06, BISH 724851; KIN-03-04, BISH 724709; KIN-05P-04, BISH 725821; KIN-07-06, BISH 726333; KIN-19-06, BISH 725510.

*Herposiphonia arcuata* Hollenberg; Hollenberg 1968c: 538, fig. 5.

Specimens examined: Jarvis. JAR-01-04, BISH 732995; JAR-07P-04, BISH 723846; JAR-12-06, BISH 723816.

*Herposiphonia obscura* Hollenberg; Hollenberg 1968c: 549, fig. 25.

Specimens examined: Jarvis. JAR-04P-06, BISH 723920; JAR-04P-04, BISH 723952. Kingman. KIN-17-02, BISH 725835.

*Herposiphonia pacifica* Hollenberg; Hollenberg 1968c: 549, figs. 2A, 2B, 4, 19.

Specimens examined: Jarvis. JAR-04P-06, BISH 723922.

*Herposiphonia secunda* (C. Agardh) Ambronn; Abbott 1999: 376, figs. 109A–E.

Previous record: Jarvis. Hollenberg 1968c as *Herposiphonia tenella f. secunda* (C. Agardh) Hollenberg.

Specimens examined: Jarvis. JAR-04P-06, BISH 723901; JAR-07P-02, BISH 723958; JAR-07P-04, BISH 723839; JAR-08-06, BISH 723996; JAR-11P-04, BISH 724042.


Previous record: Jarvis. Hollenberg 1968c.

Specimens examined: Jarvis. JAR-08-06, BISH 723990; JAR-09-02, BISH 724095; JAR-10-04, BISH 723875; JAR-10-06, BISH 723887; JAR-11P-06, BISH 723978.
*Laurencia majuscula* (Harvey) Lucas; Saito 1969: 149.

*Neosiphonia apiculata* (Hollenberg) Masuda & Kogame [= *Polysiphonia apiculata* Hollenberg]; Hollenberg 1968a: 61, figs. 1D, 8, 9.

*Neosiphonia cf. poko* (Hollenberg) Abbott [= *Polysiphonia poko* Hollenberg]; Hollenberg 1968a: 70, figs. 3A, 15, 22.
Previous record: Jarvis. Hollenberg 1968a.

*Polysiphonia anomala* Hollenberg; Hollenberg 1968a: 59, figs. 1A, 1B, 1C.
Specimen examined: Kingman. KIN-07-06, *BISH* 724737.

*Polysiphonia scopulorum* Harvey; Hollenberg 1968a: 79, figs. 6F, 30, 31, 33, 36.
Previous record: Jarvis. Hollenberg 1968a.

**BISH 724019** possesses short rhizoids with multicellular tips and may represent another species.

Specimens examined: Jarvis. Smithsonian Institution, C. R. Long (2703.1), BISH 594680, 16.xi.1964; JAR-02-06, BISH 723797; JAR-07P-02, BISH 723963; JAR-07P-04, BISH 723829; JAR-08-04, BISH 724019; JAR-09-06, BISH 724063. Kingman. KIN-03-06, BISH 724768; KIN-12-02, BISH 726320; KIN-12-04, BISH 725400.

**Polysiphonia upolensis** (Grunow) Hollenberg; Hollenberg 1968a: 94, figs. 6D, 6E, 29, 35, 42.

Specimen examined: Jarvis. JAR-04P-06, BISH 723897.

**Spirocladia barodensis** Børgesen; Abbott 1999: 438, figs. 131A, B.

Specimens examined: Jarvis. JAR-10-04, BISH 723869. Kingman. KIN-03-04, BISH 724707; KIN-03-06, BISH 724767; KIN-07-02, PSV 10165f; KIN-11-04, BISH 726403.

**Family Sarcomeniaceae**

**Dotyella hawaiiensis** (Doty & Wainwright) Womersley & Shepley [= **Cottoniella hawaiiensis** Doty & Wainwright]; Doty & Wainwright 1958: 229, figs. 1–9; Abbott 1999: 334, figs. 96A–C.

