

## MARINE BENTHIC ALGAE OF KAYANGEL ATOLL, PALAU

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### Introduction

During January 13-17, 1976, four faculty members from the University of Guam Marine Laboratory visited Kayangel Atoll in the Palau District to conduct a preliminary biological survey of the algae, corals and fishes. Our original plan was to incorporate all of the findings under one cover, but other research priorities of the faculty directed each member to work at his own pace in getting the results in print.

This paper reports on the 51 species of marine benthic algae collected on the barrier reef flat, channel and lagoon of Kayangel Atoll. All specimens cited here are deposited in the Herbarium of the University of Guam Marine Laboratory. Previous to our visit to Kayangel Atoll, only one paper (Lowenstam, 1955) mentions the algae from this atoll; this study reports on aragonite needles secreted by the calcareous green alga *Halimeda*. Based on the collections and observations of *Sargassum crassifolium* during our visit to Kayangel Atoll, Tsuda (1976) reported its presence on atolls and speculated why this genus is rarely observed on atolls as opposed to high islands. Five species of sea-grasses were also collected during our survey and are included in another paper, presently in preparation, on Micronesian sea-grasses.

Kayangel Atoll (8°05'N, 134°43'E), about 7 km long (N-S orientation) and about 4 km wide (E-W orientation), is the northernmost atoll in the Palau Archipelago. The atoll is almost completely encircled by a barrier reef with four islets present on the eastern side. The maximum depth of the lagoon is only 11 m. Gressitt (1952) provides a description of the atoll, as well as the four islets.

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#### Stations

- The terminology of Tracey *et al.* (1955) is used to describe the different zones of Kayangel Atoll.
- Station 1. Lagoon reef margin, northern end of atoll, .5 m deep, Jan. 13, 1976. (RT 5088 - 5098).
- Station 2. Lagoon reef margin, northwest end of atoll, .5 m deep, Jan. 13, 1976. (RT 5099).
- Station 3. Inner reef flat, coral mound off northwest tip of Ngariungs Islet, .3 m deep, Jan. 14, 1976 (RT 5100 - 5103).
- Station 4. Lagoon, coral mound, 1.5 km south of main channel, 1 m deep, Jan. 14, 1976. (RT 5104 - 5117).
- Station 5. Reef flat, 1 km north of main channel, 2 m deep, Jan. 15, 1976. (RT 5119 - 5122).
- Station 6. Lagoon shelf, southwest of Ngariungs Islet, 1 m deep, Jan. 15, 1976. (RT 5124 - 5129).
- Station 7. Lagoon, coral mound, 1 km northeast of channel, 9 m deep, Jan. 15, 1976. (RT 5130 - 5133).
- Station 8. Lagoon, coral mound, 1 km west of southern tip of Ngajangel Islet, 9 m deep, Jan. 15, 1976. (RT 5134 - 5140).
- Station 9. Reef flat, .6 km north of Ngajangel Islet, .5 m deep, Jan. 15, 1976. (RT 5144 - 5149).
- Station 10. Lagoon, coral mound, west of mid-section of Ngajangel Islet, 2-8 m deep, Jan. 16, 1976. (RT 5150 - 5157).
- Station 11. Reef flat, 2 km south of main channel entrance, .3 m deep, Jan. 16, 1976. (RT 5158 - 5159).
- Station 12. South channel, just west of Gorak Islet, 2 m deep, Jan. 16, 1976. (RT 5161 - 5163).
- Station 13. Slope of main channel, 1-10 m deep, Jan. 16, 1976. (RT 5164 - 5176).

- Station 14. Inner reef flat, between Ngajangel and Ngariungs Islets, 1 m deep, Jan. 17, 1976. (RT 4773, 5177 - 5182).
- Station 15. Slope of main channel, 2-9 m deep, Jan. 17, 1976. (RT 5183 - 5188).
- Station 16. Inner reef flat, between Ngariungs and Ngaraplas Islets, 1 m deep, Jan. 17, 1976. (RT 4774, 5189).
- Station 17. Reef flat, just northwest of the northwest tip of Ngajangel Islet, 1 m deep, Jan. 15, 1976. (RT 5190 - 5198).
- Station 18. Lagoon shelf, sea-grass beds off Ngajangel Islet, 1 m deep, Jan. 17, 1976. (RT 5201 - 5203).

