Pacific Science (1989), vol. 43, no. 3


# Marine Algae of the Northwest Hawaiian Islands[1]

ISABELLA A. ABBOTT[2]

ABSTRACT: Reexamination of some previous collections of marine algae from the Northwest Hawaiian Islands (NWHI), also known as the Leeward Hawaiian Islands, and the addition of more recent collections have resulted in recognition of 48 taxa of Chlorophyta (green algae), with eight new records for the NWHI; 33 taxa of Phaeophyta (brown algae), with seven new records; and 124 species of Rhodophyta (red algae), of which 26 are new records for the NWHI. Among the 41 new records, 14 taxa are newly reported for the entire Hawaiian archipelago. Among the new records are *Nemacystus decipiens*, *Halimeda copiosa*, and *H. velasquezii* and among the microscopic algae *Crouania mageshimensis*. Total macroscopic marine flora consists of 205 taxa, a number close to the 222 species known from Eniwetak in the northern Marshall Islands. Proportions of greens and reds in the two places are markedly different, however, with more green and fewer red species in Eniwetak.

NEW COLLECTIONS from the Northwest Hawaiian Islands, which are small islets, pinnacles, or atolls northwest of the main Hawaiian chain, have substantially added to the number of taxa previously reported from those locations (Buggeln 1965, Tsuda 1965, 1966, Balazs 1979). Opportunities to collect marine algae at these 11 locations are not numerous, and phycologists are dependent on the good nature and cooperation of biologists who are visitors for other reasons. The new collections reported upon here were made by Fred Ball, then an employee of the State of Hawaii in the Department of Land and Natural Resources, and Heather J. Fortner, who was employed on board ship for the National Marine Fisheries, and by Ira A. Levine, who was collecting blue-green algae for a natural products study. Because of sterile specimens, not all material is reported upon here; perhaps four to six species remain unidentified.

The coral atolls and reefs that constitute the older northwesternmost leeward Hawaiian Islands (officially known as the Northwest Hawaiian Islands [NWHI]) form a different substratum and habitat from the volcanic and younger main Hawaiian Islands. The two southern islands of the northwestern group, Necker and Nihoa, are more similar to the main islands in their basalt substratum, and their marine flora may be expected to be more like those of the northernmost of the main group, Kauai and Niihau. At this time, however, there are few data for making a critical comparison owing to the poor knowledge of the marine algae of Kauai (where only a few collections have been made) and of Niihau (from which no collections are known). The new collections reported from Necker, from which only two algae were previously known, are of taxa that also occur on Kauai.

The remaining nine islands, atolls, islets, pinnacles, and reefs, however, present a substantially different substratum and very little intertidal space. Their flora, therefore, was expected to be different from that of the southern volcanic islands with fringing reefs that are primarily of coralline algal nature. The differing geological ages of these groups also have a bearing on the nature of the substrate. In the NWHI, a larger species list is available from the Midway Islands than from the remaining 10 islands combined. This is due, in part, to the larger size of the atoll and to the larger number of collections from the islets.

[1] Manuscript accepted 28 October 1988.
[2] Department of Botany, University of Hawaii, Honolulu, Hawaii 96822.

Although some of the collections from Midway may be termed intertidal, the intertidal zone is much narrower in the northern islands than in the main southern islands. No previous collections of marine algae are known from Gardner Pinnacle and the few that are reported here were growing on a tunicate. Collections from La Perouse and French Frigate Shoals, which are midway between Kure in the north and Nihoa in the south, are also still scant. Moreover, the new collections are for the most part deepwater algae, relatively unknown from the major Hawaiian islands (Doty et al. 1974, Abbott 1984, Agegian and Abbott 1985). The deepwater algae from the main islands are more diverse (Doty et al. 1974), in part because of greater collecting effort. Considering the total reef and shore areas available in the northern islands, the total of 205 species and varieties forms a very respectable flora for what are essentially specks of reefs. It is expected that the marine algal flora of the main islands will be only a little more than twice this number.

## MATERIALS AND METHODS

The algae were preserved in weak formaldehyde–sea water (ca. 4%) or dried. If the former, microscope slides were made for examination, following the methods of Tsuda and Abbott (1985). If the latter, small portions were soaked in a drop of water or weak detergent, then removed to a slide, stained, and mounted in 50% glucose syrup. Some of the specimens were compared with herbarium material of previous collections studied by Tsuda (1965, 1966) and Buggeln (1965), which are housed in the B. P. Bishop Museum (BISH). The majority of the collections from Heather Fortner was collected from the outsides of lobster traps that were brought up from depths of between 30 and 100 m, with the algae clinging to the traps after being dislodged from substrata by the traps on their way to the surface. The exact depth from which these specimens came is therefore not known; however, as a result of these collections from off Maro Rock and Necker Island in particular, we can expect a richer flora than had been previously thought to be present. All of these specimens will be deposited in the Herbarium of the B. P. Bishop Museum, Honolulu.

## RESULTS

A checklist of species, presented alphabetically among the green, brown, and red algae and arranged by locality from which they were collected, is shown in Table 1. In this table, previous collections are acknowledged (T65 and T66 for Tsuda [1965] and [1966]; B65 for Buggeln [1965]; Ba79 for Balazs [1979]; Br84 for Brostoff [1984]; H67, H68a, and H68b for Hollenberg [1967, 1968*a*, *b*]), and new collections are designated A for Abbott. The last column in this table gives the total number of times a given taxon has been collected and cited.