Erect axes, 40–64 μm diam. and up to 10 mm long, are polysiphonous with four pericentral cells and possess numerous monosiphonous filaments, 4 μm diam. and up to 800 μm long. The mature tetrasporangial stichidia are terminal on stalks; the swollen sections are 270–600 μm long with acute apices as illustrated in Doty & Wainwright (1959).

Specimens examined: Jarvis. JAR-10-04, BISH 723869. Kingman. KIN-06-01, BISH 725541; KIN-08-06, BISH 724828; KIN-13-04, BISH 726413.

**Dotyella irregularis** Abbott; Abbott 1984: 370, figs. 3–6, 8.

Specimens examined: Kingman. KIN-05P-04, BISH 725801; KIN-07-04, BISH 726354; KIN-11-04, BISH 726397; KIN-13-06, BISH 726446.

**Malacocena minimum** Hollenberg; Hollenberg 1963: 169, figs. 1–3.

Specimens examined: Jarvis. JAR-07P-01, BISH 724168; JAR-08-01, BISH 724085; JAR-09-02, BISH 724101; JAR-09-06, BISH 724077; JAR-12-06, BISH 723817. Kingman. KIN-07-01, BISH 724737; KIN-09-01, BISH 724689; KIN-10P-06, BISH 724792; KIN-12-04, BISH 725395; KIN-12-06, BISH 726497.

**Family Wrangeliaceae**

**Anotrichium secundum** (Harvey ex. J. Agardh) Furnari; Abbott 1999: 245, figs. 68A–C.

Erect axial filaments are 180–280 μm diam.

Specimens examined: Jarvis. JAR-01-04, BISH 732992; JAR-07P-04, BISH 723849; JAR-08-06, BISH 723994; JAR-10-04, BISH 723874; JAR-12-06, BISH 723807.

**Anotrichium tenue** (C. Agardh) Nägeli; Abbott 1999: 247, fig. 68D; N’Yeurt & Payri 2010: 104, fig. 203.
Erect axial filaments are 80–126 µm diam.  

*Diplothamnion jolyi* van den Hoek; Abbott 1999: 297, fig. 83C.  
Opposite determinate branches produced on 48 µm diam. prostrate axis.  
Specimen examined: Kingman. KIN-07-02, *PSV 10163e*.

*Griffithsia heteromorpha* Kützing; Abbott 1999: 300, figs. 84A–C.  

*Griffithsia subcylindrica* Okamura; Abbott 1999: 302, figs. 85C–D.  

*Lejolisia pacifica* Ito; Abbott 1999: 307, figs. 86F–G.  
Disk-shaped rhizoid and 1-cell stalked tetrasporangia are conspicuous.  
Specimen examined: Kingman. KIN-04-06, *BISH 726298*.

*Monosporus indicus* Børgesen; Abbott 1999: 308, figs. 86H–J.  

*Ptilothamnion cladophorae* (Yamada & Tanaka) Feldmann-Mazoyer; Abbott 1999: 313, fig. 871.  

**Phylum Heterokontophyta**  
**Class Phaeophyceae**  
**Order Ectocarpales**  
**Family Ectocarpaceae**

Filaments are 18–24 µm diam. Sessile plurilocular reproductive bodies (1–2 locules wide) are 80 µm long and 20 µm diam., and elongate cylindrical with rounded apices.  
Specimen examined: Kingman. KIN-WRECK2-01, *BISH 724675*.

**Order Dictyotales**  
**Family Dictyotaceae**

*Dictyopteris repens* (Okamura) Børgesen; Tsuda 1972: 94, pl. 3 (fig. 1).  
**Dictyota ceylanica** Kützing; Abbott & Huisman 2004: 202, fig. 77B.