#### Species Listing

The species are listed alphabetically under their respective Divisions.

#### Cyanophyta

- Calothrix confervicola* (Roth) Ag. - RT 5132a (epiphytic on *Ceramium mazatlanense*).
- Calothrix pilosa* Harvey - RT 5162, RT 5198.
- Microcoleus lyngbyaceus* (Kütz.) Crouan - RT 5145 (epiphytic on *Halimeda incrassata*), RT 5203.
- Schizothrix calcicola* (Ag.) Gomont - RT 5111.

#### Chlorophyta

- Avrainvillea lacerata* Harvey - RT 5095, RT 5100.
- Avrainvillea obscura* J. Ag. - RT 5201.
- Caulerpa antoenis* Yamada - RT 5194 (on sand).
- Caulerpa racemosa* (Forsskal) J. Ag. - RT 5108, RT 5124, RT 5153, RT 5182.
- Caulerpa serrulata* (Forsskal) J. Ag. - RT 5096, RT 5114, RT 5129c, RT 5135, RT 5152, RT 5154.
- Caulerpa taxifolia* (Vahl) C. Ag. - RT 5138.
- Caulerpa urvilliana* Montagne - RT 5181.
- Caulerpa vickersiae* Boerg. - RT 5103 (on sand), RT 5133.
- Dictyosphaeria cavernosa* (Forsskal) Boerg. - RT 5167.
- Dictyosphaeria versluysii* W. v. Bosse - RT 5093, RT 5113, RT 5119, RT 5196.
- Halimeda cylindracea* Decaisne - RT 5104, RT 5131, RT 5183.
- Halimeda discoidea* Decaisne - RT 5144, RT 5150, RT 5184b.

- Halimeda gracilis* Harvey - RT 5088, RT 5165  
*Halimeda incrassata* (Ellis) Lamx. - RT 5149, RT 5202b.  
*Halimeda lacunalis* Taylor - RT 5091a, RT 5106, RT 5126a, RT 5134,  
 RT 5184a.  
*Halimeda micronesica* Yamada - RT 5089, RT 5105, RT 5129b, RT 5185a,  
 RT 5192.  
*Halimeda minima* (Taylor) Colinvaux - RT 5151, RT 5164, RT 5186.  
*Halimeda opuntia* (L.) Lamx. - RT 5090a, RT 5107, RT 5125, RT 5187.  
*Halimeda simulans* Howe - RT 5202a.  
*Halimeda stuposa* Taylor - RT 5190b, RT 5202a.  
*Halimeda taenicola* Taylor - RT 5126b, RT 5191.  
*Microdictyon okamurai* Setchell - RT 5097, RT 5130, RT 5136, RT 5155.  
*Neomeris mucosa* Howe - RT 5139.  
*Rhipilia orientalis* A. & E. S. Gepp - RT 5173, RT 5189.  
*Valonia utricularis* (Roth) C. Ag. - RT 5157, RT 5176, RT 5195.  
*Valonia ventricosa* J. Ag. - RT 5127, RT 5172.  
*Valoniopsis pachynema* (Martens) Boerg. - RT 5116.

#### Phaeophyta

- Dictyopteris repens* (Okamura) Boerg. - RT 5170b.  
*Dictyota bartayresii* Lamx. - RT 5179.  
*Feldmannia irregularis* (Kütz.) Hamel - RT 5158.  
*Lobophora variegata* (Lamx.) Womersley - RT 5094, RT 5099, RT 5110,  
 RT 5121, RT 5147, RT 5171.  
*Padina tenuis* Bory - RT 5146.  
*Sargassum crassifolium* J. Ag. - RT 4773, RT 4774.  
*Turbinaria ornata* (Turner) J. Ag. - RT 5092, RT 5109, RT 5163.

