

Marine Benthic Algae of Johnston Atoll: New Species Records, Spatial Distribution, and Taxonomic Affinities with Neighboring Islands¹

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Abstract: Forty-five of the 107 species of marine benthic algae collected during 2004 and 2006 NOAA cruises to isolated Johnston Atoll and two additional species from earlier collections represent new species records. Total number of algae is now increased to 189 species: 26 species of cyanobacteria (blue-green algae), 105 species of red algae, 15 species of brown algae, and 43 species of green algae. The macroalga *Caulerpa serrulata* and the epiphyte *Lomentaria bakodatenensis* were the most widely distributed species at Johnston Atoll based on frequency of occurrence at 10 of 12 stations and 8 of 12 stations, respectively, during the 2004 NOAA cruise. Despite the atoll's isolation, the parasitic red alga *Neotenophycus ichthyosteus* and the cyanobacterium *Borzia elongata* are the only endemic algal species on Johnston Atoll. Nonmetric multidimensional scaling analyses indicate that taxonomic affinities of Johnston Atoll lie between French Frigate Shoals and Wake Atoll. In terms of atolls, biodiversity of the marine flora of Johnston Atoll (i.e., 189 species) is surpassed only by the 256 algal species of the much-larger and better-studied Enewetak Atoll in the Marshall Islands.

JOHNSTON ATOLL (16° 45' N, 169° 31' W) is an isolated atoll (Figure 1) in the North central Pacific that lies 804 km south of

French Frigate Shoals (Northwestern Hawaiian Islands), 1,448 km northwest of Kingman Reef (Line Islands), and 2,575 km northeast of the Marshall Islands. The atoll has been jointly managed by the U.S. Army, the U.S. Air Force, and the U.S. Fish and Wildlife Service and has served as both a military base and a National Wildlife Refuge. Currently, the lagoon at Johnston Atoll covers an area of 158 km² and contains a heterogeneous mix of environments ranging from sandy plains to highly rugose coral-dominated reefs. On 6 January 2009, Johnston Atoll and six other U.S. atolls and islands were designated as the Pacific Remote Islands National Marine Monument by presidential decree, which protects and preserves all natural resources within the designated area. Amerson and Shelton (1976) provided extensive information on the natural history of the atoll.

Both land and marine environments at Johnston Atoll have been substantially modified by anthropogenic activities over the past 70 yr (Coles et al. 2001, Lobel 2003). After an initial contract was awarded in 1939 to construct a small navy base, portions of the lagoon were dredged and filled to enlarge Johnston and Sand islets from 0.18 to 2.58

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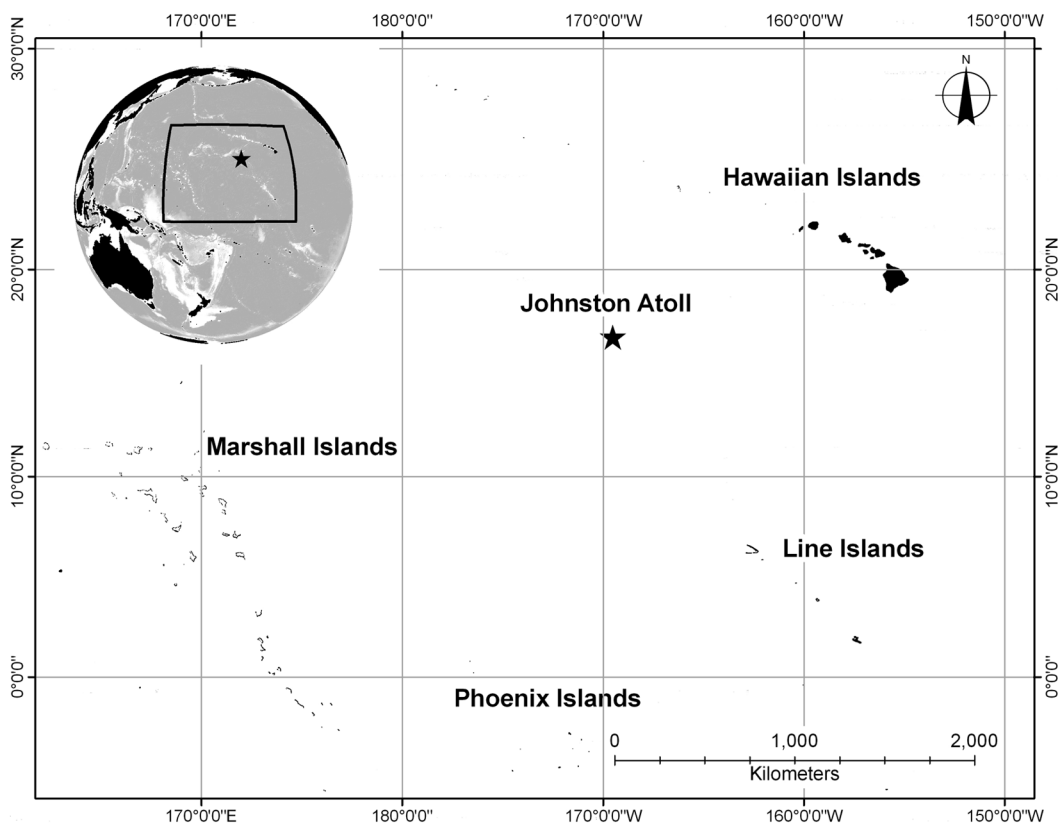


FIGURE 1. Location of Johnston Atoll in relationship to the Northwestern Hawaiian Islands, the main Hawaiian Islands, the Line Islands, the Phoenix Islands, and the Marshall Islands.

km² and from 0.04 to 0.09 km², respectively, and to create two additional islets, North (Akau) (0.1 km²) and East (Hikina) (0.7 km²) islets (Lobel 2003). In August 1958 and July 1962, aboveground thermonuclear devices were detonated over Johnston Atoll that resulted in radioactive fallout on the islets and in the lagoon. Although the atoll is considered to contain relatively healthy reef communities, historical human impacts have undoubtedly affected some marine habitats.

Moul (1964) recorded the first marine alga, *Halimeda tuna* (Ellis & Solander) Lamouroux, from Johnston Atoll during his study of the green alga *Halimeda* and *Udotea* in the Pacific. Studies were conducted on the ecological impact of dredging operations in the Johnston lagoon (Brock et al. 1965, 1966). As part of that study, Richard G. Bug-

geln and Roy T. Tsuda collected marine benthic algae from the lagoon in August and December 1965. The majority of the collections consisted of hammered or chiseled pieces of calcareous substrata covered by algal turf communities. An annotated account of 76 species of marine benthic algae (16 cyanobacteria [blue-green algae], 34 red algae, seven brown algae, and 19 green algae) was provided in an unpublished technical report of the University of Hawai'i, Hawai'i Institute of Marine Biology (Buggeln and Tsuda 1966). The listing also included 16 taxa identified only at the generic level.

Based in part on those collections and earlier collections made by Robert S. Jones in April 1965, Hollenberg (1968a,c) reported seven species of *Polysiphonia*: *P. anomala* Hollenberg, *P. flaccidissima* Hollenberg var.

decimera Hollenberg [now *Neosiphonia flaccidissima* (Hollenberg) M. S. Kim & I. K. Lee], *P. poko* Hollenberg [now *Neosiphonia poko* (Hollenberg) Abbott], *P. scopulorum* Harvey var. *minima* Hollenberg, *P. setacea* Hollenberg, *P. tenuis* Hollenberg [now *P. triton* Silva as a replaced name], and *P. upolensis* (Grunow) Hollenberg, and four species of *Herposiphonia*: *H. pacifica* Hollenberg, *H. parca* Setchell, *H. tenella* f. *secunda* (C. Agardh) Hollenberg [now *H. secunda* (C. Agardh) Ambronn], and *H. variabilis* Hollenberg, from Johnston Atoll. The holotypes of *Neosiphonia poko*, *Polysiphonia triton*, and *Herposiphonia variabilis* were specimens from Johnston Atoll. *Corallophila apiculata* (Yamada) R. E. Norris was also reported from Johnston Atoll by Hollenberg (1968d) and later by Buggeln and Tsuda (1969) as *Centroceras apiculatum* Yamada.

R. G. Buggeln and colleagues returned to Johnston Atoll in July 1966 and collected additional algal specimens. The unpublished technical report by Buggeln and Tsuda (1966) was updated to include additional species collected in July 1966 and published (Buggeln and Tsuda 1969). The updated listing included 90 species of marine benthic algae (19 species of cyanobacteria identified by the late "W" Jan Newhouse, 38 species of red algae, nine species of brown algae, and 24 species of green algae) from Johnston Atoll. The red alga *Crotonia minutissima* Yamada was inadvertently listed twice. Fourteen of the 90 entities (four cyanobacteria, two brown algae, and eight red algae) were cited only by the generic names.

Sixteen years later, Aegegian and Abbott (1985) reported seven species of marine algae in waters 45 to 250 m deep collected during four dives in the manned submersible *Makali'i* on the southwestern side of Johnston Atoll in October 1983. The species included two brown algae, *Dictyota bartayresiana* Lamouroux and *Lobophora variegata* (Lamouroux) Womersley; four green algae, *Caulerpa bikenensis* Taylor, *Caulerpella ambigua* (Okamura) Prud'homme van Reine & Lokhorst, *Dictyosphaeria versluysii* Weber-van Bosse, and *Halimeda gracilis* Harvey; and a red alga of the genus *Dasya*. *Lobophora variegata*, *C. ambigua*,

and *D. versluysii* were previously reported by Buggeln and Tsuda (1969) but not at great depths. A new species of cyanobacteria, *Borzia elongata* Baker, Patterson & Ikagawa, was described from Johnston Atoll by Baker et al. (1997).

Coles et al. (2001) reported on the identity of marine species observed and collected during a 5-day marine survey of Johnston Atoll on 16–20 June 2000. A total of 75 algal species was presented (55 red algae, six brown algae, and 14 green algae). An additional 23 algal taxa (16 red algae, three brown algae, and four green algae) were identified to genus. No specimen numbers were provided in the technical report; later, herbarium and slide specimens were provided specimen numbers and deposited in BISH.