Specimens are light brown, up to 2 cm long and blades 3–4 mm wide and 0.1 mm thick with rounded apices. Single layer of medullary cells is ca. 64 µm tall and 56 µm wide, and is flanked by single rows of much smaller cortical cells ca. 16 µm tall and 8 µm wide.

**Lobophora variegata** (Lamouroux) Womersley ex Oliveira; Tsuda 1972: 97, pl. 5 (fig. 1).

**Phylum Chlorophyta**
**Class Ulvophyceae**
**Order Ulvales**

**Ulva clathrata** (Roth) C. Agardh [= *Enteromorpha clathrata* (Roth) Greville]; Abbott & Huisman 2004: 46, figs. 5A–C.
Based on the molecular studies by O’Kelly et al. (2010) on Hawai’i’s *Ulva*, the Line Islands specimens most likely reported here belong to an operational taxonomic unit which is unnamed. *BISH* 723918 and 723945 are less than 2 mm long with predominantly uniseriate branches. The other two specimens are 3–5 mm long with multiseriate branches. At this time, the present binomial based on morphological characters is used until further molecular studies with larger samplings are conducted (O’Kelly et al. 2010).
Specimens examined: Jarvis. Whippoorwill Expedition, H. J. Bergman (66), BISH 506204, viii.1924; JAR-04P-04, BISH 723945; JAR-04P-06, BISH 723918; JAR-11P-04, BISH 724049. Kingman. KIN-WRECK1-01, BISH 724676.

*Ulva lactuca* Linnaeus; Abbott & Huisman 2004: 55, figs. 10A–D as *Ulva fasciata* Delile; O’Kelly et al. 2010: 731.

Strap-like thalli are 2-cell thick, 96–104 µm diam.; rhizoidal cells are prominent in cross-sections. Based on molecular evidence, O’Kelly et al. (2010) could only substantiate *Ulva lactuca* as one of the 12 *Ulva* species occurring in Hawaii.


**Order Cladophorales**

**Family Anadyomenaceae**

*Microdictyon setchellianum* Howe; Egerod 1952: 366, figs. 6c–g, pl. 33.

Cells of primary branches are 176–240 µm diam. with crenulating anastomosing cells present. The single specimen looks similar to *Boodlea montagnei* (Harvey ex J.E. Gray) Egerod, but lacks the characteristic tenacular cells.

Specimens examined: Kingman. KIN-05P-02, BISH 725770; KIN-12-06, BISH 726481.

*Microdictyon umbilicatum* (Velley) Zanardini; Abbott & Huisman 2004: 62, fig. 15B.

Primary branches are 176–240 µm in diameter.

Specimens examined: Jarvis. JAR-09-01, BISH 724135; JAR-09-02, BISH 724099; JAR-12-06, BISH 723813. Kingman. KIN-02-06, BISH 724842; KIN-05P-06, BISH 724802; KIN-08-06, BISH 724057; KIN-16P-02, BISH 724983; KIN-19-06, BISH 725499.

*Phyllodictyon anastomosans* (Harvey) Kraft & Wynne; Kraft & Wynne 1996: 131, figs. 16–25.

Few siphons have developed opposite lateral knobs; net-like pattern present in few specimens.

Specimens examined: Jarvis. JAR-07P-04, BISH 723851; JAR-09-01, BISH 724146. Kingman. KIN-07-01, BISH 724735; KIN-10P-04, BISH 725731; KIN-11-02, BISH 725470; KIN-20-06, BISH 724862.

**Family Cladophoraceae**

*Cladophora catenata* (Linnaeus) Kützing [= *Cladophoropsis luxurians* Gilbert, *Cladophora luxurians* (Gilbert) Abbott & Huisman]; Gilbert 1962: 136, fig. 2; Abbott & Huisman 2003: 282, figs. 7, 8; Leliaert & Coppejans 2006: 672.