New records from the recent collections for the entire Hawaiian archipelago are marked with an asterisk (*); additions to the marine flora of the Northwest Hawaiian Islands are marked #. There are 14 new records for the Hawaiian Islands, and 41 new to the Northwest Hawaiian group. Of the new records, six seem to be restricted to the NWHI and are not in present collections (unpublished) of my own or the Bishop Museum from the main islands. They are *Halimeda velasquezii*, *Hincksia conifera*, *Liagora robusta*, *Pugetia* sp., *Crouania megashimensis*, and *Wrangelia tenuis*. The numbers of taxa in each division of algae and the total numbers differ from those of Tsuda (1966) because of the addition of the new collections. Having most of the material available for study at the Bishop Museum has made it possible to combine identifications and reduce the total numbers. However, fertile specimens necessary to identify certain of the taxa were missing; thus more material is necessary to complete identification. In other cases, comparison with material from other herbaria is needed.

No species was found in every location. The most frequently occurring species, *Turbinaria ornata*, was recorded from 8 of the 11 islands; *Halimeda discoidea*, *Caulerpa racemosa* var. *peltata*, *Chnoospora minima*, and *Falkenbergia hillebrandii* from 7 localities; *Dictyosphaeria*

TABLE 1

IDENTIFICATION AND RECORDS[a] OF MARINE ALGAE FROM THE NORTHWEST HAWAIIAN ISLANDS (ISLANDS LISTED FROM NORTHWEST TO SOUTHEAST)

| ALGAE | KURE | MIDWAY | PEARL AND HERMES | LISIANSKI | LAYSAN | MARO | GARDNER | FRENCH FRIGATE SHOALS | LA PEROUSE | NECKER | NIHOA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHLOROPHYTA | | | | | | | | | | | | |
| Cladophorales | | | | | | | | | | | | |
| Cladophoraceae | | | | | | | | | | | | |
| *Chaetomorpha antennina* (Bory) Kuetzing | | | | T66 | T65 | | | A | | T66,A | | 5 |
| *Cladophora socialis* Kuetzing[b] | | A | | | | Ba79 | | | | | A | 3 |
| *Cladophora* sp. | | A | T66 | | A | A | | A | | A | | 6 |
| *C. vagabunda* (L.) Hoek[c] | | A | | | | | | | | | | 1 |
| Ulvaceae | | | | | | | | | | | | |
| *Enteromorpha intestinalis* (L.) Link | | | | | A | | | | | | | 1 |
| *Enteromorpha* sp. 1 | | A | T66 | T66 | | | | | | | | 3 |
| *Enteromorpha* sp. 2 | T66 | | T66 | | | | | | | | | 2 |
| *Enteromorpha* sp. 3 | | | T66 | | | | | | | | | 1 |
| *E. tubulosa* Kuetzing | | A | T66 | T66 | T65 | | | | | | | 4 |
| *Ulva fasciata* Delile | A | | | | T65 | | | | | T66 | | 3 |
| *U. rigida* C. Ag. | | | | | T65 | | | | | | | 1 |
| *Ulva* sp. | | B65 | | | | | | | | | | 1 |
| Siphonocladales | | | | | | | | | | | | |
| Anadyonemaceae | | | | | | | | | | | | |
| *Boodlea composita* (Harvey) Brand | | B65 | | | | | | | | A | A | 3 |
| *Boodlea vanbossae* Reinbold | | B65 | | | | | | | | | | 1 |
| *Microdictyon japonicum* Setchell | A | A | A | A | A | | | | | | | 5 |
| *M. setchellianum* Howe | T66,A | B65 | T66 | | T65,A | Ba79 | | T66,A | | T66,Ba79,A | | 12 |
| *Struvea anastomosans* (Harvey) Picc. & Grun. | | B65 | | | | | | | | | | 1 |
| Valoniaceae | | | | | | | | | | | | |
| *Dictyosphaeria cavernosa* (Forssk.) Børg. | T66,A | A | | A | | | | | | | | 4 |
| *D. versluysii* Weber van Bosse | T66 | | T66 | T66 | T65 | | | | | A | A | 6 |
| *Valonia aegagropila* C. Ag. | | A | | | | | | | | | | 1 |
| *V. ventricosa* J. Ag.# | | | A | | | | | | | | | 1 |
| Derbesiales | | | | | | | | | | | | |
| Bryopsidaceae | | | | | | | | | | | | |
| *Bryopsis hypnoides* Lamour.# | A | | | | | | | | | | | 1 |
| *B. pennata* Lamour. | | | | T66,A | T65 | | | | | T66 | A | 5 |
| Codiales | | | | | | | | | | | | |
| Codiaceae | | | | | | | | | | | | |
| *Codim arabicum* Kuetzing | | B65 | T66 | | | | | | | | | 2 |
| *C. edule* Silva | | B65 | | T66 | | | | | | Ba79 | | 3 |
| *C. mamillosum* Harvey | | | | | | A | | | | Ba79,A | | 3 |
| *C. reediae* Silva | Ba79 | B65 | | | | | | | | | | 2 |
| *Codium* sp. | | A | | | | A | | | | | | 2 |
| Caulerpales | | | | | | | | | | | | |

TABLE 1 (continued)

