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Marine benthic algae from the leeward Hawaiian group

by

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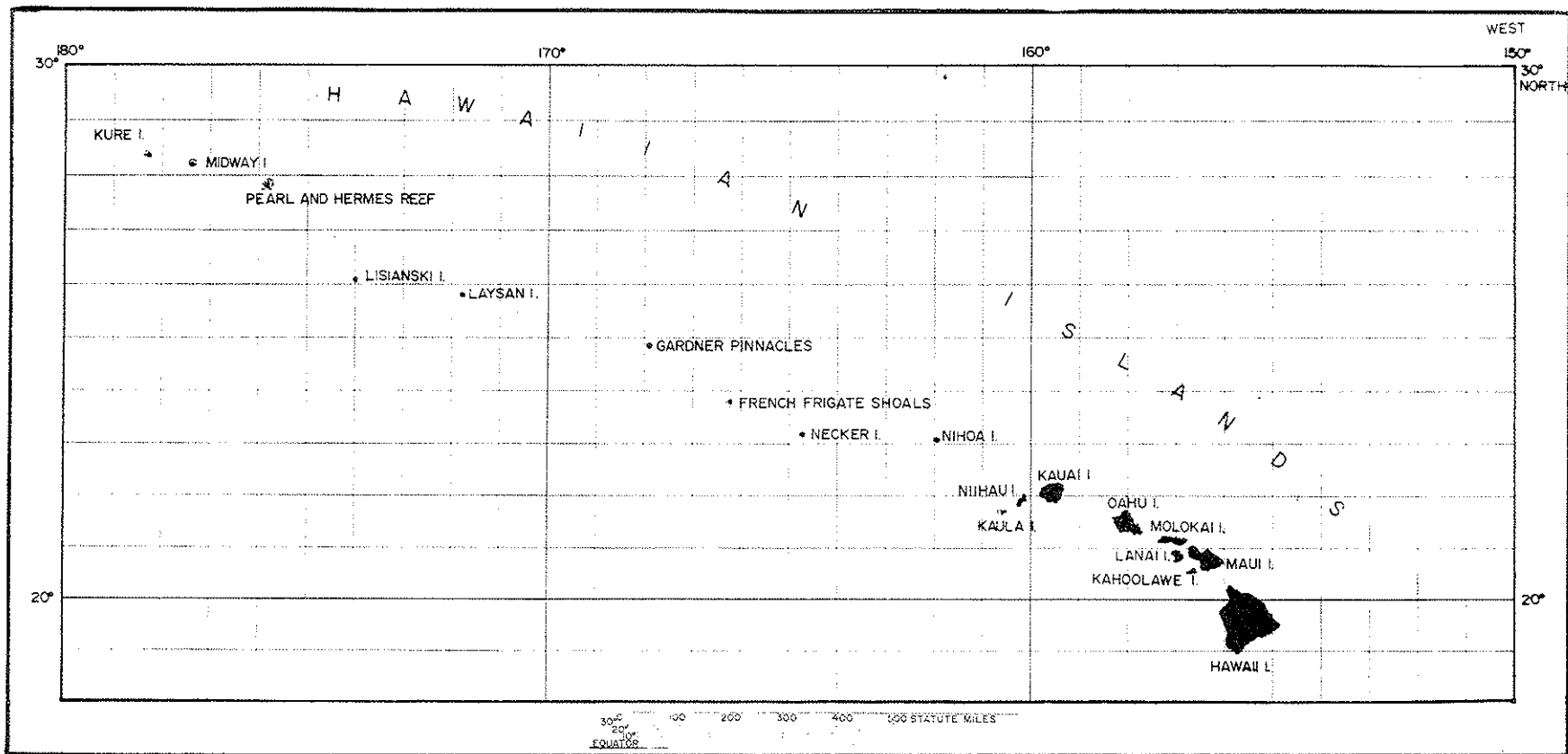


Fig. 1. Map of the Hawaiian Islands showing the relative position of each of the islands reported on.

Marine Benthic Algae from the

Leeward Hawaiian Group<sup>1/</sup>

by Roy T. Tsuda<sup>2/</sup>

The following is an account of all the marine benthic algae accumulated by the author from various collectors from six of the nine islands in the Leeward Hawaiian Group (Nihoa, Necker, French Frigate Shoals, Lisianski, Pearl and Hermes Reef, Kure). The islands comprising this group (Fig. 1) consist of remnants of nine former high islands which at present make up low volcanic islands, reefs, and atolls. They extend approximately 1300 miles northwest from Kauai and are located between 23° 05' N. and 28° 25' N. latitude and 161° 58' W. and 178° 25' W. longitude. For further information on the geography and history of each of these islands, see Bryan (1942).