Filaments are 160–280 µm diam. Proximal originating digitate rhizoids are approximately 24 µm diam. and up to 4.2 mm long, and can be non-septate or 1–2 septate. Leliaert & Coppejans (2006) relegated *C. luxurians* as a synonym of *C. catenata*.
Specimens examined: Jarvis. JAR-01-04, BISH 732991; JAR-08-04, BISH 724025; JAR-08-06, BISH 723999. Kingman. KIN-07-01, BISH 724744; KIN-07-04, BISH 726362; KIN-09-01, BISH 725528; KIN-10P-04, BISH 725744; KIN-11-04, BISH 726382.

*Cladophora cf. flexuosa* (O. F. Müller) Kützing; Abbott & Huisman 2004: 72, fig. 20C.

Filaments, up to 7 mm long, appear like fragments or young specimens of *Cladophora flexuosa* which can attain a height of 30 cm (Abbott & Huisman 2004). Basal sector, 320–360 µm diam., tapers toward the distal sector, 80–100 µm diam. Two branching sites of BISH 725713 show trichotomous branches, similar to those observed in *Cladophora laetevirens* (Dillwyn) Kützing, which possesses narrower main branches, 90–180 µm diam.

Specimens examined: Jarvis. JAR-11P-04, BISH 724033. Kingman. KIN-02-06, BISH 724846; KIN-03-06, BISH 724778; KIN-08-06, BISH 724831; KIN-11-01, BISH 725713; KIN-12-04, BISH 725384.

**Family Siphonocladiaceae**

*Cladophoropsis cf. philippinensis* Taylor; Leliaert & Coppejans 2006: 666, figs. 35–39.

Matted specimens are either immature or fragments, less than 2.5 cm across with apical cells 480–940 µm diam. Except for the large diameter, some specimens appear similar to *Cladophoropsis membranacea* (Hofman Bang ex C. Agardh) Børjesen as per fig. 33 in Leliaert & Coppejans (2006); a few specimens morphologically resemble the genus *Valoniopsis*.

Specimens examined: Kingman. KIN-02-06, BISH 724849; KIN-05P-02, BISH 725772; KIN-06-06, BISH 725488; KIN-11-06, BISH 724805; KIN-15-06, BISH 725558.

*Dictyosphaeria cavernosa* (Forsskål) Børjesen; Egerod 1952: 350, figs. 1b–f, 2f, 2g.

Specimens examined: Jarvis. JAR-04P-01, BISH 724124; JAR-04P-04, BISH 723931; JAR-04P-06, BISH 723892; JAR-07P-01, BISH 724161; JAR-11P-02, BISH 724152. Kingman. KIN-06-01, BISH 725689; KIN-07-01, BISH 724729; KIN-11-01, BISH 725759; KIN-11-02, BISH 725446.

*Dictyosphaeria versluysii* Weber-van Bosse; Egerod 1952: 351, figs. 1a, 2h–k.

Specimens examined: Jarvis. Itasca Expedition, BISH 506161, 28.vi.1935; JAR-01-06, BISH 724114; JAR-02-06, BISH 723780; JAR-04P-01, BISH 724132; JAR-08-01, BISH 724079. Kingman. KIN-08-01, BISH 725683; KIN-09-01, BISH 724693; KIN-13-02, BISH 725777; KIN-15-02, BISH 724990; KIN-19-06, BISH 725501.

**Family Valoniaceae**


Valonia utricularis (Roth) C. Agardh; Skelton & South 2007: 260, fig. 689.
Specimens are characterized by irregular sized vesicles.
Specimens examined: Jarvis. JAR-02-06, BISH 723801; JAR-04P-04, BISH 723949; JAR-04P-06, BISH 723890; JAR-07P-06, BISH 723858; JAR-11P-06, BISH 723979. Kingman. KIN-10P-01, BISH 725699; KIN-10P-06, BISH 726303; KIN-12-04, BISH 725409; KIN-13-04, BISH 726418; KIN-14-02, BISH 725676.