IDENTIFICATION AND RECORDS[a] OF MARINE ALGAE FROM THE NORTHWEST HAWAIIAN ISLANDS (ISLANDS LISTED FROM NORTHWEST TO SOUTHEAST)

| ALGAE | KURE | MIDWAY | PEARL AND HERMES | LISIANSKI | LAYSAN | MARO | GARDNER | FRENCH FRIGATE SHOALS | LA PEROUSE | NECKER | NIHOA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Caulerpaceae | | | | | | | | | | | | |
| *Caulerpa ambigua* Okamura[#] | | A | | | T65 | | | | | | | 2 |
| *C. racemosa* (Forssk.) Lamour. | | A | A | | | | | | | | | 2 |
| *C. racemosa* var. *clavifera* (Turner) Weber van Bosse | | | | | | | | | | T66 | | 1 |
| *C. racemosa* var. *imbricata* (Kjellman) Eubank | | | | | | | | | | T66 | | 1 |
| *C. racemosa* var. *laetevirens* (Mont.) Weber van Bosse | | | | | T65 | | | | | T66 | | 2 |
| *C. racemosa* var. *peltata* (Lamour.) Eubank | A | A | A | | T65 | | | | | T66,A | A | 7 |
| *C. racemosa* var. *turbinata* (J. Ag.) Eubank | | | | | T65 | | | | | | | 1 |
| *C. serrulata* (Forssk.) J. Ag. | | A | T66 | | | | | | | A | | 3 |
| *C. taxifolia* (Vahl) C. Ag. | | A | | | T65,A | | | | | | T66,A | 5 |
| *C. webbiana* Montagne[#] | | A | | A | T65 | | | | | | | 3 |
| Udoteaceae | | | | | | | | | | | | |
| *Chlorodesmis hildebrandtii* A. & E. S. Gepp[d] | | | | T66 | | | | | | | | 1 |
| *Halimeda copiosa* Goreau & Graham*[#] | | | | | T65 | Ba79 | | | | Ba79 | | 3 |
| *H. discoidea* Decaisne | A | B65 | T66,A | T66,A | T65,A | | | | | A | | 9 |
| *H. opuntia* (L.) Lamour. | | T66,B65 | T66,A | A | T66 | | | | | | | 6 |
| *H. tuna* (Ellis & Solander) Lamour.*[#] | | | | | | | | | | A | | 1 |
| *H. velasquezii* Taylor*[#] | | A | | A | A | A | A | | | A | | 6 |
| *Udotea javensis* (Mont.) Gepp & Gepp | | B65 | | | | | | | | | | 1 |
| Dasycladales | | | | | | | | | | | | |
| Polyphysaceae | | | | | | | | | | | | |
| *Acetabularia mobii* Solms-Laubach | | | | | T65 | | | | | | | 1 |
| Dasycladaceae | | | | | | | | | | | | |
| *Bornetella sphaerica* (Zanard.) Solms-Laubach | | | | | T65 | | | | | | | 1 |
| *Neomeris annulata* Dickie | | | | A | | | | | | | A | 2 |
| PHAEOPHYTA | | | | | | | | | | | | |
| Ectocarpales | | | | | | | | | | | | |
| Ectocarpaceae | | | | | | | | | | | | |
| *Feldmannia indica* (Sonder) Wom. & Bail.[e] | | B65 | | | T65 | | | | | | | 2 |
| *Hincksia breviarticulata* (J. Ag.) Silva | | A | | | T65 | | | | | | A | 3 |
| *H. conifera* (Børgesen) Abbott, n. comb.[f]*[#] | | A | | | | | | | | | | 1 |
| *H. mitchelliae* (Harvey) Silva | | | | | | | | | | A | | 1 |
| Sphacelariales | | | | | | | | | | | | |
| Sphacelariaceae | | | | | | | | | | | | |
| *Sphacelaria novae-hollandiae* Sonder | | A | | | | | | | | | | 1 |
| *S. rigidula* Kuetzing | | | | | | A | | | | | | 1 |
| *S. tribuloides* Meneghini | | B65 | T66 | | T65 | | | | | | | 3 |
| Dictyotales | | | | | | | | | | | | |

TABLE 1 (continued)