Past published papers on the marine algae concern only three of the nine islands. These are Schauinsland (1899), Reinbold (1899), Lemmermann (1905), Tsuda (1965) on Laysan Island; Buggeln (1965) on Midway Island; and Howe (1934) on Pearl and Hermes Reef.

The fifteen species of algae reported in Howe (1934) on Pearl and Hermes Reef and one species of Turbinaria reported in Taylor (1964) from French Frigate Shoals are incorporated in this present paper. Except for them, all species listed represent new records. The recent algal collections made from Laysan Island by Mr. C. R. Long in September 1964, are excluded since no new records were found. Any name which is now relegated to synonymy is cited with the currently accepted name.

Also included in this paper are the corrected specific epithets of three species of Liagora and one species of Halimeda which were reported inaccurately from Laysan Island (Tsuda, 1965) and Midway Island (Buggeln, 1965).

Below is a list of the islands with the collectors, dates and specimen numbers as available. The initials within the parentheses identify the specimen numbers of Dr. Maxwell S. Doty, Dr. Charles H. Lamoureux, Mr. Ronald Walker, and the author.

NIHOA ISLAND (23° 05' N. Lat., 161° 58' W. Long.):

E. Christophersen, July 1924; R. Walker, March 1964 (RW 2).

NECKER ISLAND (23° 10' N. Lat., 164° 41' W. Long.):

E. Christophersen, July 1924; C. R. Long, September 1964 (RT 938-955).

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FRENCH FRIGATE SHOALS (23° 50' N. Lat., 166° 15' W. Long.):  
C. T. Crocker, December 1936 (in Taylor, 1964); R. Rogers, March 1961  
(MSD 19476); C. R. Long, September 1964 (RT 931-937).

LISIANSKI ISLAND (26° 02' N. Lat., 173° 59' W. Long.): S. C. Ball  
(Tanager Expedition), April 1923; A. L. Young, August 1964 (RT 637-645);  
C. R. Long, September 1964 (RT 920-928).

PEARL AND HERMES REEF (27° 50' N. Lat., 175° 50' W. Long.):  
P. C. Galtsoff, Summer 1930 (in Howe, 1934); E. C. Jones, June 1956  
(MSD 13346); A. L. Young, August 1964 (RT 613-633); C. R. Long,  
September 1964 (RT 899-919).

KURE ATOLL (28° 25' N. Lat., 178° 25' W. Long.): C. H. Lamoureux,  
September 1961 (MSD 19573-19576, CHL 2778); A. Anderson, March 1965  
(RT 980-986).

In the following annotated list, the specimen numbers are listed  
with the species and by their use the collectors can be determined.

#### MYXOPHYTA

Species determinations in this group are contributed by Dr. Francis  
Drouet.

Lyngbya aestuarii (Mert.) Lyngb.

French Frigate Shoals: RT 937 (East Island - on reef flat).

Lyngbya majuscula (Dillw.) Harv.

Pearl and Hermes Reef: RT 914 (North Island - on reef flat),  
RT 916 (in central lagoon); Kure Atoll: MSD 19576A (Green Island - on  
reef flat).

Oscillatoria chalybea Mert.

Necker Island: RT 938 (west point of island).

Schizothrix mascarenica Gom.

Kure Atoll: CHL 2778 (Green Island - forming crust in sand about  
5 mm thick on edge of dune facing lagoon beach).

CHLOROPHYTA

Bryopsis pennata Lamx., 1809a: 134, figs. 1a-b, pl. 3; Egerod, 1952: 370, fig. 7.

Necker Island: RT 950; Lisianski Island: RT 736 (on reef flat).

Caulerpa racemosa var. clavifera (Turner) Weber-van Bosse, 1898: 361, pl. 33 (figs. 1-5).

Necker Island: Christophersen (det. by Dr. W. J. Gilbert).

Caulerpa racemosa var. imbricata (Kjellm.) Eubank, 1946: 423, fig. 2w.

Necker Island: RT 944.