Among this collection, a new genus and species of parasitic red alga, *Neotonophycus ichthyosteus* Kraft & Abbott, was described growing on its host, *Neosiphonia poko* (Kraft and Abbott 2002). Holotypes of the parasite and host alga are from Johnston Atoll. *Neosiphonia poko* is known from several islands and atolls in the Pacific, but the parasite is thus far known only from Johnston Atoll.

The study reported here provides an account of 47 new species records of marine benthic algae from Johnston Atoll, spatial distribution based on frequency of occurrences at 12 stations during the 2004 and 2006 cruises conducted by the National Oceanic and Atmospheric Administration (NOAA), and their taxonomic affinities to algae from neighboring islands and atolls. Prior records of species identified only to the generic level are not included here unless the specimens are the only representatives of the genera from Johnston Atoll (*Cladophoropsis* sp. and *Wurdemannia* sp. [Buggeln and Tsuda 1969] and *Kallymenia* sp. and *Spermathamnion* sp. [Coles et al. 2001]). Crustose coralline algae were not collected on the two cruises.

MATERIALS AND METHODS

Fourteen of the 18 NOAA stations (Figure 2) were situated in the lagoon at depths between 1.5 and 17.4 m. The remaining four stations were located on the foreereef in waters 13.7

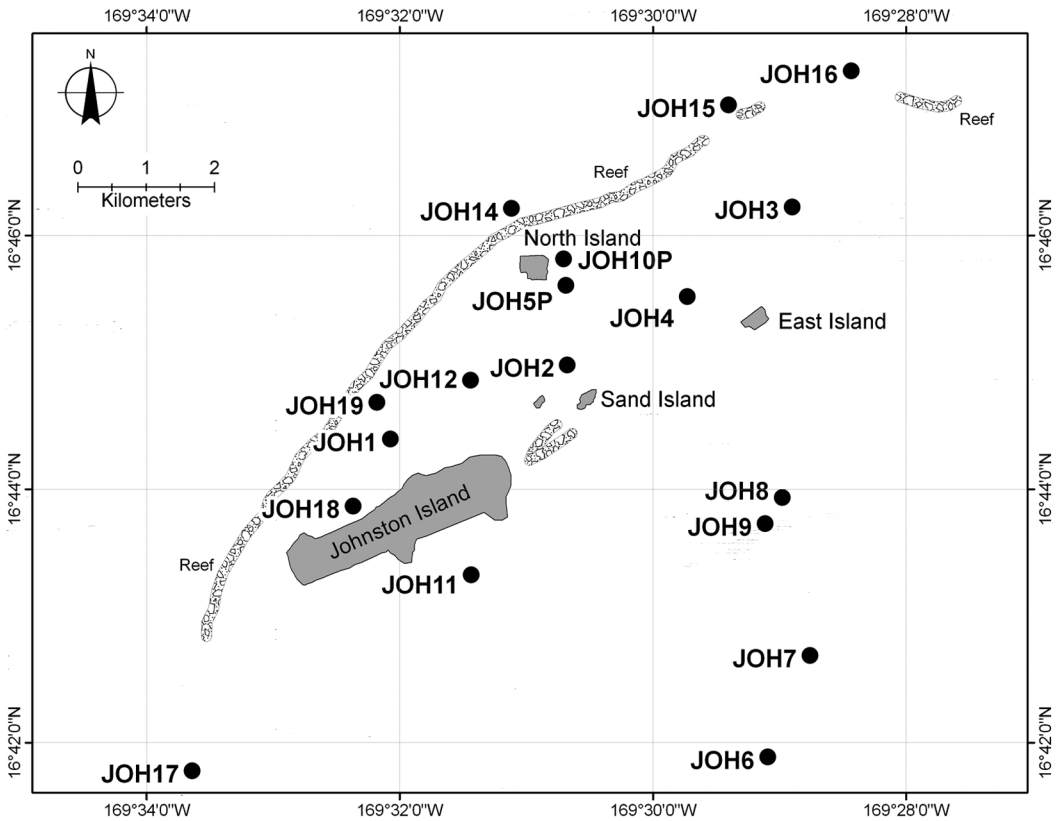


FIGURE 2. Locations of established NOAA monitoring stations at Johnston Atoll. The barrier reef is located on the north and west side of Johnston Island with the south and east side open to the sea.

to 16.8 m deep; see Preskitt et al. (2004) for sampling method performed during the algal collections. Before examination, plastic bags of frozen algae from each station were thawed in tap water. Thawed seawater was poured carefully out of the bag and replaced with 4% formalin in seawater. The collections were examined using a dissecting microscope, and all epiphytes and turf were separated. Small specimens (<1 cm) or sections of larger specimens were mounted on glass slides: specimens were decalcified with 10% hydrochloric acid, stained with aniline blue, and mounted with 30% sugar syrup (Karo) with phenol. Macroalgae were mounted on herbarium paper except for one specimen of *Amphiroa* cf. *rigida* Lamouroux, which was dried and stored in a vial. Four specimens were also preserved in vials with

4% formalin in seawater for future sectioning. The small quantities of nonprocessed replicate 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 critical taxonomic re-examinations of all specimens, including epiphytes.

NOAA stations at Johnston Atoll were identified by using the first three letters of the atoll's name followed by the station and year of collection (e.g., JOH-01-04 signifies Johnston Atoll (JOH), station number 01, and the year 2004). Specimens were collected by Peter S. Vroom and Kimberly N. Page from 12 stations during the 2004 NOAA cruise, and by Peter S. Vroom and Meghan L. Dailer from 18 stations during the 2006

NOAA cruise. All NOAA specimens were deposited at BISH. Replicate specimens were deposited in the Herbarium of the NOAA Coral Reef Ecosystem Division (CRED), Honolulu. BISH specimen numbers were also inserted in the listing that follows to document the specimens of species cited in Coles et al. (2001). See Appendix 1 for description of NOAA collection sites.

The higher-level classification systems used were as follows: cyanobacteria, Anagnostidis and Komárek (1988), Komárek and Anagnostidis (1989), and Silva et al. (1996); red algae, Abbott (1999) and Choi et al. (2008); green and brown algae, Abbott and Huisman (2004). Citations listed after the species refer to references used in the identification or re-examination of specimens. Annotations were provided when specimens differed from the norm or were uncommon to the central Pacific. New records of algal species for Johnston Atoll are preceded by an asterisk (*).

Because all algal species from each station of the January 2004 and January 2006 NOAA cruises were identified and recorded, the frequency of occurrence (Oosting 1956) (i.e., number or percentage of stations at which a species was recorded) provided one indication of the spatial distribution of a species at Johnston Atoll. In addition, records from the 2004 and 2006 cruises provided two sets of data.

Data on species presence and absence of 404 definitively identified eukaryotic algal species (i.e., red, brown, and green algae) were culled from the literature (French Frigate Shoals, Northwestern Hawaiian Islands [Vroom et al. 2006]; Howland and Baker islands [Tsuda and Trono 1968, Tsuda et al. 2008]; Wake Atoll [Tsuda et al. 2006, 2010]; and Enewetak Atoll, Marshall Islands [Tsuda 1987, 2002]). The data provided a means to compare the marine benthic algal flora of Johnston Atoll with marine floras of five neighboring islands and atolls. A Bray-Curtis similarity matrix of species presence among islands was generated using PRIMER-E software, v. 6 (Clarke and Warwick 2001), and multidimensional scaling (MDS) (number of restarts = 50) was used to map relationships between islands based on floristic composition.

RESULTS

The 107 species collected from Johnston Atoll during the NOAA cruises in January 2004 and January 2006 included 45 new species records (42%): six cyanobacteria, 25 red algal species, four brown algal species, and 10 green algal species. Two other new species records, *Rosenvingea intricata* and *Codium campanulatum*, were ascertained during the reexamination of prior collected specimens that were listed by generic names only. Of the 142 species previously collected from Johnston Atoll, 81 species (57%) were not recollected during the NOAA cruises: 19 cyanobacteria, 35 red algae, six brown algae, and 21 green algae. Seventy-nine of the 81 species (excluding *R. intricata* and *C. campanulatum*) are listed in Appendix 2. The 189 species of marine benthic algae thus far recorded from Johnston Atoll consist of 26 cyanobacteria, 105 species of red algae, 15 species of brown algae, and 43 species of green algae.

Class CYANOPHYCEAE Order OSCILLATORIALES Family OSCILLATORIAEAE

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

Past record: Buggeln and Tsuda (1969).
NOAA specimens: JOH-07-04, BISH 735189;
JOH-08-04, BISH 735210.

Family PHORMIDIACEAE

**Hydrocoleum coccineum* Gomont; Littler and Littler (2003):276.

NOAA specimen: JOH-19-06, BISH 735532.

**Symploca* cf. *hydnoides* Kützinger; Desikachary (1959):335, pl. 60 (figs. 2, 3, 6).

NOAA specimens: JOH-08-06, BISH 735397; JOH-18-06, BISH 735512.

Family PSEUDANABAENACEAE

**Leptolyngbya crosbyanum* (Tilden) Anagnostidis & Komárek; Tilden (1910):96, pl. 4 (figs. 60, 61).

NOAA specimens: JOH-01-04, BISH 735038; JOH-02-04, BISH 735063; JOH-02-

06, BISH 735322; JOH-12-04, BISH 735295; JOH-12-06, BISH 735470.

Order NOSTOCALES
Family RIVULARIACEAE

**Calotbrix confervicola* (Dillwyn) C. Agardh; Tilden (1910):256, pl. 16 (figs. 6–8).

NOAA specimens: JOH-04-04, BISH 735103; JOH-18-06, BISH 735523.

**Calotbrix fuscviolacea* P. Crouan & H. Crouan; Tilden (1910):258, pl. 16 (fig. 10).

NOAA specimen: JOH-10-04, BISH 735269.

**Dichotbrix* cf. *penicillata* Zanardini; Tilden (1910):280.

NOAA specimens: JOH-05P-06, BISH 735358; JOH-10P-06, BISH 735442.

Class RHODOPHYCEAE
Order PORPHYRIDIALES
Family PORPHYRIDIACEAE

Stylonema alsidii (Zanardini) K. Drew; Abbott (1999):44, fig. 1B–C.

Past records: Buggeln and Tsuda (1969) as *Goniotrichum alsidii* (Zanardini) Howe; Coles et al. (2001), BISH 665261. NOAA specimen: JOH-08-04, BISH 735221.