| ALGAE | KURE | MIDWAY | PEARL AND HERMES | LISIANSKI | LAYSAN | MARO | GARDNER | FRENCH FRIGATE SHOALS | LA PEROUSE | NECKER | NIHOA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dictyotaceae | | | | | | | | | | | | |
| *Dictyopteris australis* (Sonder) Askenasy | | | | | | Ba79 | | | | | | 1 |
| *D. plagiogramma* (Mont.) Vickers | | A | | | | | | | | A | | 2 |
| *D. repens* (Okamura) Børgesen | | A | | | | | | | | A | | 1 |
| *Dictyota acutiloba* J. Ag. | Ba79,A | A | | | T65,A | Ba79 | | | | | | 6 |
| *D. crenulata* J. Ag. | | | | | B65 | | | | | | | 1 |
| *D. divaricata* Lamour. | | B65 | | | T65,A | | | | | | | 3 |
| *D. friabilis* Setchell | | | T66 | | T65 | | | | | T66 | | 3 |
| *Dictyota* sp. | T66,Ba79,A | A | | | A | | | | | | | 5 |
| *Lobophora variegata* (Lamour.) Womersley | A | A | | T66 | T65,A | | | | A | A | | 7 |
| *Padina boergesenii* Allender & Kraft*# | | | | | | | | | | A | | 1 |
| *P. crassa* Yamada | | A | | | T65,A | Ba79 | | | | Ba79,A | | 6 |
| *P. japonica* Yamada*# | | | | | T65 | | | | | | | 1 |
| *P. japonica* (Vaughaniella stage) | | | | | | | | | | A | | 1 |
| *Stypopodium hawaiiensis* (Doty & Newhouse) Abbott[9]# | T66 | B65,A | T66 | | T65,A | | | | | | | 6 |
| Scytosiphonales | | | | | | | | | | | | |
| Scytosiphonaceae | | | | | | | | | | | | |
| *Colpomenia sinuosa* (Roth) Derbes & Solier | | | T66 | | | | | | | | | 1 |
| *Hydroclathrus clathratus* (C. Ag.) Howe | | A | T66 | | T65 | Ba79 | | A | A | | | 6 |
| Dictyosiphonales | | | | | | | | | | | | |
| Dictyosiphonaceae | | | | | | | | | | | | |
| *Chnoospora minima* (Hering) Papenfuss | | A | | | T65 | | A | A | A | T66 | A | 7 |
| Sporochnales | | | | | | | | | | | | |
| Sporochnaceae | | | | | | | | | | | | |
| *Sporochnus dotyi* Brostoff | | | | | | | | Br84 | | | | 1 |
| Chordariales | | | | | | | | | | | | |
| Chordariaceae | | | | | | | | | | | | |
| *Nemacystus decipiens* (Suringar) Kuckuck*# | | A | | | | | | | | A | | 2 |
| Fucales | | | | | | | | | | | | |
| Sargassaceae | | | | | | | | | | | | |
| *Sargassum echinocarpum* J. Ag. | | A | T66 | | T65 | | | | | T66 | T66,A | 6 |
| *S. hawaiiensis* Doty & Newhouse | Ba79 | | | | | | | | | | | 1 |
| *S. obtusifolium* J. Ag. | A | A | T66 | | T65,A | | | | | | | 5 |
| *S. piluliferum* (Turn.) J. Ag. | | | T66 | | | | | | | | | 1 |
| *S. polyphyllum* J. Ag. | A | A | | | T65 | A | | | | Ba79 | | 5 |
| *Sargassum* sp. | | | | | | Ba79 | | | | | | 1 |
| *Turbinaria ornata* (Turn.) J. Ag. | A | T66,A | T66 | A | T65,T66 | | | T66,A | | | A | 1 |
| RHODOPHYTA | | | | | | | | | | | | |
| Bangiales | | | | | | | | | | | | |
| Bangiaceae | | | | | | | | | | | | |
| *Bangia fuscopurpurea* (Dillwyn.) Lyngbye | | | | | | | | A | | | | 1 |
| Acrochaetiaceae | | | | | | | | | | | | |
| *Acrochaetium* sp. | | | T66 | | | | | | | | | 1 |

TABLE 1 (continued)

IDENTIFICATION AND RECORDS[a] OF MARINE ALGAE FROM THE NORTHWEST HAWAIIAN ISLANDS (ISLANDS LISTED FROM NORTHWEST TO SOUTHEAST)

| ALGAE | KURE | MIDWAY | PEARL AND HERMES | LISIANSKI | LAYSAN | MARO | GARDNER | FRENCH FRIGATE SHOALS | LA PEROUSE | NECKER | NIHOA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Liagoraceae | | | | | | | | | | | | |
| *Liagora ceranoides* Lamour. | A | A | T66 | | | | | | | | | 3 |
| *L. coarctata* Zanard. | | | | | T65 | | | | | | | 1 |
| *L. farinosa* Lamour. | | A | | | T66,A | | | | | | | 3 |
| *L. hawaiiana* Butters | | | | | | | | | A | | | 1 |
| *L. kahukuana* Abbott | | | | | T65 | | | | | | | 1 |
| *L. orientalis* J. Ag.*# | | | A | | | | | | | | | 1 |
| *L. papenfussii* Abbott*# | | A | | | | | | | | | | 1 |
| *L. robusta* Yamada*# | | | | | | | | | A | | | 1 |
| *L. setchellii* Yamada | | A | | | | | | | | | | 1 |
| *L. valida* Harvey | | A | | | T65,A | | | | | | | 3 |
| *Trichogloea requienii* (Mont.) Kuetzing# | | A | | | | | | | | | | 1 |
| *Trichogloeopsis hawaiiana* Abbott & Doty# | | | A | | | | | | | | | 1 |
| Galaxauraceae | | | | | | | | | | | | |
| *Galaxaura cylindrica* (Solander) Kjellman | | B65 | | | | | | | | | | 1 |
| *G. oblongata* (Ellis & Solander) Lamour.*# | | A | | | | | | | | | | 1 |
| *G. pacifica* Tanaka*# | | A | | | | | | | | | | 1 |
| *G. rugosa* (Solander) Lamour. | | A | | | | | | | | | | 1 |
| *Galaxaura* sp. | | A | | | | | | | | | | 1 |
| Gelidiales | | | | | | | | | | | | |
| Gelidiaceae | | | | | | | | | | | | |
| *Gelidium pusillum* (Stackhouse) Le Jolis | | A | T66 | T66 | T65 | | | | | | T66 | 5 |
| *Pterocladia parva* Dawson*# | | A | | | T65 | | | | | | | 2 |
| Bonnemaisoniales | | | | | | | | | | | | |
| Bonnemaisoniaceae | | | | | | | | | | | | |
| *Asparagopsis taxiformis* (Delile) Collins & Harvey | Ba79,A | B65,A | | | T65 | | | | | | | 5 |
| *Falkenbergia hillebrandii* (Bornet) Falkenberg | A | B65,A | T66,A | | A | | A | A | | | A | 9 |
| Cryptonemiales | | | | | | | | | | | | |
| Corallinaceae | | | | | | | | | | | | |
| *Amphiroa fragilissima* (L.) Lamour. | | | | T66,A | T65,A | | | | | | | 4 |
| *Corallina sandwicensis* Lemmermann | | | | | T65 | | | | | | | 1 |
| *Hydrolithon reinboldii* (Weber van Boss & Foslie) Foslie | | B65,A | | | | | | | | | | 2 |
| *Jania capillacea* Harvey | T66 | B65,A | T66 | T66 | | | | | | T65 | | 6 |
| *J. decussata-dichotoma* (Yendo) Yendo | | | | | T65 | | | | | | | 1 |
| *J. mexicana* Taylor | | | | | T65 | | | | | | | 1 |
| *J. microarthrodia* Lamour. | | | | | T65 | | | | | | | 1 |
| *J. natalensis* Harvey | | | | | T65 | | | | | | | 1 |
| *J. ungulata* Yendo | | | T65 | | T65 | | | | | | | 2 |