#### Rhodophyta

- Amphiroa fragilissima* (L.) Lamx. - RT 5148.  
*Ceramium gracillimum* v. *byssoideum* (Harv.) Mazoyer - RT 5112b.  
*Ceramium mazatlanense* Dawson - RT 5132a.  
*Claudea multifida* Harvey - RT 5161, RT 5168.  
*Endosiphonia spinuligera* Zanard. - RT 5101a, RT 5156.  
*Galaxaura oblongata* (E. & S.) Lamx. - RT 5180.  
*Gelidiopsis intricata* (Ag.) Vickers - RT 5122.  
*Jania capillacea* Harvey - RT 5178 (epiphytic on *Sargassum crassifolium*),  
 RT 5197.

*Laurencia cartilaginea* Yamada - RT 5101b, RT 5128.

*Laurencia majuscula* (Harv.) Lucas - RT 5098 (intermixed with *Laurencia cartilaginea*), RT 5140 (epiphytic on *Halimeda opuntia*), RT 5169 (epiphytic on *Halimeda lacunalis*), RT 5188 (on dead coral).

*Liagora pinnata* Harvey - RT 5177, RT 5193.

*Polysiphonia howei* Hellenberg - RT 5112a, RT 5117, RT 5120, RT 5129 (mixed with *Polysiphonia scopulorum*), RT 5159, RT 5174.

*Polysiphonia scopulorum* Harvey - RT 5102, RT 5129 (mixed with *Polysiphonia howei*), RT 5132b.

#### Discussion

*Claudea multifida* (see Papenfuss, 1937) is the only alga collected from Kayangel Atoll which has not been previously reported from the Micronesian region. The rest of the algae represents an extension of the marine algae previously known from Palau proper or other Micronesian islands (see Tsuda and Wray, 1977).

The prostrate green alga *Microdictyon okamurai* is the dominant alga on the solid calcareous substratum of the barrier reef and on the coral mounds in the lagoon. This species covers about 23% of the consolidated substratum on the northern barrier reef and is equally abundant in the lagoon. *Lobophora variegata* and *Dictyosphaeria cavernosa* are also conspicuous in these same areas.

The calcareous green alga *Halimeda* is abundant in the channel and lagoon areas. Of the 11 species of *Halimeda* collected from this atoll, four species (*H. cylindracea*, *H. incrassata*, *H. simulans*, and *H. stuposa*) inhabit the sandy substratum which makes up the majority of the substrata type within the lagoon. Four species of *Caulerpa* (*C. antoensis*, *C. taxifolia*, *C. urvilliana*, and *C. vickersiae*) also inhabit the sandy areas of the lagoon. The turf community is developed on the coral mounds in the lagoon. *Polysiphonia howei*, *P. scopulorum*, *Jania capillacea*, and *Laurencia majuscula* are the dominant algae comprising the turf.

The small size and shallow depth of Kayangel Lagoon makes this atoll a perfect natural laboratory for distributional and seasonal studies of benthic algae, especially the *Halimeda* species, in a lagoon environment.

#### REFERENCES

- Gressitt, J.L. 1952. Description of Kayangel Atoll, Palau Islands. *Atoll Res. Bull.* 14:1-6.
- Lowenstam, H.A. 1955. Aragonite needles secreted by algae and some sedimentary implications. *J. Sed. Petrol.* 25:270-272.

- Papenfuss, G.F. 1937. The structure and reproduction of *Claudea multifida*, *Vanvoorstia spectabilis*, and *Vanvoorstia coccinea*. *Symbolae Botanicae Upsalienses* II(4):1-66.
- Tracey, J.I., P.E. Cloud, Jr. and K.O. Emery. 1955. Conspicuous features of organic reefs. *Atoll Res. Bull.* 46:1-3, 2 figs.
- Tsuda, R.T. 1976. Occurrence of the genus *Sargassum* (Phaeophyta) on two Pacific atolls. *Micronesica* 12:279-282.
- Tsuda, R.T., and F.O. Wray. 1977. Bibliography of marine benthic algae in Micronesia. *Micronesica* 13:85-120.