Order ERYTHROPELTIDALES
Family ERYTHROPELTIDACEAE

**Erythrotrichia carnea* (Dillwyn) J. Agardh; Abbott (1999):45, fig. 1E.

NOAA specimen: JOH-06-04, BISH 735145. Unbranched uniseriate filaments consist of cuboidal cells, 8–10 µm diam.

Order ACROCHAETIALES
Family ACROCHAETIACEAE

**Acrochaetium hypneae* (Børgesen) Børgesen; Abbott (1999):56, fig. 37 as *Acrochaetium seriatum* Børgesen.

NOAA specimens: JOH-02-04, BISH 735053; JOH-03-04, BISH 735088; JOH-07-04, BISH 735173; JOH-08-04, BISH 735207; JOH-12-04, BISH 735308. Filaments are 7–8 µm diam. with monosporangia, 8 µm diam., arranged in series.

Order NEMALIALES
Family GALAXAURACEAE

**Galaxaura filamentosa* Chou; Itono (1980):2, fig. 1.

NOAA specimens: JOH-04-04, BISH 735099; JOH-05P-04, BISH 735129; JOH-05P-06, BISH 735353 with dense *Polysiphonia* coverage; JOH-10P-06, BISH 735443; JOH-19-06, BISH 735537.

Order GIGARTINALES
Family CAULACANTHACEAE

Caulacanthus ustulatus (Turner ex Mertens) Kützing; Abbott (1999):104, figs. 20D–F.

Past record: Coles et al. (2001), BISH 665789. NOAA specimens: JOH-01-04, BISH 735048; JOH-12-04, BISH 735301.

Family HYPNEACEAE

Hypnea spinella J. Agardh; Abbott (1999):117, fig. 25B–E.

Past record: Coles et al. (2001), BISH 665268. NOAA specimens: JOH-01-04, BISH 735043; JOH-05P-04, BISH 735128; JOH-07-04, BISH 735177; JOH-10P-06, BISH 735445; JOH-11-04, BISH 735278.

Family PEYSSONNELIACEAE

Peyssonnelia inamoena Pilger; Abbott (1999):156, fig. 38B.

Past record: Coles et al. (2001), BISH 665272. NOAA specimens: JOH-06-04, BISH 735154; JOH-06-06, BISH 735362; JOH-11-04, BISH 735274; JOH-12-04, BISH 735302.

Order BONNEMAISONIALES
Family BONNEMAISONIACEAE

**Asparagopsis taxiformis* (Delile) Trevisan; Abbott (1999):174, fig. 43C–D.

NOAA specimens: JOH-06-06, BISH 735373; JOH-11-04, BISH 735283; JOH-11-06, BISH 735452. All specimens were sporophytes (*Falkenbergia*).

Order CORALLINALES
Family CORALLINACEAE

**Amphiroa* cf. *rigida* Lamouroux; Abbott (1999):178, figs. 44D, 45C.

NOAA specimens: JOH-08-06, BISH 735418; JOH-09-04, BISH 735245.

**Amphiroa valonioides* Yendo; Abbott (1999): 180, figs. 44E, 45D.

NOAA specimens: JOH-03-06, BISH 735336; JOH-05P-06, BISH 735355.

Jania pumila Lamouroux; Abbott (1999): 189, fig. 48C.

Past records: Buggeln and Tsuda (1969) as *Jania capillacea* Harvey and *J. decussato-dichotoma* (Yendo) Yendo; Coles et al. (2001), BISH 664286. NOAA specimens: JOH-01-04, BISH 735045; JOH-01-06, BISH 735320; JOH-02-04, BISH 735062; JOH-02-06, BISH 735327; JOH-03-06, BISH 735335; JOH-04-04, BISH 735098, 735109; JOH-05P-04, BISH 735123; JOH-06-04, BISH 735157; JOH-07-04, BISH 735191; JOH-11-06, BISH 725458; JOH-12-04, BISH 735300; JOH-12-06, BISH 735465; JOH-18-06, BISH 735524; JOH-19-06, BISH 735536. All branches, decalcified with HCl, were 48–80 µm diam.

Order GELIDIALES
Family GELIDIACEAE

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

Past record: Coles et al. (2001), BISH 664298. NOAA specimens: JOH-06-04, BISH 735158; JOH-11-04, BISH 735286; JOH-17-06, BISH 735508.

Family GELIDIACEAE

**Gelidiella antipai* Celán; Abbott (1999): 202, fig. 53D–F.

NOAA specimens: JOH-06-06, BISH 735381; JOH-11-04, BISH 735281; JOH-11-06, BISH 735456; JOH-18-06, BISH 735522.

Order RHODYMENIALES
Family CHAMPIACEAE

Champia parvula (C. Agardh) Harvey; Abbott (1999): 218, fig. 60A–C.

Past records: Buggeln and Tsuda (1969); Coles et al. (2001), BISH 665772. NOAA specimens: JOH-06-04, BISH 735137; JOH-07-04, BISH 735182; JOH-15-06, BISH 735490.

Family LOMENTARIACEAE

Lomentaria bakodatensis Yendo; Abbott (1999): 224, fig. 62A–D.

Past records: Buggeln and Tsuda (1969); Coles et al. (2001), BISH 664278. NOAA specimens: JOH-01-04, BISH 735047; JOH-02-04, BISH 735056; JOH-06-04, BISH 735134; JOH-06-06, BISH 735379; JOH-07-04, BISH 735179; JOH-08-04, BISH 735201; JOH-08-06, BISH 735398, 735403; JOH-09-04, BISH 735239; JOH-09-06, BISH 735423; JOH-11-04, BISH 735288; JOH-12-04, BISH 735297; JOH-16-06, BISH 735501.

Family RHODYMENIACEAE

**Botryocladia skottsbergii* (Børgesen) Levring; Abbott (1999): 226, fig. 63A–B.

NOAA specimen: JOH-15-06, BISH 735491.

**Chrysiomenia okamurae* Yamada & Segawa; Abbott (1999): 230, fig. 64C–D.

NOAA specimens: JOH-06-04, BISH 735132; JOH-08-04, BISH 735197; JOH-09-04, BISH 735196; JOH-09-06, BISH 735426.

Order CERAMIALES
Family CALLITHAMNIACEAE

Aglaothamnion boergesenii (Aponte & Ballantine) L'Hardy-Halos & Rueness; Abbott (1999): 244, fig. 67C–F.

Past record: Coles et al. (2001), BISH 665769. NOAA specimen: JOH-06-06, BISH 735375.

Crouania mageshimensis Itono; Abbott (1999): 293, fig. 82A–D.

Past record: Coles et al. (2001), BISH 665809. NOAA specimen: JOH-08-06, BISH 735413. Terminal cells of lateral branches of this species are pointed as opposed to the rounded terminal cells of *Crouania minutissima*.

Crouania minutissima Yamada; Abbott (1999): 294, fig. 82E–G.

Past record: Buggeln and Tsuda (1969). NOAA specimen: JOH-06-06, BISH 735364.

Family CERAMIACEAE

Antithamnion antillanum Børgesen; Abbott (1999):248, fig. 69A–B.

Past records: Buggeln and Tsuda (1969); Coles et al. (2001), BISH 665805. NOAA specimens: JOH-02-04, BISH 735055; JOH-03-04, BISH 735076; JOH-04-04, BISH 735095; JOH-08-04, BISH 735220; JOH-08-06, BISH 735399; JOH-09-04, BISH 735230; JOH-09-06, BISH 735422; JOH-11-04, BISH 735277; JOH-11-06, BISH 735453; JOH-16-06, BISH 735497.

**Antithamnion decipiens* (J. Agardh) Athanasiadis; Abbott (1999):250, fig. 69C–D.

NOAA specimen: JOH-07-06, BISH 735387.

Antithamnionella breviramosa (Dawson) Wolleston; Abbott (1999):253, fig. 71A–C.

Past record: Coles et al. (2001), BISH 665240. NOAA specimens: JOH-03-04, BISH 735079; JOH-06-04, BISH 735144; JOH-06-06, BISH 735372; JOH-08-04, BISH 735209; JOH-17-06, BISH 735507.

**Antithamnionella graeffei* (Grunow) Athanasiadis; Abbott (1999):254, fig. 71D.

NOAA specimen: JOH-08-06, BISH 735404. Other specimen: BISH 665230, VI-16-2000, R. G. DeFelice (not listed in Coles et al. [2001]).

Centroceras minutum Yamada; Abbott (1999):262, fig. 73H–I.

Past record: Coles et al. (2001), BISH 664282. NOAA specimens: JOH-02-04, BISH 735058; JOH-02-06, BISH 735324.

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

Past record: Buggeln and Tsuda (1969). NOAA specimens: JOH-04-04, BISH 735100; JOH-11-04, BISH 735542.

Ceramium codii (Richards) G. Mazoyer; Cho and Fredericq (2006):496, figs. 24–55.

Past record: Coles et al. (2001), BISH 665784. NOAA specimens: JOH-01-06, BISH 735321; JOH-02-04, BISH 735060; JOH-03-04, BISH 735077; JOH-03-06, BISH 735334 on *Microdictyon umbilicatum*; JOH-04-04,

BISH 735094; JOH-04-06, BISH 735346; JOH-05P-04, BISH 735118; JOH-10P-04, BISH 735253; JOH-11-04, BISH 735279; JOH-12-04, BISH 735306; JOH-12-06, BISH 735464; JOH-17-06, BISH 735510; JOH-19-06, BISH 735528.

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

NOAA specimens: JOH-08-04, BISH 735217; JOH-09-04, BISH 735248.

Ceramium macilentum J. Agardh; South and Skelton (2000):71, figs. 52–62.

Past record: Coles et al. (2001), BISH 665273. NOAA specimens: JOH-03-04, BISH 735083; JOH-06-04, BISH 735160; JOH-08-04, BISH 735200; JOH-08-06, BISH 735419; JOH-09-06, BISH 735431, 735538; JOH-11-04, BISH 735284.

Ceramium vagans Silva; Abbott (1999):284, fig. 80A–D.

Past records: Buggeln and Tsuda (1969) as *Ceramium vagabunda* Dawson; Coles et al. (2001), BISH 665237. NOAA specimens: JOH-06-04, BISH 735142; JOH-07-04, BISH 735176; JOH-08-04, BISH 735544; JOH-12-06, BISH 735471; JOH-18-06, BISH 735521.