TABLE 1 (continued)

| ALGAE | KURE | MIDWAY | PEARL AND HERMES | LISIANSKI | LAYSAN | MARO | GARDNER | FRENCH FRIGATE SHOALS | LA PEROUSE | NECKER | NIHOA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lithothamnium* sp. | | | | | T65 | | | | | | | 1 |
| *Porolithon* sp. | | | A | | | | | | | | | 1 |
| Peyssoneliaceae | | | | | | | | | | | | |
| *Peyssonelia* sp. | | A | | A | T65 | | | | | | A | 4 |
| Dumontiaceae | | | | | | | | | | | | |
| *Dudresnaya* sp.# | | A | | | | | | | | | | 1 |
| Rhizophyllidaceae | | | | | | | | | | | | |
| *Portieria hornemannii* (Lyngb.) Silva[h]# | | | | A | T65,A | | | | | | | 3 |
| Kallymeniaceae | | | | | | | | | | | | |
| *Pugetia* sp.*# | A | | | | | | | | | | | 1 |
| Gigartinales | | | | | | | | | | | | |
| Gracilariaceae | | | | | | | | | | | | |
| *Gelidiopsis intricata* (C. Ag.) Vickers | Ba79 | | | | | | | | | | | 1 |
| *Gracilaria coronopifolia* J. Ag.# | | | | | | A | | | | | | 1 |
| Hypneaceae | | | | | | | | | | | | |
| *Hypnea cervicornis* J. Ag. | | | | | T65,A | | | | | | | 2 |
| *H. esperi* Bory | | A | | | T65 | | | | | | | 2 |
| *H. pannosa* J. Ag.# | | | | | T65 | | | | | A | | 2 |
| *H. spinella* (C. Ag.) Kuetzing | | B65 | | | | | | | | A | | 2 |
| *Hypnea* sp. 1 | | | | | T65 | | | | | | | 1 |
| *Hypnea* sp. 2 | | | | | T65 | | | | | | | 1 |
| Plocamiaceae | | | | | | | | | | | | |
| *Plocamium sandwicense* J. Ag. | | A | | | A | | | | | A | | 3 |
| Rhodymeniales | | | | | | | | | | | | |
| Champiaceae | | | | | | | | | | | | |
| *Champia parvula* (C. Ag.) Harvey | | A | | | T65 | | | | | | | 2 |
| Rhodymeniaceae | | | | | | | | | | | | |
| *Coelarthrum albertisii* (Piccone) Børgesen | | | | | | | | | | A | | 1 |
| *C. boergesenii* Weber van Bosse | | | | | T65 | | | | | | | 1 |
| Ceramiales | | | | | | | | | | | | |
| Ceramiaceae | | | | | | | | | | | | |
| *Antithamnion ogdeniae* Abbott# | | | | | | | A | | | A | | 2 |
| *Antithamnion* sp. | | | | | T65 | A | | | | | | 2 |
| *Antithamnionella breviramosa* Dawson# | | A | | | | | | | | | A | 2 |
| *Callithamnion cordatum* Børgesen*# | | A | | | | A | | | | A | | 3 |
| *Callithamnion* sp. | | | | | | | | | | | A | 1 |
| *Centroceras apiculatum* Yamada | | A | T66 | | | | | | | | | 2 |
| *C. clavulatum* (C. Ag.) Montagne | T66,A | B65,A | | | T65 | | | | | T66 | | 6 |
| *Ceramium affine* Setchell & Gardner# | | | | | | A | | | | A | | 2 |
| *C. clarionense* Setchell & Gardner# | | | | | | | A | | | A | | 2 |
| *C. fimbriatum* Setchell & Gardner | | A | | | T65 | | | | | | | 2 |
| *C. flaccidum* (Kuetzing) Ardissone | A | A | | | | | | T66 | | | | 3 |
| *C. hamatispinum* Dawson | Ba79 | | | | | | | | | | | 1 |