*Valonia ventricosa* J. Agardh; Kraft 2007: 121, figs. 51A–D.
Specimens examined: Kingman. KIN-03-06, BISH 724766; KIN-04-06, BISH 726302; KIN-05P-01, BISH 725717; KIN-11-01, BISH 725711.

**Order Bryopsidales**

**Family Bryopsidaceae**

Bryopsis hypnoides Lamouroux; Skelton & South 2007: 262.
Specimens examined: Jarvis. JAR-07P-02, BISH 723971. Kingman. KIN-21-06, BISH 726243.

Bryopsis pennata Lamouroux; Egerod 1952: 370, fig. 7.
Specimens examined: Jarvis. Whippoorwill Expedition, south end, coral reef, *H. J. Bergman* (60), BISH 544167, 10.viii.1924; JAR-02-06, BISH 723796; JAR-04P-01, BISH 724115; JAR-04P-06, BISH 723919 (drift); JAR-11P-04, BISH 724041. Kingman. KIN-06-06, BISH 725472; KIN-12-04, BISH 725375.

**Family Caulerpaceae**

*Caulerpa nummularia* Harvey ex J. Agardh; Abbott & Huisman 2004: 121, fig. 44A.
Specimen examined: Kingman. KIN-21-06, BISH 726252.

*Caulerpa serrulata* (Forsskål) J. Agardh; Meñeñez & Calumpong 1982: 9, pl. 2E.
Specimens examined: Jarvis. JAR-04P-04, BISH 723941; JAR-11P-04, BISH 724030. Kingman. KIN-06-06, BISH 725471; KIN-07-04, BISH 726344; KIN-08-06, BISH 724830; KIN-09-01, BISH 724696; KIN-15-06, BISH 725552.

Caulerpella ambiguа (Okamura) Prud’homme van Reine & Lokhorst [= Caulerpa ambiguа Okamura]; Eubank 1946: 410, figs. 2a, 2b, pl. 22 as *Caulerpa ambiguа*.
Specimens examined: Jarvis. JAR-04P-01, BISH 726465; JAR-08-01, BISH 726475.

**Family Codiaceae**

Codium edule Silva; Egerod 1952: 392, fig. 18, pl. 35b.
Utricles are 120–160 µm diam. and 240–560 µm long which are thinner than utricles of Samoan *Codium geppiorum* O. Schmidt, 180–410 µm diam. as reported by Skelton & South (2007).
Specimens examined: Jarvis. JAR-04P-01, BISH 724122; JAR-04P-04, BISH 723927; JAR-08-01, BISH 726477.
Family Derbesiaceae


All siphons are sterile and less than 1 cm long and 160–265 µm diam. (central part), i.e., narrower than *Pedobesia clavaeformis* (J. Agardh) Macrailand & Womersley (see Macrailand & Womersley 1974) which is up to 1,100 µm diam. but wider than *P. ryukyuensis* (Yamada & T. Tanaka) Kobara & Chihara (see Kobara & Chihara 1984) which is 35–50 µm diam. Fertile *Derbesia ryukyuensis* Yamada & Tanaka, now *Pedobesia ryukyuensis*, was reported from Palmyra Atoll, located 67 km southeast of Kingman Reef, by Dawson (1959). The absence of sporangia on all of the Jarvis Island and Kingman Reef specimens makes this identification tentative. The shape of the spheroidal sporangia of *P. simplex* differs considerably from the obovoid sporangia of *P. ryukyuensis*. *Pedobesia simplex* has previously been reported in the Pacific from Japan (Kobara & Chihara 1984) and Korea (Lee & Kang 1986).

Specimens examined. Jarvis. JAR-04P-04, BISH 723954; JAR-04P-06, BISH 723908; JAR-07P-04, BISH 723850; JAR-09-01, BISH 724139; JAR-11P-04, BISH 724038. Kingman. KIN-06-01, BISH 725694; KIN-13-02, BISH 725791.

Family Halimedaceae

*Halimeda fragilis* Taylor; Taylor 1950: 88, pl. 48 (fig. 2).