Corallophila apiculata (Yamada) R. E. Norris; Abbott (1999):288, fig. 81A–C.

Past records: Hollenberg (1968d) and Buggeln and Tsuda (1969) as *Centroceras apiculatum* Yamada; Coles et al. (2001), BISH 665831. NOAA specimens: JOH-03-04, BISH 735084; JOH-05P-04, BISH 735115; JOH-06-04, BISH 735139; JOH-06-06, BISH 735374; JOH-08-06, BISH 735402; JOH-09-04, BISH 735247; JOH-10P-04, BISH 735256; JOH-14-06, BISH 735478. Prostrate and erect axes are 120–180 µm diam. with apiculate apices.

Corallophila huysmansii (Weber-van Bosse) R. E. Norris; Abbott (1999):290, fig. 81D–E.

Past records: Buggeln and Tsuda (1969) as *Ceramium huysmansii* Weber-van Bosse; Coles et al. (2001), BISH 665821. NOAA specimens: JOH-03-06, BISH 735340; JOH-06-04, BISH 735539; JOH-07-04, BISH 735172. Erect axes are 68–120 µm diam. and gradually tapering.

**Corallophila itonoi* (Ardre) R. E. Norris; Abbott (1999):290, fig. 81F–H.

NOAA specimens: JOH-07-04, BISH 735192; JOH-08-04, BISH 735226; JOH-15-06, BISH 735486. Erect axes, 100–200 μm diam., with apical pinchers present in few axes.

Gayliella flaccida (Kützing) T. O. Cho & L. Melvor; South and Skelton (2000):65, figs. 32–39, 41–44 as *Ceramium flaccidum* (Harvey ex Kützing) Ardissonne.

Past records: Buggeln and Tsuda (1969) as *Ceramium gracillimum* var. *byssoides* (Harvey) G. Mazoyer; Coles et al. (2001) as *Ceramium flaccidum* (Harvey) Mazoyer, BISH 665242. NOAA specimens: JOH-03-04, BISH 735078; JOH-03-06, BISH 735339; JOH-06-04, BISH 735138; JOH-06-06, BISH 735363; JOH-08-04, BISH 735216; JOH-08-06, BISH 735395; JOH-09-04, BISH 735246; JOH-09-06, BISH 735434; JOH-11-04, BISH 735285; JOH-14-06, BISH 735474; JOH-18-06, BISH 735515.

Family DASYACEAE

**Dasya corymbifera* J. Agardh; Abbott (1999):320, fig. 90A–C.

NOAA specimens: JOH-03-04, BISH 735070; JOH-03-06, BISH 735328; JOH-04-04, BISH 735096; JOH-06-04, BISH 735141; JOH-06-06, BISH 735365; JOH-07-04, BISH 735171; JOH-07-06, BISH 735390; JOH-08-04, BISH 735205; JOH-08-06, BISH 735396; JOH-09-04, BISH 735238; JOH-11-06, BISH 735451; JOH-16-06, BISH 735500.

Dasya kristeniae Abbott (1998):105, figs. 19–22.

Past record: Coles et al. (2001), BISH 665825. NOAA specimens: JOH-04-04, BISH 735108; JOH-06-04, BISH 735161; JOH-15-06, BISH 735487.

Heterosiphonia crispella (C. Agardh) Wynne; Abbott (1999):328, fig. 94A–D.

Past records: Buggeln and Tsuda (1969) as *Heterosiphonia wurdemanii* var. *laxa* Børgesen; Coles et al. (2001), BISH 665776. NOAA specimens: JOH-07-04, BISH 735186; JOH-10P-06, BISH 735446.

Family DELESSERIACEAE

**Hypoglossum caloglossoides* Wynne & Kraft; Abbott (1999):337, fig. 97B–C.

NOAA specimens: JOH-05P-04, BISH 735543; JOH-07-04, BISH 735166; JOH-10P-06, BISH 735435.

**Hypoglossum simulans* Wynne, Price & Balantine (1989):31, figs. 12–26.

NOAA specimen: JOH-05P-04, BISH 735126.

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

Past records: Buggeln and Tsuda (1969) as *Taenioma macrourum* Thuret; Coles et al. (2001), BISH 665815. NOAA specimen: JOH-06-04, BISH 735152.

Family RHODOMELACEAE

Chondria polyrbiza Collins & Hervey; Abbott (1999):360, fig. 103G–H.

Past records: Buggeln and Tsuda (1969) as *Chondria repens* Børgesen; Coles et al. (2001), s.n. NOAA specimens: JOH-03-04, BISH 735086; JOH-06-04, BISH 735153; JOH-06-06, BISH 735370; JOH-08-04, BISH 735202, 735212; JOH-08-06, BISH 735408; JOH-09-06, BISH 735430; JOH-10P-04, BISH 735262; JOH-14-06, BISH 735473; JOH-15-06, BISH 735488; JOH-19-06, BISH 735530. Erect branches are 160–200 μm diam. with mature cortical cells rectilinear.

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

NOAA specimens: JOH-01-04, BISH 735050; JOH-03-06, BISH 735333; JOH-05P-04, BISH 735124; JOH-06-04, BISH 735148; JOH-06-06, BISH 735376; JOH-07-04, BISH 735180, 735181; JOH-07-06, BISH 735384; JOH-08-04, BISH 735203; JOH-08-06, BISH 735401; JOH-10P-06, BISH 735439; JOH-15-06, BISH 735493; JOH-16-06, BISH 735504; JOH-17-06, BISH 735505. Erect branches are 240–320 μm diam. with distal cortical cells hexagonal or elongate ovoid.

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

NOAA specimens: JOH-03-06, BISH

735337; JOH-10P-04, BISH 735267; JOH-10P-06, BISH 735444.

Herposiphonia pacifica Hollenberg (1968c):549, figs. 2A, 2B, 4, 19.

Past record: Hollenberg (1968c). NOAA specimen: JOH-10P-04, BISH 735257.

Herposiphonia parca Setchell; Hollenberg (1968c):552, figs. 2C, 16, 20, 22, 23.

Past records: Hollenberg (1968c); Coles et al. (2001), BISH 665778. NOAA specimens: JOH-04-04, BISH 735106; JOH-06-04, BISH 735159; JOH-06-06, BISH 735371; JOH-08-04, BISH 735208.

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

Past records: Hollenberg (1968c) as *H. tenella* (C. Agardh) Ambronn f. *secunda* (C. Agardh) Hollenberg; Coles et al. (2001), BISH 665793. NOAA specimen: JOH-06-04, BISH 735143.

Herposiphonia variabilis Hollenberg (1968c):557, figs. 1F, 2G, 17, 18, 21.

Past records: Hollenberg (1968c) (holotype); Coles et al. (2001), BISH 664349. NOAA specimens: JOH-03-04, BISH 735081; JOH-07-04, BISH 735183; JOH-08-04, BISH 735213; JOH-12-04, BISH 735294.

Laurencia majuscula (Harvey) Lucas; Saito (1969):149; Abbott (1999):388, fig. 112G–H.

Past record: Coles et al. (2001), BISH 664341. NOAA specimens: JOH-03-04, BISH 735085; JOH-06-04, BISH 735136. Immature fragment is less than 0.7 mm long with no lenticular thickenings and with faint protruding cortical cells.

Neosiphonia flaccidissima (Hollenberg) M. S. Kim & I. K. Lee; Hollenberg (1968a):63 as *Polysiphonia flaccidissima* Hollenberg.

Past record: Hollenberg (1968a) as *Polysiphonia flaccidissima* Hollenberg. NOAA specimens: JOH-08-06, BISH 735546; JOH-09-04, BISH 735545.

Neosiphonia poko (Hollenberg) Abbott; Hollenberg (1968a):70, fig. 3A as *Polysiphonia poko* Hollenberg.

Past record: Hollenberg (1968a) (holotype); Kraft and Abbott (2002). Other speci-

men: BISH 664337, VI-17-2000, R. G. DeFelice (not listed in Coles et al. [2001]).

Neosiphonia sphaerocarpa (Børgesen) M. S. Kim & I. K. Lee; Hollenberg (1968a):87 as *Polysiphonia sphaerocarpa* Børgesen.

Past record: Coles et al. (2001), BISH 664334. NOAA specimen: JOH-07-04, BISH 735194.

**Neosiphonia tepida* (Hollenberg) S. M. Guimarães & M. T. Fujii; Hollenberg (1968b):205, fig. 3D–E as *Polysiphonia tepida* Hollenberg.

NOAA specimens: JOH-01-04, BISH 735044; JOH-01-06, BISH 735313; JOH-03-04, BISH 735082; JOH-03-06, BISH 735341; JOH-08-06, BISH 735400; JOH-09-06, BISH 735425; JOH-10P-04, BISH 735252; JOH-11-04, BISH 735287; JOH-12-06, BISH 735462; JOH-19-06, BISH 735527, 735531. Erect axes, 96–140 µm diam., with seven pericentral cells.

Polysiphonia anomala Hollenberg (1968a):59, fig. 1A–C.

Past record: Hollenberg (1968a). NOAA specimens: JOH-06-04, BISH 735149; JOH-06-06, BISH 735366; JOH-08-04, BISH 735204; JOH-08-06, BISH 735414; JOH-09-06, BISH 735433; JOH-12-04, BISH 735309; JOH-14-06, BISH 735476, 735483.

Polysiphonia delicatula Hollenberg (1968a):62, fig. 1F.

Past record: Coles et al. (2001), BISH 665244. NOAA specimens: JOH-01-06, BISH 735312; JOH-03-04, BISH 735075; JOH-05P-04, BISH 735127; JOH-05P-06, BISH 735361; JOH-06-04, BISH 735131; JOH-06-06, BISH 735378 on *Peyssonnelia* sp.; JOH-07-06, BISH 735386; JOH-08-04, BISH 735211.

Polysiphonia exilis Harvey; Hollenberg (1968b):200, figs. 1C, 3G.

Past record: Coles et al. (2001), BISH 664317. NOAA specimens: JOH-04-06, BISH 735343; JOH-08-04, BISH 735224; JOH-09-04, BISH 735242; JOH-12-04, BISH 735299. Erect axes, 100–120 µm diam., with 7–9 pericentral cells.