TABLE 1 (continued)

IDENTIFICATION AND RECORDS[a] OF MARINE ALGAE FROM THE NORTHWEST HAWAIIAN ISLANDS (ISLANDS LISTED FROM NORTHWEST TO SOUTHEAST)

| ALGAE | KURE | MIDWAY | PEARL AND HERMES | LISIANSKI | LAYSAN | MARO | GARDNER | FRENCH FRIGATE SHOALS | LA PEROUSE | NECKER | NIHOA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *C. mazatlanense* Dawson | | | | T66 | | | | | | | | 1 |
| *Ceramium* sp. | | | | | A | A | | | | | | 2 |
| *Crouania mageshimensis* Itono*# | | | | | | | | | | A | | 1 |
| *C. minutissima* Yamada# | | A | | | | A | | | | | | 2 |
| *Haloplegma duperreyi* Montagne# | | A | | | T65 | | | | | | | 2 |
| *Spermothamnion* sp. | | A | | | | | | | | | | 1 |
| *Spyridia filamentosa* (Wulf.) Harvey | A | B65,A | | | A | | | | | | | 4 |
| *Tiffaniella codicola* (Yamada & Tanaka) Doty & Menez*# | | | | | | A | | | | | | 1 |
| *T. saccorhiza* (Setchell & Gardner) Doty & Menez | | | | | | A | | | | A | | 2 |
| *Wrangelia tenuis* Noda*# | | | | | | | | | | A | | 1 |
| Dasyaceae | | | | | | | | | | | | |
| *Dasya baillouviana* (Gmel.) Montagne# | | B65,A | | | | A | | | | | | 3 |
| *D. corymbifera* J. Ag.*# | | B65,A | | | | | | | A | A | A | 5 |
| *D. villosa* J. Ag. | Ba79 | | | | | | | | | | | 1 |
| *Eupogodon* sp.*# | | A | A | | | | | | A | | | 3 |
| *Heterosiphonia crispella* (C. Ag.) Wynne[i]*# | | | | | | A | A | | | A | | 3 |
| Delesseriaceae | | | | | | | | | | | | |
| *Hypoglossum* sp.# | | | | | | | | | | A | | 1 |
| *Martensia fragilis* Harvey# | | | | | A | | | | | | | 1 |
| *Taenioma perpusillum* (J. Ag.) J. Ag. | | B65 | | | | | | | | | | 1 |
| Rhodomelaceae | | | | | | | | | | | | |
| *Amansia glomerata* C. Ag. | | | | | T65 | A | | | | A | A | 4 |
| *Chondria repens* Børgesen | | B65 | | | | | | | | | | 1 |
| *Chondria* sp. | | | A | | | | | | | A | | 2 |
| *Chondria* sp. 1 | | | | | T65 | | | | | | | 1 |
| *Chondria* sp. 2 | | | | | T65 | | | | | | | 1 |
| *Ditria reptans* Hollenberg | | H67 | | | | | | | | | | 1 |
| *Dotyella hawaiiensis* (Doty & Wainwr.) Wom. & Shep.# | | | | | | A | | | | | | 1 |
| *Herposiphonia delicatula* Hollenberg# | | A | | | | | | | | A | | 2 |
| *H. dendroidea* Hollenberg# | | | | A | | | | | | A | | 2 |
| *H. dubia* Hollenberg# | | | | | | | | | | A | | 1 |
| *H. nuda* Hollenberg# | | | | | | | | | | A | | 1 |
| *H. pacifica* Hollenberg | | | | | | | | H68b | | | | 1 |
| *H. parca* Setchell# | | A | | | A | A | | | | | | 3 |
| *H. tenella* (C. Ag.) Schmitz | | B65 | | | A | | | H68b | | | | 3 |
| *Herposiphonia* sp. | | | | | T65 | | | | | A | | 1 |
| *Laurencia corymbosa* J. Ag. | | | | | T65 | | | | | | | 1 |

TABLE 1 (continued)