Specimens examined: Jarvis. Whippoorwill Expedition, reef, 0.3-0.6 m deep, H. J. Bergman (62), BISH 506179, 10.viii.1924; Itasca Expedition, BISH 506160, 28.vi.1935; JAR-01-04, BISH 732988; JAR-04P-06, BISH 723902; JAR-07P-04, BISH 723844; JAR-10-06, BISH 723884. Kingman. KIN-07-01, BISH 724733; KIN-14-02, BISH 725674; KIN-16P-04, BISH 725415; KIN-19-04, BISH 724746.

*Halimeda opuntia* (Linnaeus) Lamouroux; Hillis-Colinvaux 1980: 110, figs. 19, 51, 92.

Specimens examined: Jarvis. JAR-09-01, BISH 724148. Kingman. KIN-02-06, BISH 724838; KIN-03-01, BISH 724679; KIN-13-02, BISH 725775.

*Halimeda taenicola* W.R. Taylor 1950: 86, pl. 46 (fig. 1).

Specimens examined: Kingman. KIN-08-06, BISH 724818; KIN-09-01, BISH 724700; KIN-11-04, BISH 726396; KIN-12-02, BISH 726306; KIN-16P-04, BISH 725445.

Family Udoteaceae

*Avrainvillea amadelpha* (Montagne) A. Gepp & E. Gepp; Olsen-Stojkovich 1985: 36, fig. 19, pl. 7a.

Siphons, 16–20 µm diam., have more rounded than pointed apices; pseudocortex is present.

Specimen examined: Kingman. KIN-11-04, BISH 726381.

*Avrainvillea lacerata* Harvey ex J. Agardh; Olsen-Stojkovich 1985: 33, fig. 18, pl. 6b.
Fronds are thin and lack pseudocortex.

Specimens examined: Kingman. KIN-06-06, BISH 725475; KIN-08-01, BISH 725682; KIN-12-04, BISH 725393; KIN-16P-04, BISH 725413; KIN-20-06, BISH 724855.


Siphons are less than 4 mm long with dichotomous branches (28–40 µm diam.) not constricted at base of dichotomy. The genus *Pseudochlorodesmis* is retained since it has not been clearly shown that *P. furcellata* represents a life phase of *Halimeda tuna* (J. Ellis & Solander) Lamouroux or any other species of *Halimeda* (see Kraft 2007).

Specimens examined. Jarvis. JAR-04P-01, BISH 726464; JAR-04P-06, BISH 723915.


Siphons are less than 2 mm long, terminally branched and 20–40 µm diam. As per Verbruggen et al. (2009), the form genus *Pseudochlorodesmis* is retained at this time.

Specimens examined. Kingman. KIN-07-02, PSV 10172; KIN-07-04, BISH 726375.

**Order Dasycladales**
**Family Dasycladaceae**

*Neomeris vanbosseae* Howe; Egerod 1952: 405, fig. 22b, pl. 41.

Two sterile juvenile specimens of *Neomeris, BISH 725396* (KIN-12-04) and *BISH 725500* (KIN-19-06), were also present in the Kingman Reef collections. Since the external calcification patterns were non-descriptive, no species designation could be assigned to the two specimens.

Specimens examined: Kingman. KIN-03-04, BISH 724715; KIN-07-06, BISH 726342; KIN-08-04, BISH 725661; KIN-10P-06, BISH 724790; KIN-16P-06, BISH 724811.

**Discussion**

A total of 124 species of marine benthic algae was identified from Jarvis Island and Kingman Reef, i.e., 8 Cyanobacteria, 82 Rhodophyta, 6 Heterokontophyta and 28 Chlorophyta. The 95 species recorded from Kingman Reef (Table 1) as opposed to the 79 species recorded from Jarvis Island may reflect differences in collecting effort (47 collections occurred at Kingman Reef versus 22 collections at Jarvis Island during the 2001, 2002, 2004 and 2006 cruises), or may be the result of habitat differences between the two islands, or the amount of available reef area. Whereas Jarvis Island contains only fore-reef habitat and one shallow-reef shelf, Kingman Reef is a classic atoll system with fore reef, back reef, and lagoonal habitats. Additionally, Kingman Reef possesses 11 times more reef area that is
shallower than 30 m than Jarvis Island (47.63 km² vs. 4.32 km² for Kingman Reef and Jarvis Island, respectively).