Caulerpa racemosa var. laetevirens (Mont.) Weber-van Bosse, 1898: 366, pl. 33 (figs. 8, 16-22).

Necker Island: Christophersen (det. by Dr. W. J. Gilbert).

Caulerpa racemosa var. peltata (Lamx.) Eubank, 1946: 421, figs. 2r-s.

Necker Island: RT 943.

Caulerpa serrulata (Forssk.) J. Ag. emend. Boergesen, 1932: 5, pl. 1 (fig. 2).

Pearl and Hermes Reef: Howe (in a meter of water).

Caulerpa taxifolia (Vahl) C. Ag., 1822: 435; Eubank, 1946: 417, figs. 2f-g.

Nihoa Island: Christophersen (det. by Dr. W. J. Gilbert).

Chaetomorpha antennina (Bory) Kützting, 1849: 379; Boergesen, 1940: 38.

Necker Island: RT 953.

Chlorodesmis hildebrandtii A. & E. S. Gepp, 1911: 16, 137, figs. 74-75; Egerod, 1952: 377, fig. 9b, pl. 34a.

Lisianski Island: RT 644 (small filaments about 2-3 mm in length attached to coral).

Cladophora sp.

Pearl and Hermes Reef: RT 627 (Bird Island - entangled mass of yellowish-green filaments with spongy texture).

Codium arabicum Kützting, 1856: 35, pl. 100 (fig. II).

(Codium coronatum Setchell)

Pearl and Hermes Reef: Howe (in 3 meters of water). Egerod (1952) relegates C. coronatum to synonymy under C. arabicum.

Codium edule Silva in Egerod, 1952: 392, figs. 18a-c, pl. 35.

French Frigate Shoals: RT 932 (Trig Island); Lisianski Island: RT 927 (on eastern beach).

Dictyosphaeria cavernosa (Forsskål) Boerg., 1932: 2, pl. 1 (fig. 1); Egerod, 1952: 350, fig. 1e-g.

Kure Atoll: RT 982 (Green Island - beachdrift).

Dictyosphaeria versluysii Weber-van Bosse, 1905: 144; Egerod, 1952: 351, figs. 1a and 2h-k.

Lisianski Island: RT 642; Pearl and Hermes Reef: RT 903 (Southeast Island - beachdrift).

Enteromorpha tubulosa Kützting, 1856: 11; Dawson, 1954: 384, figs. 6a-b.

Pearl and Hermes Reef: RT 911 (Southeast Island - on rocks on west side of island).

Enteromorpha sp. 1

Lisianski Island: RT 645 (on coral); Pearl and Hermes Reef: RT 628 (North Island - on coral).

Enteromorpha sp. 2

Kure Atoll: MSD 19576D (Green Island - small thallus branching profusely from base).

Enteromorpha sp. 3

Pearl and Hermes Reef: RT 913 (Southeast Island - in shallow pool).

Halimeda discoidea Decaisne, 1842: 91; Hillis, 1959: 352, pl. 2 (fig. 5), pl. 5 (fig. 11), pl. 6 (fig. 11), pl. 7 (figs. 9-10), pl. 8 (figs. 5-8), pl. 11.

Lisianski Island: RT 638, RT 922 (on eastern beach); Pearl and Hermes Reef: Howe, as H. cuneata Hering (in a meter of water). Hillis in her monograph of the genus Halimeda lists the specimen identified by Howe as H. cuneata Hering under H. discoidea Decaisne.

Halimeda opuntia (L.) Lamx., 1816: 308; Hillis, 1959: 359, pl. 2 (figs. 7-8), pl. 5 (figs. 3-4), pl. 6 (fig. 6), pl. 7 (fig. 3), pl. 10.

Pearl and Hermes Reef: Howe (small segmented form in about 7 meters of water); Midway Island: MSD 18707, MSD 18738, MSD 18747, MSD 18758 (as H. incrassata (Ellis) Lamx. in Buggeln, 1965); Laysan Island: Tanager Expedition (as H. lacunalis Taylor in Tsuda, 1965).

The author in an earlier (1965) paper had listed H. lacunalis Taylor as occurring on Laysan while Mr. Richard Buggeln listed H. incrassata (Ellis) Lamx. as occurring on Midway (Buggeln, 1965). After a more thorough study of these two specimens, Mr. Buggeln and the author agree that both are juvenile forms of H. opuntia, with this decision later verified by Dr. William J. Gilbert.