| ALGAE | KURE | MIDWAY | PEARL AND HERMES | LISIANSKI | LAYSAN | MARO | GARDNER | FRENCH FRIGATE SHOALS | LA PEROUSE | NECKER | NIHOA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *L. dotyi* Saito# | | | | A | | | | | | | | 1 |
| *L. galtsoffii* Howe | | A | | A | A | | | | | A | | 4 |
| *L. majuscula* (Harvey) Lucas# | | A | | A | A | Ba79 | | | | A | | 5 |
| *L. nidifica* J. Ag.# | | | | A | A | | A | | | | | 3 |
| *L. obtusa* (Hudson) Lamour. | T66 | B65 | | | | | A | T66 | | | | 4 |
| *L. parvipapillata* Tseng | | B65,A | | | | | | | | | | 2 |
| *L. perforata* (Bory) Montagne | | | | | T65 | | | | | | | 1 |
| *L. pygmaea* Weber van Bosse | | | | | T65 | | | | | | | 1 |
| *Laurencia* sp. | A | A | A | | | | | | | A | | 4 |
| *Laurencia* sp. 1 | | | T65 | | T65 | | | | | | | 2 |
| *Laurencia* sp. 2 | | | | | T65 | | | T66 | | | | 2 |
| *Laurencia* sp. 3 | T66 | | | | T65 | | | | | | | 2 |
| *Laurencia* sp. 4 | | | | | T65 | | | | | | | 1 |
| *Laurencia* sp. 5 | | | | | T65 | | | | | | | 1 |
| *Lobosiphonia cristata* Falkenberg | | H68a | | | | | | | | | | 1 |
| *Lophocladus trichoclados* (C. Ag.) Schmitz*# | | A | | | | | | | | | | 1 |
| *Polysiphonia exilis* Harvey | | H68b | | | | | | | | | | 1 |
| *P. polyphysa* Kuetzing | | | | | T65 | | | | | | | 1 |
| *P. rubrorhiza* Hollenberg | | H68a | | | | A | | | | A | | 3 |
| *P. saccorhiza* (Collins & Harvey) Hollenberg | | H68a | | | | | | | | | | 1 |
| *P. savatieri* Hariot | | H68a | | | | | | | | | | 1 |
| *P. scopulorum* Harvey | | | | | | | | | | A | | 1 |
| *P. scopulorum* var. *iki* Hollenberg | | A | | | | | | | | | | 1 |
| *P. scopulorum* var. *scopulorum* Harvey | | | H68a | | | | | | | | | 1 |
| *P. simplex* Hollenberg | | | T66 | | | | | A | | | | 2 |
| *P. sphaerocarpa* Børgesen | | A | | | T65 | | | | | | | 2 |
| *P. upolensis* (Grunow) Hollenberg | A | | H68a | | H68a | | | | | | | 3 |
| *Polysiphonia* sp. | | | | | | | A | | | Ba79 | | 2 |

[a] Previous collections are identified by author (Ba, Balazs; B, Buggeln; Br, Brostoff; H, Hollenberg; T, Tsuda) and date, new collections by "A."
[b] Formerly *Cladophora socialis* var. *hawaiiana*.
[c] Formerly *Cladophora fascicularis*.
[d] Doubtfully distinct from *C. fastigiata*.
[e] Formerly *Ectocarpus indicus*.
[f] Basionym: *Ectocarpus coniferus* Børgesen 1914: 8–13, figs. 5–6.
[g] Formerly *Zonaria* sp.
[h] Formerly *Chondroccoccus hornemannii*.
[i] Formerly *Heterosiphonia wurdemannii*.
* New records for the Hawaiian Islands.
# Additions to the marine flora of the Northwest Hawaiian Islands.

*versluysii*, *Microdictyon setchellianum*, and *Halimeda velasquezii* from 6 localities; and the most numerous occurrences of the red algae (*Gelidium pusillum*, *Jania capillacea*, *Dasya corymbifera*, and *Laurencia majuscula*) were from only 5 localities. Of these frequently occurring taxa, *Halimeda velasquezii* and *Dasya corymbifera* are reported from the NWHI for the first time.

## DISCUSSION

The new additions are mainly tiny to microscopic algae that occur as epiphytes on those algae that are more or less perennial (e.g., *Amansia glomerata* and *Halimeda* spp.), but a number of them are macroscopic algae (e.g., *Nemacystus decipiens* and the species of *Halimeda*). W. J. Gibert (unpublished key to orders and genera of Hawaiian marine Chlorophyta, 1965) listed three species of *Halimeda* for Hawaii, namely *H. discoidea* Decaisne (the most common species in both the main and Northwest Hawaiian Islands), *H. gracilis* J. Agardh, and *H. opuntia* (L.) Lamour. (the latter is more common in the north than in the south). This study records three species for the first time that were found in the northwest islands: *H. copiosa* Goreau & Graham, *H. tuna* L., and *H. velasquezii* Taylor. *H. copiosa* is thought to be similar (Noble 1987) to *H. gracilis*, differing by its single, small holdfast as opposed to the multiple points of anchorage shown by *H. gracilis*. Gilbert (unpublished key, 1965) described the specimen he identified as *H. gracilis* as having a single rhizoidal base; it is clear that he had *H. copiosa*. Removing *H. gracilis* from the Hawaiian flora leaves five species of *Halimeda* in the Hawaiian Islands, with all five in the Northwest Hawaiian islands, and only three in the main islands.

Of other macroscopic algae, four groups of specimens of the green alga *Codium* can be sorted out, but some remain without names at this time owing to the need to compare them with known specimens. Fertile material of the most unusual occurrence of a species of *Pugetia*, from Kure Island, is necessary for identification. *Pugetia* species have been reported from temperate waters of North and South America; the closest species to this Hawaiian specimen may be *P. latiloba* (Taylor) R. E. Norris from the Galápagos, but without fertile material it is impossible to be certain of its true affinities.

Among the tiny algae, the first report outside of southern Japan is made of *Crouania mageshimensis* Itono, which was an epiphyte on *Amansia* from Necker Island; from Maro and Midway islands, the second and third reports of *Crouania minutissima* Yamada (originally reported from western Micronesia) are recorded, the first for the Hawaiian Islands having been made earlier by Doty et al. (1974). *C. mageshimensis* is characterized by relatively stiff whorl branchlets with four to five divisions and a relatively erect axis; *C. minutissima* is distinguished by its very small size (up to 5 mm tall), having a creeping axis, and branchlets less rigid. It was possible to identify ten species of *Polysiphonia* owing to the pioneering studies of Hollenberg (1968*a*) on this genus in the Pacific Islands, and the microscopic *Herposiphonia* species are represented by six species, recognizable also by detailed studies of Hollenberg (1968*b*).