Table 1. Number of species of Cyanobacteria, Rhodophyta, Heterokontophyta and Chlorophyta reported from Jarvis Island and Kingman Reef, and number of new species records for the Line Islands.

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Number of Species</th>
<th>Jarvis Island (22 stations)</th>
<th>Kingman Reef (47 stations)</th>
<th>Total</th>
<th>New Line Islands Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyanobacteria</td>
<td>3</td>
<td>8</td>
<td>8</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Rhodophyta</td>
<td>52</td>
<td>59</td>
<td>82</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Heterokontophyta</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Chlorophyta</td>
<td>19</td>
<td>24</td>
<td>28</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>79</td>
<td>95</td>
<td>124</td>
<td>77 (62%)</td>
<td></td>
</tr>
</tbody>
</table>

Of the 124 species reported here, 77 (62%) represent new species records for the Line Islands, i.e., 4 blue-green algae, 57 red algae, 2 brown algae and 14 green algae. Forty-one percent of the species encountered occurred at both Kingman Reef and Jarvis Island, while 23% were reported only for Jarvis Island and 36% were reported only for Kingman Reef. Only Herposiphonia parca reported by Hollenberg (1968c) from Jarvis Island was not among the present collections.

The presence of the green alga Pedobesia cf. simplex and the red alga Dotyella hawaiiensis collected from both Jarvis Island and Kingman Reef is noteworthy. The first record of the genus Pedobesia in the central and western Pacific islands, i.e., Pedobesia clavaeformis (J. Agardh) MacRaild & Womersley, was reported from Swains Island, American Samoa (Tsuda et al. 2011). Pedobesia cf. simplex represents the second record of the genus from central and western Pacific islands. Specimens of Dotyella hawaiiensis from Jarvis Island and Kingman Reef represent the first record of this species from central Pacific islands outside the Hawaiian Archipelago.

Understanding baseline diversity and abundance of marine algae and other organisms on near-pristine reefs surrounding isolated and unpopulated islands such as Jarvis Island and Kingman Reef is imperative for successful reef conservation efforts on a global scale. Macroalgal overgrowth of coral in degraded ecosystems has erroneously led to the belief that the presence of algae in tropical marine ecosystems is indicative of decreased reef health (Vroom et al. 2006, Vroom 2011), and documenting the high algal species diversity and abundance on protected and healthy reefs in U.S. Marine National Monuments is fundamentally altering perceived negative stereotypes of the algal communities that naturally occur alongside coral and other benthic invertebrates (Tsuda et al. 2006, 2008, 2010a, 2010b; Vroom et al. 2005, 2010; Vroom & Timmers 2009; Vroom & Braun 2010). Understanding that algal populations typically cover a majority of hard-bottomed substrate in healthy tropical marine environments is forcing management agencies to reevaluate metrics useful for gauging ecosystem health (Vroom 2011).
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References


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Appendix 1. Previous records of marine benthic algae from the Line Islands, Central Pacific. The synonyms cited below represent species reported by authors for specimens collected from the Line Islands. Type specimens from the Line Islands are presented in boldface.

Cyanobacteria


*Rhodophyta*


*Alsidium pacificum* Dawson 1959 (Type from Palmyra).


*Antithamnion thermini* (P. Crouan & H. Crouan) Bornet ex Nasr [= *Antithamnion palmyrense* Dawson 1959, Palmyra]


Cryptonemia umbraticola Dawson 1959 (Type from Palmyra).