These two specimens each have a single distinct holdfast, while anatomically the central filaments at the internode are fused in pairs and the utricles fall within the size range as specified in Hillis(1959).

Microdictyon setchellianum Howe, 1934: 38; Egerod, 1952: 366, figs. 6c-g, pl. 33.

Necker Island: RT 954; French Frigate Shoals: RT 933 (Trig Island); Pearl and Hermes Reef: Howe (in about 7 meters of water), RT 618 (Bird Island - epiphytic on Laurencia obtusa (Huds.) Lamx.), RT 624 (Bird Island), RT 902 (Southeast Island - beachdrift); Kure Atoll: RT 986 (Green Island - beachdrift).

Ulva fasciata Delile, 1813: 153; Boergesen, 1940: 10.

Necker Island: RT 942.

#### PHAEOPHYTA

Colpomenia sinuosa (Roth) Derbes & Solier, 1856: 11; Dawson, 1954: 402, figs. 18a, c, d.

Pearl and Hermes Reef: Howe (epiphytic on Halimeda opuntia (L.) Lamx. in about 7 meters of water).

Chnoospora minima (Hering) Papenfuss, 1956: 69.

Necker Island: RT 947.

Dictyota friabilis Setchell, 1926: 91, pl. 13 (figs. 4-7) and pl. 20 (fig. 1).

Necker Island: RT 948 (fragments); Pearl and Hermes Reef: RT 617 (Bird Island - epiphytic on Laurencia obtusa (Huds.) Lamx.)

Dictyota sp.

Kure Atoll: RT 981 (Green Island - beachdrift).

Hydroclathrus clathratus (C. Ag.) Howe, 1920: 590.

Pearl and Hermes Reef: Howe (in about a meter of water).

Pocockiella variegata (Lamx.) Papenfuss, 1943: 467, figs. 1-14.

Lisianski Island: RT 640 (small prostrate thallus adhering to coral); Kure Atoll: RT 985 (Green Island - beachdrift).

Sargassum echinocarpum J. Ag., 1848: 327.

Nihoa Island: EW 2; Necker Island: RT 941.

Sargassum obtusifolium J. Ag., 1848: 339.

(Sargassum vulgare var. linearifolium J. Ag.)

Pearl and Hermes Reef: Howe (in about 7 meters of water on coral and sand, probably unattached).

Howe (1934) places a question mark after this variety, but says that this specimen agrees very well with Yendo (1907). At present, Doty & Newhouse (unpublished manuscript) places this variety under the species S. obtusifolium J. Ag. which is circumscribed to include all round and smooth stemmed Sargassums from Hawaii.

Sargassum piluliferum (Turn.) C. Ag., 1821: 27.

Pearl and Hermes Reef: Howe (floating in 2 meters of water), MSD 13346 (floating in 3-4 meters of water), RT 915 (in central lagoon).

Specimen RT 915 is very light brown in color, with proliferations on the main axis, narrow leaf-segments, and numerous air vesicles on short pedicels.



Sphacelaria tribuloides Meneghini, 1840: 2; Boergesen, 1941: 41, figs. 18a-c.

Pearl and Hermes Reef: RT 633A (Bird Island - on coral).

Turbinaria ornata (Turner) J. Ag., 1848: 266; Taylor, 1964: 483.

French Frigate Shoals: (reported in Taylor, 1964); Lisianski Island: RT 921 (on eastern side of island); Pearl and Hermes Reef: Howe (in about a meter of water), RT 620 (Bird Island), RT 899 (Southeast Island - beachdrift); Kure Atoll: MSD 19573 (Green Island - beachdrift).

Zonaria sp.

Pearl and Hermes Reef: RT 613 (Bird Island); Kure Atoll: MSD 19575 and RT 980 (Green Island - beachdrift).

#### RHODOPHYTA

Acrochaetium sp.

Pearl and Hermes Reef: RT 622 (Bird Island - epiphytic on Turbinaria ornata (Turner) J. Ag.).

Amphiroa fragillissima (L.) Lamx., 1816: 298; Taylor, 1960: 403, pl. 47 (figs. 1-2).

Lisianski Island: RT 641, RT 926 (on eastern beach).

Bangia fuscopurpurea (Dillwyn) Lyngbye, 1819: 83; Taylor, 1960: 293.