**Polysiphonia homioia* Setchell & Gardner; Hollenberg (1968b):201, fig. 2B.

NOAA specimen: JOH-11-04, BISH 735290.

Polysiphonia scopulorum Harvey; Hollenberg (1968a):79.

Past record: Hollenberg (1968a); Coles et al. (2001), BISH 665798. NOAA specimens: JOH-02-04, BISH 735059; JOH-08-04, BISH 735222. Rhizoid is connected to the pericentral cell by a pit connection.

Polysiphonia setacea Hollenberg (1968a):85, fig. 5A–C.

Past record: Hollenberg (1968a). NOAA specimens: JOH-05P-06, BISH 735351; JOH-10-06, BISH 735450.

**Polysiphonia* cf. *tsudana* Hollenberg (1968b): 205, figs. 1F, 1G, 2C.

NOAA specimen: JOH-16-06, BISH 735499 (sterile). Erect axes, 142–160 µm diam., are larger than the epizoic type specimens (45–50 µm diam.). Prostrate axes and base of erect axes consist of four pericentral cells with upper erect axes consisting of 6–7 pericentral cells.

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

Past record: Hollenberg (1968a). NOAA specimens: JOH-10P-04, BISH 735263; JOH-11-04, BISH 735280. Branched erect axes, 96–132 µm diam., with swollen rhizoids.

Family SARCOMENIACEAE

**Dotyella hawaiiensis* (Doty & Wainwright) Womersley & Shepley; Abbott (1999):334, fig. 96A–C.

NOAA specimens: JOH-03-04, BISH 735541; JOH-05P-06, BISH 735360; JOH-07-04, BISH 735185.

**Malaconema minimum* Hollenberg (1963): 169, figs. 1–3.

NOAA specimens: JOH-01-04, BISH 735042; JOH-12-06, BISH 735469; JOH-19-06, BISH 735529.

Family WRANGELIACEAE

Anotrichium secunda (Harvey ex J. Agardh) Furnari; Abbott (1999):245, fig. 68A–C.

Past record: Coles et al. (2001), BISH 665819. NOAA specimens: JOH-03-04, BISH

735072; JOH-06-04, BISH 735133; JOH-07-04, BISH 735168; JOH-07-06, BISH 735389; JOH-08-06, BISH 735406; JOH-09-04, BISH 735241; JOH-09-06, BISH 735432; JOH-14-06, BISH 735475; JOH-16-06, BISH 735503.

Anotrichium tenue (C. Agardh) Nägeli; Abbott (1999):247, fig. 68D.

Past records: Buggeln and Tsuda (1969) as *Griffithsia tenuis* C. Agardh; Coles et al. (2001), BISH 665785. NOAA specimens: JOH-06-06, BISH 735369; JOH-08-04, BISH 735206.

Griffithsia heteromorpha Kützing; Abbott (1999):300, fig. 84A–C.

Past record: Coles et al. (2001), BISH 664297. NOAA specimens: JOH-01-04, BISH 735052; JOH-02-04, BISH 735057; JOH-02-06, BISH 735325; JOH-04-04, BISH 735102; JOH-05P-04, BISH 735125; JOH-08-04, BISH 735225; JOH-08-06, BISH 735415; JOH-10P-04, BISH 735254; JOH-10P-06, BISH 735448.

Griffithsia subcylindrica Okamura; Abbott (1999):302, fig. 85C–D.

Past record: Coles et al. (2001), BISH 664342. NOAA specimens: JOH-06-04, BISH 735156; JOH-07-04, BISH 735188; JOH-10P-04, BISH 735540.

**Haloplegma duperreyi* Montagne; Abbott (1999):305, fig. 86E.

NOAA specimen: JOH-07-04, BISH 735165.

**Lejoliea pacifica* Itono; Abbott (1999):307, fig. 86F–G.

NOAA specimens: JOH-09-04, BISH 735244 on *Halimeda taenicola*. Filaments include a single stalked tetrasporangium, 8 µm diam.

Ptilothamnion cladophorae (Yamada & Tanaka) Feldmann-Mazoyer; Abbott (1999):313, fig. 87I.

Past record: Coles et al. (2001), BISH 665263. NOAA specimens: JOH-01-06, BISH 735319; JOH-03-04, BISH 735073; JOH-05P-04, BISH 735119; JOH-05P-06, BISH 735356; JOH-06-04, BISH 735151; JOH-07-06, BISH 735383; JOH-10P-04, BISH 735261; JOH-10P-06, BISH 735436; JOH-12-06, BISH 735467; JOH-19-06, BISH 735526.

Spermothamnion sp.

Past record: Coles et al. (2001), BISH 664305. NOAA specimen: JOH-10P-06, BISH 735266 (sterile). Coles et al. (2001) listed this specimen as *Spermothamnion* sp.; the NOAA specimen (BISH 735266) is sterile and could be either a *Spermothamnion* or *Tiffaniella*.

Class PHAEOPHYCEAE
Order ECTOCARPALES
Family ECTOCARPACEAE

**Kuetzingiella elachistaeformis* (Heydrich) Balakrishnan & Kinkar; Abbott and Huisman (2004):163, fig. 60A–B.

NOAA specimen: JOH-11-04, BISH 735282.

Order SCYTOSIPHONALES
Family SCYTOSIPHONACEAE

**Rosenvingea intricata* (J. Agardh) Børgesen; Abbott and Huisman (2004):185, fig. 69A–C.

Past record: Coles et al. (2001) as *Rosenvingea* sp., BISH 665791, VI-18-2000, leg. R. G. DeFelice.

Order SPHACELARIALES
Family SPHACELARIACEAE

Sphacelaria novaehollandiae Sonder; Tsuda (1972):93, pl. 1 (fig. 5).

Past records: Buggeln and Tsuda (1969), Coles et al. (2001), BISH 665797. NOAA specimens: JOH-15-06, BISH 735489; JOH-18-06, BISH 735520.

Sphacelaria rigidula Kützinger; Abbott and Huisman (2004):190, fig. 72C.

Past record: Buggeln and Tsuda (1969) as *Sphacelaria furcigera* Kützinger. NOAA specimen: JOH-06-04, BISH 735146.

Order DICTYOTALES
Family DICTYOTACEAE

Dictyopteris repens (Okamura) Børgesen; Tsuda (1972):94, pl. 3 (fig. 1).

Past record: Coles et al. (2001), BISH 664294. NOAA specimens: JOH-08-04, BISH 735218; JOH-11-04, BISH 735275; JOH-18-06, BISH 735519.

Dictyota ceylanica Kützinger; Abbott & Huisman (2004):202, fig. 77B.

Past records: Coles et al. (2001) as *Dictyota divaricata* Lamouroux, BISH 664292, and as *D. acutiloba* J. Agardh, BISH 665764. NOAA specimens: JOH-07-04, BISH 735174; JOH-10P-04, BISH 735265; JOH-11-04, BISH 735273.

**Dictyota friabilis* Setchell; Tsuda (1972):96, pl. 4 (fig. 3).

NOAA specimens: JOH-02-04, BISH 735065; JOH-06-04, BISH 735150; JOH-07-04, BISH 735170; JOH-14-06, BISH 735479; JOH-15-06, BISH 735492; JOH-18-06, BISH 735514.

**Dictyota sandvicensis* Sonder; Abbott and Huisman (2004):205, fig. 78A–B.

NOAA specimens: JOH-01-04, BISH 734049; JOH-07-06, BISH 735391; JOH-11-04, BISH 735276; JOH-17-06, BISH 735506.

Lobophora variegata (Lamouroux) Womersley ex Oliveira; Taylor (1950):97 as *Pocockiella variegata* (Lamouroux) Papenfuss.

Past records: Buggeln and Tsuda (1969) as *Pocockiella variegata* (Lamouroux) Papenfuss; Aegeian and Abbott (1985), 140 m deep; Coles et al. (2001), BISH 665788. NOAA specimens: JOH-03-04, BISH 735080; JOH-03-06, BISH 735332; JOH-04-04, BISH 735097; JOH-06-04, BISH 735155; JOH-07-04, BISH 735178; JOH-08-04, BISH 735198; JOH-08-06, BISH 735411; JOH-09-04, BISH 735249; JOH-11-04, BISH 735271; JOH-15-06, BISH 735485; JOH-16-06, BISH 735498; JOH-17-06, BISH 735509.

Order CUTLERIALES
Family CUTLERIACEAE

**Cutleria irregularis* Abbott & Huisman (2003):175, figs. 7–15.

NOAA specimens: JOH-01-04, BISH 735046; JOH-01-06, BISH 735317; JOH-02-04, BISH 735061; JOH-02-06, BISH 735326; JOH-04-06, BISH 735345; JOH-05P-04, BISH 735120; JOH-05P-06, BISH 735354; JOH-07-06, BISH 735385; JOH-10P-04, BISH 735259; JOH-11-06, BISH 735455; JOH-12-04, BISH 735293; JOH-12-06, BISH 735461; JOH-18-06, BISH 735516; JOH-19-06, BISH 735535.

Class ULVOPHYCEAE
Order ULVALES
Family ULVACEAE

Ulva clatbrata (Roth) C. Agardh; Abbott and Huisman (2004):46, fig. 5A–C as *Enteromorpha clatbrata* (Roth) Greville.

Past record: Coles et al. (2001) as *Enteromorpha clatbrata*, BISH 665781. NOAA specimens: JOH-04-04, BISH 735104; JOH-05P-04, BISH 735117; JOH-07-04, BISH 735193; JOH-08-06, BISH 735409; JOH-10P-04, BISH 735264; JOH-12-04, BISH 735304. All specimens are less than 5 mm long and possess mainly uniseriate branches from base to apex.

Class CLADOPHOROPHYCEAE
Order CLADOPHORALES
Family ANADYOMENACEAE

Microdictyon setchellianum Howe; Abbott and Huisman (2004):61, fig. 15A.

Past record: Buggeln and Tsuda (1969). NOAA specimen: JOH-08-06, BISH 735394.

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

NOAA specimens: JOH-03-04, BISH 735090; JOH-03-06, BISH 735329; JOH-08-06, BISH 735548.