Hydrolithon gardineri (Foslie) Verheij & Prud’homme van Reine [= Porolithon gardineri Foslie, Porolithon marshallense Taylor]. Palmyra. Howe & Lyon 1916 as Lithophyllum craspedium


*Polysiphonia herpa* Hollenberg. Kiritimati. Hollenberg 1968a


*Pterodictyliella caerulescens* (Kützing) Santelices & Hommersand [= *Pterocladia tropica* Dawson 1959, Palmyra].


Heterokontophyta


Chlorophyta


Dictyosphaeria cavernosa (Forsskål) Børgesen [= D. favulosa (C. Agardh) Decaisne ex Endlicher].
Ulva clathrata (Roth) C. Agardh [= Enteromorpha clathrata (Roth) Greville]. Palmyra. Dawson et al. 1955.
Valonia utricularis (Roth) C. Agardh. Palmyra. Dawson 1959.

Jarvis Island

JAR-01-04 (00° 22.062' S, 159° 58.751' W). Gradual declining reef slope at northeast side, limestone and coral rubble, 14 m deep, 26.iii.2004.
JAR-01-06. See JAR-01-04 for coordinates and habitat, 20.iii.2006.
JAR-02-06 (00° 22.878' S, 160° 00.494' W). Reef slope at southwest side, high coral cover, 14.3 m deep, 21.iii.2006.
JAR-04P-01 (00° 22.920' S, 159° 59.958' W). Reef wall at south side, 15.2 m deep, 17.ii.2001.
JAR-04P-04 (00° 22.900' S, 159° 59.895' W). Reef slope at south side, high coral cover, 15.2 m deep, 27.iii.2004.
JAR-04P-06. See JAR-04P-04 for coordinates and habitat, 21.iii.2006.
JAR-07P-01 (00° 22.570' S, 160° 00.856' W). Steep reef slope at west side, soft corals abundant, 23.8 m deep, 16.ii.2001.
JAR-07P-04 (00° 22.592' S, 160° 00.863' W). Steep reef slope at west side, 14.6 m deep, 27.iii.2004.
JAR-07P-06. See JAR-07P-04 for coordinates and habitat, 22.iii.06.
JAR-08-04 (00° 21.800' S, 159° 59.451' W). Gradual declining reef slope at north side, limestone and coral rubble, 17.1 m deep, 26.iii.04.
JAR-08-06. See JAR-08-04 for coordinates and habitat, 20.iii.06.
JAR-09-02. See JAR-09-01 for coordinates and habitat, 10.iii.2002.
JAR-09-06. (00° 21.925' S, 160° 00.385' W). Reef slope at northwest side, 14.6 m deep, 20.iii.2006.
JAR-10-04 (00° 22.831' S, 159° 58.367 W). Reef slope off southeast corner, limestone and coral rubble, 12.2 m deep, 26.iii.2004.
JAR-10-06. See JAR-10-04 for coordinates and habitat, 21.iii.2006.
KIN-03-06 (06° 23.413' N, 162° 21.625' W). Back reef in southeast end of lagoon, 15.9 m deep, 02.iv.2006.

Kingman Reef

KIN-02-06 (no coordinates). 01.iv.2006.
KIN-06-06. See KIN-06-01 for coordinates and habitat, March 2006.
KIN-08-06 (06° 25.746’ N, 162° 22.946’ W). Reef slope in north lagoon, 10.1 m deep, 30.iii.2006.
KIN-12-06. See KIN-12-04 for coordinates and habitat, 31.iii.2006.
KIN-14-02 (06° 26.090’ N, 162° 23.413’ W). North back-reef slope, 14.6 m deep, 18.iii.2002.
KIN-16P-02 (06° 23.533’ N, 162° 20.542’ W). Southeast lagoon back reef, 7.3 m deep, 18.iii.2002.
KIN-16P-06 (06° 23.542’ N, 162° 20.523’ W). Southeast lagoon back reef, 7.3 m deep, 02.iv.2006.