French Frigate Shoals: MSD 19476 (as a tuft near high tide line on La Perouse Rock). Det. by Dr. Maxwell S. Doty.

Centroceras apiculatum Yamada, 1944a: 42.

Pearl and Hermes Reef: RT 629 (Bird Island - on piece of coral), RT 908 (Southeast Island - beachdrift, epiphytic on Microdictyon setchellianum Howe).

Centroceras clavulatum (C. Ag.) Montagne in Durieu, 1846: 140; Dawson, 1954: 446, fig. 54h.

Necker Island: RT 955; Kure Atoll: MSD 19576E (Green Island).

Ceramium gracillimum Griffiths & Harvey in Harvey, 1846-1851, pl. 206.

French Frigate Shoals: RT 936 (East Island).

Ceramium mazatlanense Dawson, 1950b: 130, pl. 2 (figs. 14-15).

Lisianski Island: RT 643 (epiphytic on Amphiroa fragillissima (L.) Lamx.).

Falkenbergia hillebrandii (Bornet) Falkenbert = sporophyte generation of Asparagopsis taxiformis (Delile) Collins & Hervey; Feldmann & Feldmann, 1942: 89; Dawson, 1954: 414, fig. 25L.

Pearl and Hermes Reef: RT 623 (Bird Island).

Gelidium pusillum (Stackh.) Le Jolis, 1864: 139; Dawson, 1954: 420, figs. 31a-c.

Necker Island: RT 952; Lisianski Island: Ball (tuft on coral), RT 920 (on east beach); Pearl and Hermes Reef: RT 626 (Bird Island - juvenile forms covering small piece of coral).

Goniolithon frutescens Fosl., 1900: 9.

Pearl and Hermes Reef: Howe (in a meter of water).

Griffithsia ovalis Harvey, 1862, vol. 4: pl. 203; Abbott, 1946: 440, pl. 1 (figs. 1-4); pl. 2 (figs. 1-2).

Pearl and Hermes Reef: RT 910 (Southeast Island - beachdrift, epiphytic on Microdictyon setchellianum Howe). This sterile bead-like thallus about a centimeter long is tentatively listed under this species.

Haloplegma sp.

Kure Atoll: RT 984 (Green Island - beachdrift).

Herposiphonia sp. 1

French Frigate Shoals: RT 934A (Trig Island). At present, Dr. G. J. Hollenberg is studying all of these specimens of Herposiphonia from the Leeward group and will report on them later.

Herposiphonia sp. 2

Pearl and Hermes Reef: RT 625 (Bird Island - epiphytic on Microdictyon setchellianum Howe).

Herposiphonia sp. 3

Pearl and Hermes Reef: RT 906 (Southeast Island - beachdrift, epiphytic on Microdictyon setchellianum Howe), RT 912 (on rocks on west side of island).

Hypnea pannosa J. Ag., 1847: 14; Tanaka, 1941: 247, fig. 20.

Necker Island: RT 945 (forming entangled clumps).

Hypnea sp.

Lisianski Island: RT 925 (epiphytic on base of Halimeda discoidea Decaisne on eastern beach); Pearl and Hermes Reef: RT 919 (central lagoon - epiphytic on Sargassum piluliferum (Turn.) C. Ag.).

Jania capillacea Harvey, 1853: 84; Dawson, 1952: 116.

Necker Island: RT 951 (epiphytic on Sargassum echinocarpum J. Ag.); Lisianski Island: RT 923 (epiphytic on Turbinaria ornata (Turner) J. Ag. on eastern beach); Pearl and Hermes Reef: RT 907 (Southeast Island - beachdrift, epiphytic on Microdictyon setchellianum Howe); Kure Atoll: MSD 19576 (Green Island - epiphytic on Turbinaria ornata (Turner) J. Ag.).

Jania ungulata Yendo, 1902: 27, pl. 3 (figs. 7-8) and pl. 7 (fig. 8).

Pearl and Hermes Reef: RT 621 (Bird Island - epiphytic on Turbinaria ornata (Turner) J. Ag.).

Laurencia galtsoffi Howe, 1934: 39.

Pearl and Hermes Reef: Howe (on sand and coral in 3 meters of water).

Laurencia obtusa (Huds.) Lamx., 1813: 130; Yamada, 1931: 222, pl. 16 (figs. a-e) and pl. 17 (figs. a-c).