Family CLADOPHORACEAE

**Cladophora dotyana* Gilbert; Abbott and Huisman (2004):71, fig. 20A–B.

NOAA specimens: JOH-11-04, BISH 735289; JOH-11-06, BISH 735454.

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

NOAA specimens: JOH-05P-04, BISH 735114; JOH-05P-06, BISH 735349.

**Cladophora luxurians* (Gilbert) Abbott & Huisman; Abbott and Huisman (2004):77, fig. 22D.

NOAA specimens: JOH-01-04, BISH 735040; JOH-07-04, BISH 735190.

Family SIPHONOCLADACEAE

Cladophoropsis sp.

Past record: Buggeln and Tsuda (1969). NOAA specimen: JOH-12-04, BISH 735303.

Dictyosphaeria vershuysii Weber-van Bosse; Egerod (1952):351, figs. 1a, 2b–k.

Past record: Buggeln and Tsuda (1969); Aegegian and Abbott (1985), 50 m deep; Coles et al. (2001), BISH 665257. NOAA specimens: JOH-01-06, BISH 735311; JOH-04-04, BISH 735093; JOH-04-06, BISH 735344; JOH-05P-04, BISH 735113; JOH-05P-06, BISH 735359; JOH-08-04, BISH 735214; JOH-08-06, BISH 735412; JOH-10P-06, BISH 735437; JOH-14-06, BISH 735480; JOH-18-06, BISH 735513; JOH-19-06, BISH 735534.

Family VALONIACEAE

Valonia ventricosa J. Agardh; Kraft (2007):121, fig. 51A–D.

Past record: Buggeln and Tsuda (1969). NOAA specimens: JOH-01-06, BISH 735310; JOH-04-04, BISH 735092; JOH-04-06, BISH 735348; JOH-05P-04, BISH 735112; JOH-05P-06, BISH 735352; JOH-10P-04, BISH 735250; JOH-10P-06, BISH 735441; JOH-12-04, BISH 735296; JOH-12-06, BISH 735466; JOH-19-06, BISH 735533.

Class BRYOPSIDOPHYCEAE
Order BRYOPSIDALES
Family BRYOPSIDACEAE

Bryopsis pennata Lamouroux; Egerod (1952):370, fig. 7.

Past records: Buggeln and Tsuda (1969), Coles et al. (2001) as *B. pennata*, BISH 663163 and as *B. hypnoides*, BISH 663164. NOAA specimens: JOH-07-04, BISH 735167; JOH-11-04, BISH 735270; JOH-11-06, BISH 735459. Coles et al. (2001) described the bloom of *Bryopsis hypnoides* Lamouroux, up to 10 cm long, at the sewer outfall site on the south side of Johnston Islet during June 2000. The specimens, however, are more applicable to *B. pennata*.

Family CAULERPACEAE

Caulerpa bikinensis Taylor (1950):66, pl. 33.

Past record: Aegegian and Abbott (1985), 45–76 (121) m deep. NOAA specimens: JOH-07-04, BISH 735175; JOH-07-06, BISH 735393; JOH-08-04, BISH 735223; JOH-08-

06, BISH 735405; JOH-09-04, BISH 735236; JOH-09-06, BISH 735427.

**Caulerpa nummularia* Harvey ex J. Agardh; Abbott and Huisman (2004):121, fig. 44A.

NOAA specimens: JOH-07-04, BISH 735169; JOH-08-04, BISH 735229.

Caulerpa racemosa (Forsskål) J. Agardh; Abbott and Huisman (2004):122, fig. 44B–C.

Past records: Buggeln and Tsuda (1969); Coles et al. (2001), BISH 663165. NOAA specimen: JOH-08-04, BISH 735215.

Caulerpa serrulata (Forsskål) J. Agardh; Meñez and Calumpong (1982):9, pl. 2E.

Past record: Coles et al. (2001), BISH 664350. NOAA specimens: JOH-02-04, BISH 735064; JOH-03-04, BISH 735087; JOH-04-04, BISH 735107; JOH-04-06, BISH 735342; JOH-05P-04, BISH 735111; JOH-06-04, BISH 735130; JOH-06-06, BISH 735368; JOH-07-04, BISH 735162; JOH-07-06, BISH 735392; JOH-08-04, BISH 735219; JOH-08-06, BISH 735416; JOH-09-04, BISH 735233; JOH-09-06, BISH 735421; JOH-10P-04, BISH 735251; JOH-10P-06, BISH 735438; JOH-12-04, BISH 735292; JOH-14-06, BISH 735482; JOH-16-06, BISH 735496; JOH-18-06, BISH 735511; JOH-19-06, BISH 735525.

**Caulerpa taxifolia* (Vahl) C. Agardh; Abbott and Huisman (2004):124, fig. 46A–B.

NOAA specimens: JOH-07-04, BISH 735164; JOH-07-06, BISH 735382; JOH-08-04, BISH 735228; JOH-09-04, BISH 735234; JOH-09-06, BISH 735420.

Caulerpa webbiana Montagne; Meñez and Calumpong (1982):10, fig. 20G–J.

Past record: Coles et al. (2001), BISH 665775. NOAA specimens: JOH-06-06, BISH 735380; JOH-15-06, BISH 735484.

Family CODIACEAE

**Codium campanulatum* P. C. Silva & M. E. Chacana; Abbott and Huisman (2004):102, fig. 35C–D.

Past record: Buggeln and Tsuda (1969) as *Codium* sp., reexamination of RT 1127b (BISH 711933), RT 1174 (BISH 711931), RT 1556 (BISH 711930). Fragments, up to 15 mm long, possess bell-shaped utricles.

Family DERBESIACEAE

Derbesia cf. *fastigiata* Taylor; Abbott and Huisman (2004):128, fig. 48A–B.

NOAA specimen: JOH-02-04, BISH 735054. Sterile siphons are 10 µm diam. with terminal dichotomous branches.

Family HALIMEDACEAE

**Halimeda taenicola* W. R. Taylor (1950):86, pl. 46 (fig. 1); Hillis (1959):354, pl. 2 (fig. 6), pl. 5 (fig. 12), pl. 6 (fig. 14), pl. 11.

NOAA specimens: JOH-03-04, BISH 735071; JOH-03-06, BISH 735330; JOH-04-04, BISH 735110; JOH-06-04, BISH 735135; JOH-06-06, BISH 735367; JOH-07-04, BISH 735163; JOH-07-06, BISH 735388; JOH-08-04, BISH 735199; JOH-08-06, BISH 735407; JOH-09-04, BISH 735232; JOH-09-06, BISH 735429; JOH-14-06, BISH 735472; JOH-15-06, BISH 735495; JOH-16-06, BISH 735502.

Family UDOTEACEAE

**Rhipidosiphon javensis* Montagne; Abbott and Huisman (2004):140, fig. 52C–D.

NOAA specimens: JOH-01-06, BISH 735316; JOH-09-04, BISH 735235.

**Pseudochlorodesmis abbreviata* Gilbert; Abbott and Huisman (2004):141, fig. 53A as *Siphonogrammen abbreviata* (Gilbert) Abbott & Huisman.

NOAA specimens: JOH-09-04, BISH 735243; JOH-18-06, BISH 735517. As per Verbruggen et al. (2009), the genus *Pseudochlorodesmis* is used instead of *Siphonogrammen*.

Pseudochlorodesmis parva Gilbert; Abbott and Huisman (2004):142, fig. 53B–C as *Siphonogrammen parva* (Gilbert) Abbott & Huisman.

Past record: Buggeln and Tsuda (1969). NOAA specimen: JOH-15-06, BISH 735494.

Class DASYCLADOPHYCEAE

Order DASYCLADALES

Family DASYCLADACEAE

**Neomeris bilimbata* J. Koster; Kraft (2007):292, fig. 108.

NOAA specimen: JOH-14-06, BISH 735477.

TABLE 1
Frequency (6/12 or 50% and greater) of Algal Species at
Stations 1–12 during January 2004 and January 2006
NOAA Cruises to Johnston Atoll

Species	Frequency (12 Stations)	
	2004	2006
<i>Caulerpa serrulata</i>	10	6
<i>Lomentaria bakodatensis</i>	8	4
<i>Jania pumila</i>	7	6
<i>Ceramium codii</i>	7	4
<i>Lobophora variegata</i>	7	3
<i>Halimeda taenicola</i>	6	5
<i>Dasya corymbifera</i>	6	5
<i>Antithamnion antillarum</i>	6	3
<i>Griffithsia heteromorpha</i>	6	3
<i>Cutleria irregularis</i>	5	7
<i>Chondria simpliciuscula</i>	5	6

DISCUSSION

Eleven algal species (Table 1) were recorded at six (50%) or more of 12 stations (stations 1–12) during either the 2004 or 2006 cruise. Four species can be considered macroalgae: two green algae (*Caulerpa serrulata* and *Halimeda taenicola*) and two brown algae (*Lobophora variegata* and *Cutleria irregularis*). The remaining seven red algal species were turf or epiphytes, less than 1 cm long. The macroalga *Caulerpa serrulata* and the epiphyte *Lomentaria bakodatensis* were the most spatially distributed species at Johnston Atoll. Only two species, *Caulerpa serrulata* and *Jania pumila*, were recorded in 50% or more of the 12 stations during both NOAA cruises.

The isolation and location of Johnston Atoll in the central Pacific should favor a setting for endemism. Yet, the only endemic algal species of the 189 species recorded from Johnston Atoll are the parasitic red alga *Neotenophycus ichthyosteus* (Kraft and Abbott 2002) and the cyanobacterium *Borzia elongata* (Baker et al. 1997), which will most likely be found at other islands if the parasite's host, *Neosiphonia poko*, and cyanobacteria are critically examined. Maragos and Jokiel (1986), likewise, did not find endemism among the 33 species of stony corals at Johnston Atoll, which had the least coral diversity compared

with Hawai'i (45 species), Phoenix Islands (85 species), Line Islands (70 species), and Marshall Islands (366 species).