The flora shows that if there are anchoring species ("hosts") for small algae, a relatively large number can be found. Not only space but shade is provided; some taxa were found only on lower surfaces of the blades of *Amansia,* whereas other species occurred on both top and bottom surfaces. The composition of the flora tends to be similar to that of other small coral islands of the Pacific, among which are some of the Caroline Islands (Abbott 1961, Trono 1968) and the Marshall Islands (Taylor 1950, Dawson 1957). Eniwetak (Eniwetok) Atoll, an isolated group in the Marshall Islands, was reported by Tsuda (1987) to have a total of 222 species of marine algae, omitting the blue-green algae, as compared to the 205 species reported here. As with the Eniwetak algae, blue-green algae and most coralline algae have been omitted from the NWHI list, so the comparisons reflect a good correspondence.

Tsuda (1987) reported 89 species of green algae, 24 of brown algae, and 109 species of

red algae from Eniwetak. There are 48 taxa of green algae, 32 of brown, and 124 of red algae, a total of 205 from the NWHI. Although the totals are close, the primary differences are in the larger number of green species and a smaller number of red algae in Eniwetak. Some of the differences may be attributed to the larger number of taxa of *Caulerpa* in Eniwetak, as might be expected since these taxa are primarily lagoon inhabitants; whereas there is a larger number of small epiphytic reds, such as nine species of *Polysiphonia* from NWHI versus three from the northern Marshalls, and seven *Herposiphonia* species from NWHI versus two from Eniwetak.

ACKNOWLEDGMENTS

I am especially grateful to Fred Ball, Heather Fortner, and Ira Levine for the collections that have added much new information to the marine algae of the central Pacific. I thank Joanne Noble of Melbourne University for identifying the specimens of *Halimeda*. I am also appreciative of the help and interest of Roy Tsuda with this paper.

## LITERATURE CITED

ABBOTT, I. A. 1961. A checklist of marine algae from Ifaluk Atoll, Caroline Islands. Atoll Res. Bull. 77:1–5.

———. 1984. *Peleophycus multiprocarpium* gen. et sp. nov. (Gloiosiphoniaceae, Rhodophyta). Pac. Sci. 38:324–332.

AGEGIAN, C. R., and I. A. ABBOTT. 1985. Deep water macroalgal communities: A comparison between Penguin Bank, Hawaii and Johnston atoll. Proc. 5th Int. Coral Reef Congr., Tahiti 5:47–50.

BALAZS, G. H. 1979. Marine benthic algae collected from Kure Atoll, Maro Reef and Necker Bank, Northwestern Hawaiian Islands. 'Elepaio 39:110–111.

BØRGESEN, F. 1914. The marine algae of the Danish West Indies. Part 2. Phaeophyceae. Dan. Bot. Ark. 2:1–68.

BROSTOFF, W. N. 1984. *Sporochnus dotyi* sp. nov. (Sporochnales, Phaeophyta), a brown alga from Hawaii. Pac. Sci. 38:177–181.

BUGGELN, R. G. 1965. A preliminary list of the algal flora of the Midway Islands. Atoll Res. Bull. 109:1–11.

DAWSON, E. Y. 1957. An annotated list of marine algae from Eniwetok Atoll, Marshall Islands. Pac. Sci. 11:91–132.

DOTY, M. S., W. J. GILBERT, and I. A. ABBOTT. 1974. Hawaiian marine algae from seaward of the algal ridge. Phycologia 13:345–357.

HOLLENBERG, G. J. 1967. New genera in the Rhodomelaceae from the central Pacific. Bull. South. Calif. Acad. Sci. 66:201–221.

———. 1968*a*. An account of the species of *Polysiphonia* of the central and western tropical Pacific Ocean. Pac. Sci. 22:56–98.

———. 1968*b*. An account of the species of the red alga *Herposiphonia* occurring in the central and western tropical Pacific Ocean. Pac. Sci. 22:536–559.

NOBLE, J. M. 1987. A taxonomic study of genus *Halimeda* Lamouroux (Chlorophyta, Caulerpales) from the Heron Island region of the southern G. B. R. Australia. M.S. thesis, Melbourne University.

TAYLOR, W. R. 1950. Plants of Bikini and other northern Marshall Islands. University of Michigan Press, Ann Arbor.

TRONO, G. C. 1968. The marine benthic algae of the Caroline Islands, I. Introduction, Chlorophyta and Cyanophyta. Micronesica 4:137–206.

TSUDA, R. T. 1965. Marine algae from Laysan Island with additional notes on the vascular flora. Atoll Res. Bull. 110:1–31.

———. 1966. Marine benthic algae from the Leeward Hawaiian group. Atoll Res. Bull. 115: 1–13.

———. 1987. Marine benthic algae of Enewetak Atoll. Pages 1–9 *in* Natural history of Eniwetak Atoll. Vol 2. Biogeography and systematics. U. S. Dep. Energy.

TSUDA, R. T., and I. A. ABBOTT. 1985. Collection, handling, preservation, and logistics. Pages 67–86 *in* M. M. Littler and D. S. Littler, Handbook of phycological methods. Ecological field methods, Macroalgae. Cambridge University Press, Cambridge.