Necker Island: RT 940; French Frigate Shoals: RT 931 (Trig Island); Pearl and Hermes Reef: RT 616 (Bird Island), RT 904 (Southeast Island - beachdrift), RT 917 (in central lagoon); Kure Atoll: RT 983 (Green Island - beachdrift).

Laurencia sp. 1

Pearl and Hermes Reef: Howe (on coral sand in 7 meters of water).

Laurencia sp. 2

French Frigate Shoals: RT 935 (Trig Island).

Laurencia sp. 3

Kure Atoll: MSD 19576B (Green Island).

Liagora ceranoides Lamx. f. pulverulenta (C. Ag.) Yamada, 1938: 20;  
Abbott, 1945: 156, figs. 8-9.

Pearl and Hermes Reef: RT 900 (Southeast Island - beachdrift).  
Male thallus about 11 cm in height, determined by Dr. I. A. Abbott.

Liagora farinosa Lamx., 1816: 240; Abbott, 1945: 163, figs. 14-15.

Laysan: MSD 19584 (determined as L. kahukuana Abbott in Tsuda, 1965). This specimen was sent to Dr. I. A. Abbott for verification and according to her, it is not L. kahukuana Abbott but falls within the circumscription of L. farinosa Lamx.

Liagora kahukuana Abbott, 1945: 149, fig. 2.

Laysan: Tanager Expedition (as Liagora sp. 2 in Tsuda, 1965).  
Determined by Dr. I. A. Abbott.

Liagora valida Harvey, 1852: 138, pl. 31a (figs. 1-5); Abbott, 1945:  
160, figs. 12-13.

Laysan: Tanager Expedition (as Liagora sp. 1 in Tsuda, 1965).  
Determined by Dr. I. A. Abbott.

Liagora sp.

Pearl and Hermes Reef: RT 901 (Southeast Island - beachdrift).  
Upon examination of this male specimen, Dr. I. A. Abbott reports that it is very close to L. valida Harvey in internal structure but differs externally.

Lithophyllum sp.

Pearl and Hermes Reef: Howe (on broken corals in 1-2 meters of water).

Polysiphonia simplex Hollenberg, 1942: 782, fig. 18.

French Frigate Shoals: RT 934B (Trig Island). Species determination by Dr. G. J. Hollenberg.

Polysiphonia villum J. Ag., 1863: 941.

Pearl and Hermes Reef: RT 633B (Bird Island - on piece of coral). Det. by Dr. G. J. Hollenberg.

Porolithon sp.

Pearl and Hermes Reef: Howe (on broken coral in 1-2 meters of water).

Spyridia filamentosa (Wulf.) Harv. in Hooker, 1833: 337; Dawson, 1954: 444, fig. 54i.

Lisianski Island: RT 928 (on east beach); Pearl and Hermes Reef: RT 615 (Bird Island - epiphytic on Zonaria sp.).

#### Acknowledgments

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The author is grateful to Dr. Isabella A. Abbott, Hopkins Marine Station, for her determinations of Liagora; to Dr. Francis Drouet, Academy of Natural Sciences of Philadelphia, for providing the determinations of all the blue-green algae; to Dr. William J. Gilbert, Albion College, for his verification of H. opuntia; and to Dr. George J. Hollenberg, Professor Emeritus of Biology, University of Redlands, for the species determinations of Polysiphonia.

Summary of Algal Collections

Table I summarizes the number of marine benthic algal species or varieties in each of the major divisions thus far recorded from each of the eight islands in the Leeward Hawaiian group. To date, no algal collections have been made from Gardner Pinnacles. By observing this table one can see the discrepancy between the number of algae from Laysan Island as compared to the number of algae from the other islands. More work on algal floristics is needed on these other islands, since Laysan is the only island on which a thorough collection has been made.

Table I. Number of marine benthic algae from the Leeward Hawaiian Group

Islands	Myxophyta	Chlorophyta	Phaeophyta	Rhodophyta	Total
Nihoa Island	0	1	1	0	2
Necker Island	1	8	3	5	17
French Frigate Shoals	1	2	1	6	10
Lisianski Island	0	6	2	6	14
Pearl & Hermes Reef	1	10	8	20	39
Kure Atoll	2	3	4	5	14
Midway Islands (Buggeln, 1965)	1	11	5	17	34
Laysan Island (Tsuda, 1965)	17	23	17	46	103

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