Gosline (1955) considered the 158 species of inshore fish fauna at Johnston Atoll an extension of the Hawaiian fish fauna. Based on an updated listing of 271 species of fishes from Johnston Atoll, Randall et al. (1985) reported the fish fauna impoverished as compared with those of the Hawaiian Islands (680 species) and the Marshall Islands (817 species). Reasons for the depauperate fish fauna have been attributed to the atoll's isolation, small size, and paucity of marine habitats. Three unidentified fish species observed in waters deeper than 100 m (Randall et al. 1985) and the deepwater *Centropyge nabackyi* Kosaki (1989) may be the only endemic fish species at Johnston Atoll. Kosaki et al. (1991) concluded that repeated extinctions and recolonization from the nearest high-island refuge rather than long-term residence of species may reflect the Hawaiian influence on the current fish fauna (301 species) of Johnston Atoll.

Nonmetric multidimensional scaling analyses (Figure 3) indicate that the taxonomic affinities of eukaryotic marine benthic algae of Johnston Atoll lie between its nearest northern neighbor French Frigate Shoals (Northwestern Hawaiian Islands) and Wake



FIGURE 3. Nonmetric multidimensional scaling plot comparing Johnston Atoll with neighboring islands and atolls based on presence and absence of marine eukaryotic algal species: French Frigate Shoals (FFS), Howland and Baker islands, Wake Atoll, and Enewetak Atoll.

Atoll to the west. Past studies cited in this paper have hypothesized that Johnston Atoll represents the “bridge” that links the Hawaiian Archipelago to other islands and atolls in the Pacific. Johnston Atoll and French Frigate Shoals contain 160 and 176 eukaryotic algal species, respectively. Of these, 82 are shared by both islands.

Of the six islands included in this analysis, 18 species (three species of green algae and 15 species of red algae) are unique to Johnston Atoll and French Frigate Shoals. The green algae include *Derbesia fastigiata*, *Microdictyon umbilicatum*, and *Pseudobryopsis oabuenensis*. The red algae consist primarily of epiphytes and turf: *Anotrichium secunda*, *Antithamnion decipiens*, *Caulacanthus ustulatus*, *Ceramium borneense*, *Gayliella fimbriata*, *Geliopsis variabilis*, *Griffithsia heteromorpha*, *Herposiphonia delicatula*, *H. variabilis*, *Hypnea valentiae*, *Lophosiphonia prostrata*, *Neosiphonia sphaerocarpa*, and *Polysiphonia tsudana*. One articulated coralline, *Amphiroa valonioides*, and one foliose red, *Chrysymenia okamurae*, were also unique to Johnston Atoll and French Frigate Shoals.

Fourteen algal species are common to the six islands and atolls: eight species of red algae (*Anotrichium tenue*, *Ceramium macilentum*, *Corallophila apiculata*, *Gayliella flaccida*, *Heterosiphonia crispella*, *Hypnea spinella*, *Lomentaria bakodatensis*, *Polysiphonia scopulorum*), two species of brown algae (*Asteronema breviarticulatum* and *Lobophora variegata*), and four species of green algae (*Bryopsis pennata*, *Caulerpa serrulata*, *Dictyosphaeria cavernosa*, *Ulva clathrata*). The three atolls used in the comparison, Johnston, Wake, and Enewetak, have histories of being impacted by anthropogenic activities, and the three shoals and islands, French Frigate Shoals, Howland, and Baker, have histories of being rather pristine. *Halimeda taenicola* and *Caulerpa bikimensis*, first described from the Marshall Islands (Taylor 1950), represent two macroalgae conspicuous at Johnston Atoll that still remain absent from Hawaiian waters (Abbott and Huisman 2004).

The only tropical-subtropical Pacific atoll with a greater biodiversity of marine flora than the 189 species at Johnston Atoll is the much larger and better-studied Enewetak

Atoll in the Marshall Islands with 256 species (Tsuda 1987, 2002). NOAA cruises to the U.S. Pacific Remote Islands, however, are broadening our knowledge of the diversity of marine benthic algae from rarely visited islands and atolls in the Pacific.

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Appendix 1

NOAA 2004 and 2006 Collection Sites

- JOH-01-04 (16° 44.394' N, 169° 32.073' W), lagoon, patch reef N of Johnston I. near dredged channel, 1.5–7.0 m deep, leg. P. S. Vroom and K. N. Page, I-12-04 (BISH 735038–735052).
- JOH-01-06, see JOH-01-04 for location and habitat, 1.5–7.0 m deep, leg. P. S. Vroom and M. L. Dailer, I-18-06 (BISH 735310–735321).
- JOH-02-04 (16° 44.979' N, 169° 30.676' W), lagoon, patch reef N of Sand I, 4.3–7.3 m deep, leg. P. S. Vroom and K. N. Page, I-12-04 (BISH 735053–735069).
- JOH-02-06, see JOH-02-04 for location and habitat, 4.3–7.3 m deep, leg. P. S. Vroom and M. L. Dailer, I-18-06 (BISH 735322–735327).
- JOH-03-04 (16° 46.225' N, 169° 28.901' W), lagoon reef NE side of atoll, 7.3–12.8 m deep, leg. P. S. Vroom and K. N. Page, I-13-04 (BISH 735070–735091, 735541).
- JOH-03-06, see JOH-03-04 for location and habitat, 8.2–13.4 m deep, leg. P. S. Vroom and M. L. Dailer, I-18-06 (BISH 735328–735341).
- JOH-04-04 (16° 45.518' N, 169° 29.728' W), lagoon reef near North (Akau) I, 2.1–5.5 m deep, leg. P. S. Vroom and K. N. Page, I-13-04 (BISH 735092–735110).
- JOH-04-06, see JOH-04-04 for location and habitat, 6.7–7.9 m deep, leg. P. S. Vroom and M. L. Dailer, I-22-06 (BISH 735342–735348).
- JOH-05P-04 (16° 45.607' N, 169° 30.687' W), lagoon reef SE of North (Akau) I. near mooring buoy, 4.6–9.1 m deep, leg. P. S. Vroom and K. N. Page, I-13-04 (BISH 735111–735129, 735543).
- JOH-05P-06, see JOH-05P-04 for location and habitat, 9.4–14.0 m deep, leg. P. S. Vroom and M. L. Dailer, I-22-06 (BISH 735349–735361).
- JOH-06-04 (16° 41.888' N, 169° 29.092' W), lagoon reef on S ocean-facing side of atoll, 14.9–17.1 m deep, leg. P. S. Vroom and K. N. Page, I-14-04 (BISH 735130–735161, 735539).
- JOH-06-06, see JOH-06-04 for location and habitat, 15.8–17.4 m deep, leg. P. S. Vroom and M. L. Dailer, I-20-06 (BISH 735362–735381).
- JOH-07-04 (16° 42.688' N, 169° 28.759' W), lagoon reef on S ocean-facing side of atoll, 9.4–17.1 m deep, leg. P. S. Vroom and K. N. Page, I-14-04 (BISH 735162–735196).
- JOH-07-06, see JOH-07-04 for location and habitat, 9.8–14.3 m deep, leg. P. S. Vroom and M. L. Dailer, I-20-06 (BISH 735382–735393).
- JOH-08-04 (16° 43.934' N, 169° 28.978' W), leeward lagoon reef S of East (Hikina) I, 4.3–7.0 m deep, leg. P. S. Vroom and K. N. Page, I-14-04 (BISH 735197–735229, 735544).
- JOH-08-06, see JOH-08-04 for location and habitat, 4.0–9.4 m deep, leg. P. S. Vroom and M. L. Dailer, I-20-06 (BISH 735394–735419, 735546, 735548).
- JOH-09-04 (16° 43.727' N, 169° 29.115' W), leeward lagoon patch reef S of East (Hikina) I, 7.3–11.0 m deep, leg. P. S. Vroom and K. N. Page, I-15-04 (BISH 735196, 735230–735249, 735545).
- JOH-09-06, see JOH-09-04 for location and habitat, 7.9–10.7 m deep, leg. P. S. Vroom and M. L. Dailer, I-21-06 (BISH 735240–735243, 735538).
- JOH-10P-04 (16° 45.815' N, 169° 30.706' W), lagoon reef E of North (Akau) I. under white mooring buoy, 12.2–14.9 m deep, leg. P. S. Vroom and K. N. Page, I-15-04 (BISH 735250–735269, 735540).
- JOH-10P-06, see JOH-10P-04 for location and habitat, 13.1–15.5 m deep, leg. P. S. Vroom and M. L. Dailer, I-22-06 (BISH 735435–735450).
- JOH-11-04 (16° 43.324' N, 169° 31.436' W), lagoon reef S of Johnston I, 9.8–11.9 m deep, leg. P. S. Vroom and K. N. Page, I-16-04 (BISH 735270–735290, 735542).
- JOH-11-06, see JOH-11-04 for location and habitat, 6.4–10.0 m deep, leg. P. S. Vroom and M. L. Dailer, I-21-06 (BISH 735451–735460).
- JOH-12-04 (16° 44.860' N, 169° 31.441' W), lagoon patch reef N of navigational channel, 7.9–12.2 m deep, leg. P. S. Vroom and K. N. Page, I-16-04 (BISH 735292–735309).
- JOH-12-06, see JOH-12-04 for location and habitat, 3.6–10.7 m deep, leg. P. S. Vroom and M. L. Dailer, I-21-06 (BISH 735461–735471).
- JOH-14-06 (16° 46.213' N, 169° 31.117' W), forereef N of Johnston I, 15.2–16.8 m deep, leg. P. S. Vroom and M. L. Dailer, I-19-06 (BISH 735472–735483).
- JOH-15-06 (16° 47.029' N, 169° 29.404' W), forereef NE of North (Akau) I, 15.8–16.8 m deep, leg. P. S. Vroom and M. L. Dailer, I-19-06 (BISH 735484–735495, 735547).
- JOH-16-06 (16° 47.297' N, 169° 28.435' W), forereef close to northern pass, 15.2–16.8 m deep, leg. P. S. Vroom and M. L. Dailer, I-19-06 (BISH 735496–735504).
- JOH-17-06 (16° 41.779' N, 169° 33.639' W), forereef on extreme W side of atoll, 13.7–15.8 m deep, leg. P. S. Vroom and M. L. Dailer, I-23-06 (BISH 735505–735510).
- JOH-18-06 (16° 43.866' N, 169° 32.368' W), shallow lagoon reef at N edge of Johnston I, 1.5–2.7 m deep, leg. P. S. Vroom and M. L. Dailer, I-23-06 (BISH 735511–735524).
- JOH-19-06 (16° 44.683' N, 169° 32.181' W), lagoon, backreef, 3.4–4.9 m deep, leg. P. S. Vroom and M. L. Dailer, I-23-06 (BISH 735525–735537).

Appendix 2

Alphabetized Listing and References of Previously Recorded Algal Species Not Found in the 2004 and 2006 NOAA Collections from Johnston Atoll

Cyanophyceae

- Blennotrix lyngbyacea* (Kützing) Anagnostidis & Komárek; Buggeln and Tsuda (1969) as *Hydrocoleum lyngbyaceum* Gomont.
- Borzia elongata* Baker, Patterson & Ikagawa; Baker et al. (1997).
- Calothrix crustacea* Thuret; Buggeln and Tsuda (1969).
- Calothrix scopulorum* (Weber & Mohr) C. Agardh; Buggeln and Tsuda (1969).
- Entophysalis deusta* (Meneghini) Drouet & Daily; Buggeln and Tsuda (1969).
- Hormothamnium enteromorphoides* Grunow; Buggeln and Tsuda (1969).
- Isactis plana* (Harvey) Thuret; Buggeln and Tsuda (1969).
- Lyngbya aestuarii* (Mertens) Liebman; Buggeln and Tsuda (1969).
- Lyngbya lutea* (C. Agardh) Areschoug; Buggeln and Tsuda (1969).
- Lyngbya majuscula* (Dillwyn) Harvey; Buggeln and Tsuda (1969).
- Microcoleus cthonoplastes* (Mertens) Zanardini; Buggeln and Tsuda (1969).
- Microcoleus vaginatus* (Vaucher) Gomont; Buggeln and Tsuda (1969).
- Microcystis dimidiata* (Kützing) P. Silva; Buggeln and Tsuda (1969) as *Anacystis dimidiata* (Kützing) Drouet & Daily
- Phormidium nigroviride* (Thwaites) Anagnostidis & Komárek; Buggeln and Tsuda (1969) as *Oscillatoria nigroviridis* Thwaites.
- Phormidium submembranaceum* (Ardissone & Strafforlo) Gomont; Buggeln and Tsuda (1969).
- Schizothrix calcicola* (C. Agardh) Gomont; Buggeln and Tsuda (1969).
- Schizothrix tenerrima* (Gomont) Drouet; Buggeln and Tsuda (1969) as *Microcoleus tenerrimus* Gomont.
- Spirulina tenerrima* Kützing; Buggeln and Tsuda (1969).
- Symploca atlantica* Gomont; Buggeln and Tsuda (1969).
- Rhodophyceae
- Callithamnion marshallense* Dawson; Buggeln and Tsuda (1969).
- Caloglossa leprieurii* (Montagne) J. Agardh; Buggeln and Tsuda (1969).
- Centroceras clavulatum* (C. Agardh) Montagne; Buggeln and Tsuda (1969); Coles et al. (2001), BISH 664307.
- Ceramium aduncum* Nakamura; Coles et al. (2001), BISH 665241.
- Ceramium borneense* Weber-van Bosse; Coles et al. (2001), BISH 665773.
- Ceramium maryae* Weber-van Bosse; Buggeln and Tsuda (1969).
- Ceramium serpens* Setchell & Gardner; Coles et al. (2001), BISH 664316.
- Ceramium zacaе* Setchell & Gardner; Buggeln and Tsuda (1969).
- Chroodactylon ornatum* (C. Agardh) Basson; Buggeln and Tsuda (1969) as *Asterocystis ornata* (C. Agardh) Hamel.
- Dasya anastomosans* (Weber-van Bosse) Wynne; Buggeln and Tsuda (1969) as *Dasya adbaerens* Yamada.
- Dasya iridescens* (Schlech) Millar & Abbott; Coles et al. (2001), BISH 665267.
- Dasya murrayana* Abbott & Millar; Coles et al. (2001), BISH 664332.
- Dasya sinicola* (Setchell & N. L. Gardner) Dawson; Buggeln and Tsuda (1969).
- Diplothamnion jolyi* van den Hoek; Coles et al. (2001), BISH 665768.
- Gayliella fimbriata* (Setchell & N. L. Gardner) T. O. Cho & S. M. Boo; Buggeln and Tsuda (1969) as *Ceramium fimbriatum* Setchell & Gardner.
- Gelidiopsis variabilis* (J. Agardh) Schmitz; Coles et al. (2001), BISH 664287.
- Gelidium crinale* (Turner) Gaillon; Buggeln and Tsuda (1969).
- Gelidium pusillum* (Stackhouse) Le Jolis; most likely misidentified: *Gelidium isabellae* W. R. Taylor (Millar and Freshwater 2005) or *Pterocladia caerulea* (Kützing) Santelices (Skelton and South 2007).
- Griffithsia metcalfei* C. K. Tseng; Buggeln and Tsuda (1969).
- Griffithsia ovalis* Harvey; Buggeln and Tsuda (1969).
- Griffithsia schousboei* Montagne; Coles et al. (2001), BISH 665766.
- Herposiphonia arcuata* Hollenberg; Coles et al. (2001), BISH 664301.
- Herposiphonia crassa* Hollenberg; Coles et al. (2001), BISH 665829.
- Herposiphonia delicatula* Hollenberg; Coles et al. (2001), BISH 665226.
- Hypnea pannosa* J. Agardh; Coles et al. (2001), BISH 665258.
- Hypnea valentiae* (Turner) Montagne; Buggeln and Tsuda (1969) as *Hypnea esperi* Bory; Coles et al. (2001), BISH 664303.
- Jania adbaerens* Lamouroux; Coles et al. (2001), BISH 665271.
- Kallymenia* sp.; Coles et al. (2001), BISH 665239.
- Lophosiphonia prostrata* (Harvey) Falkenberg; Coles et al. (2001), BISH 665813.
- Monosporus indicus* Børgesen; Coles et al. (2001), BISH 665791.
- Neosiphonia howei* (Hollenberg in Taylor) Skelton & South; Coles et al. (2001) as *Polysiphonia howei* Hollenberg, BISH 665248.
- Neotenophycus ichthyosteus* Kraft & Abbott (2002).
- Peyssonnelia conchicola* Piccone & Grunow; Coles et al. (2001), BISH 664338.
- Polysiphonia triton* Silva; Hollenberg (1968a) (holotype) as *Polysiphonia tenuis* Hollenberg (replaced name).
- Wurdemannia* sp.; Buggeln and Tsuda (1969).
- Phaeophyceae
- Asteronema breviarticulatum* (J. Agardh) Ouriques & Bouzon; Buggeln and Tsuda (1969) as *Ectocarpus breviarticulatus* J. Agardh.
- Dictyota bartayresiana* Lamouroux; Aegegian and Abbott (1985), 118 m deep.
- Feldmannia irregularis* (Kützing) Hamel; Buggeln and Tsuda (1969) as *Ectocarpus irregularis* Kützing.
- Hincksia indica* (Sonder) J. Tanaka; Buggeln and Tsuda (1969) as *Ectocarpus indicus* Sonder.

- Sphaelaria tribuloides* Meneghini; Buggeln and Tsuda (1969); Coles et al. (2001), BISH 665790.
- Chlorophyceae
- Palmogloea protuberans* (J. E. Smith) Kützinger; Buggeln and Tsuda (1969), most likely misidentified because *P. protuberans* is a freshwater species.
- Ulotrix flacca* (Dillwyn) Thuret; Coles et al. (2001) as *Ulotrix pseudoflacca* Wille, BISH 665266.
- Ulvophyceae
- Ulva kyllini* (Bliding) Hayden, Blomster, Maggs, P. C. Silva, M. J. Stanhope & J. R. Waaland; Buggeln and Tsuda (1969) as *Enteromorpha kyllini* Bliding.
- Cladophorophyceae
- Boodlea composita* (Harvey) Brand; Buggeln and Tsuda (1969).
- Cladophora crystallina* (Roth) Kützinger; Buggeln and Tsuda (1969).
- Dictyosphaeria cavernosa* (Forsskål) Børgesen; Coles et al. (2001), BISH 664346.
- Bryopsidophyceae
- Caulerpa lentillifera* J. Agardh; Coles et al. (2001), BISH 665249.
- Caulerpa urvilleana* Montagne; Buggeln and Tsuda (1969).
- Caulerpella ambigua* (Okamura) Prud'homme van Reine & Lokhorst; Buggeln and Tsuda (1969) and Aegegian and Abbott (1985) as *Caulerpa ambigua* Okamura, 70 m deep; Coles et al. (2001) as *Caulerpa ambigua*, BISH 664309.
- Codium arabicum* Kützinger; Buggeln and Tsuda (1969).
- Derbesia marina* (Lyngbye) Solier; Buggeln and Tsuda (1969).
- Halimeda discoidea* Decaisne; Buggeln and Tsuda (1969); Coles et al. (2001), BISH 663190.
- Halimeda gracilis* Harvey ex J. Agardh; Aegegian and Abbott (1985), 50–125 (136) m deep.
- Halimeda opuntia* (Linnaeus) Lamouroux; Coles et al. (2001), BISH 665799.
- Halimeda tuna* (Ellis & Solander) Lamouroux; Moul (1964); Buggeln and Tsuda (1969).
- Ostreobium quekettii* Bornet & Flahault; Buggeln and Tsuda (1969) as *Ostreobium reineckeii* Bornet.
- Pseudobryopsis oahuensis* Egerod; Coles et al. (2001) as *Trichosolen oahuensis* (Egerod) Taylor, BISH 664296.
- Dasycladophyceae
- Parvocaulis clavatus* (Yamada) S. Berger, Fettweiss, Gleissberg, Liddle, U. Richter, Sawitzky & Zuccarello; Buggeln and Tsuda (1969) as *Acetabularia clavata* Yamada.
- Parvocaulis exiguus* (Solms-Laubach) S. Berger, Fettweiss, Gleissberg, Liddle, U. Richter, Sawitzky & Zuccarello; Buggeln and Tsuda (1969) as *Acetabularia tsengiana* Egerod.
- Parvocaulis parvulus* (Solms-Laubach) S. Berger, Fettweiss, Gleissberg, Liddle, U. Richter, Sawitzky & Zuccarello; Buggeln and Tsuda (1969) as *Acetabularia mobii* Solms-Laubach.

