

NOTE

Notes on the Benthic Marine Algae of Nauru, Central Pacific

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Abstract—A preliminary list of 40 benthic marine Chlorophyta, Phaeophyta and Rhodophyta is provided for Nauru, a small, isolated raised limestone island, in the Central Pacific. The algal flora appears to be impoverished compared with other Central Pacific islands, and is subjected to heavy grazing by fishes. It is dominated by *Valonia aegagropila* and *Padina tenuis* in the upper intertidal; the dominant alga of the reef flat is *Jania adhaerens*, which provides the main refugium from grazing for small Cyanophyta, Chlorophyta and Rhodophyta. A characteristic of the reef crest at some sites is the presence of a sward of *Sargassum*.

Introduction

The Republic of Nauru comprises a single island 21 km² in area and 20 km in circumference, lying some 40 km south of the equator on the 167° E meridian (Fig. 1). It is an isolated, oval raised limestone island, the highest point being 65 m. More than two fifths of the island is composed of phosphate-bearing rock, and it has been the site of a potash mining industry since the discovery of these deposits in 1902 (Dupon 1983).

Nauru is surrounded by a fringing reef some 100–200 m offshore, the reef being open only in the SW in the vicinity of the potash cantilever (Aiwo and Boe districts), and in the vicinity of Meneng where an artificial opening has been blasted to give access for local fishing boats. There is a very steep drop-off to more than 2,000 m depth within 200 m of the outer reef. There is no lagoon, the inner shoreline consisting of a flat coral rubble platform with many pools and sandy humps and, in some areas, numerous coral pinnacles that extend from above the high tide level almost to the edge of the rubble platform. Wave action is continuous on the outer reef fringe, while the platform is subjected to flooding and wave wash during high tide.

There have been few studies of the marine biology of Nauru, and as far as is known there are no previously published records of the benthic marine algae (Lili 1988). The composition of the marine flora can be expected to be comparable

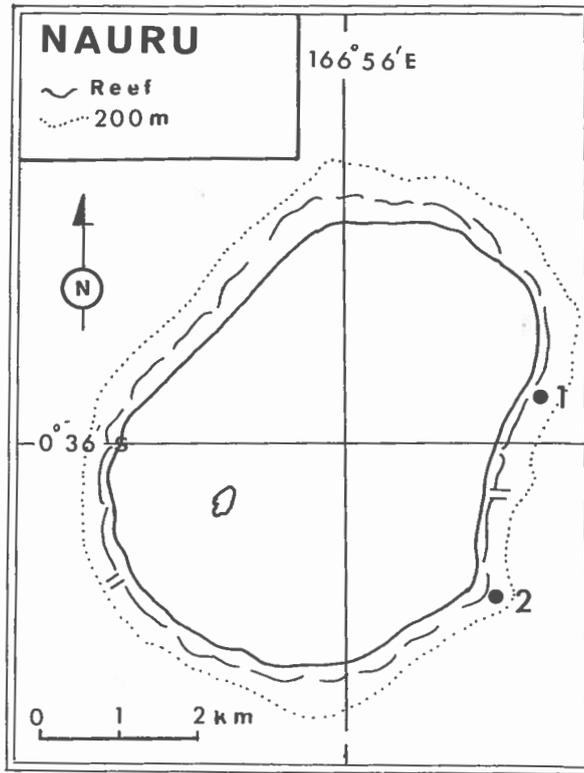


Figure 1. Map showing the general features of Nauru, and location of study sites at Anabare (1) and Meneng (2).

with that of adjacent equatorial regions that have been well studied, such as the Solomon Islands (Womersley & Bailey 1969, 1970), Micronesia (Tsuda & Wray 1977), and the Marshall Islands (Taylor 1950, Dawson, 1956, 1957). The small size and isolation of the island may influence the composition of the flora.

During late April–early May 1990, we had the opportunity to make some collections of benthic algae at two contrasting sites on the island. These observations are presented here.

Materials and Methods

Two sites were investigated, at Meneng and Anabare (Fig. 1). Intertidal collections and observations were made during several visits to each site between April 22 and May 2, 1990, and from snorkeling over the reef platform at high tide. A reef profile was constructed on the basis of the most detailed study, at Meneng (Fig. 2). General collections of algae were made and preserved for later study at the Institute of Marine Resources, University of the South Pacific, Suva, Fiji, where they are presently housed. They eventually will be incorporated in

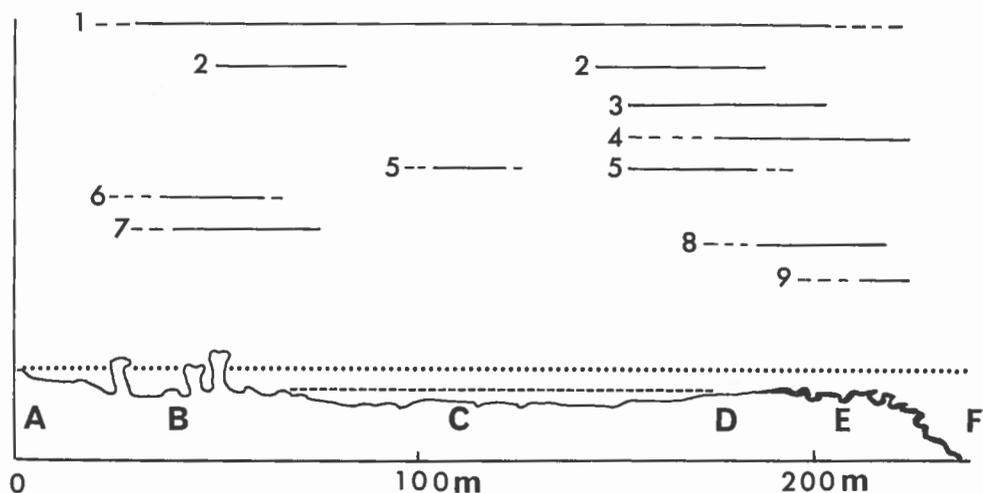


Figure 2. Profile of the reef flat, Meneng, Nauru. A: beach; B: zone of coral pinnacles; C: reef flat; D: back reef; E: reef crest; F: outer reef. The zone of living corals is shown in black. Dashed lines represent the approximate upper and lower limits of the tides. Horizontal ranges of dominant species are shown by bars 1-9. 1 = *Jania adhaerens*; 2 = *Gelidiopsis intricata*; 3 = *Sargassum* sp. aff. *S. schwartzii*; 4 = *Sargassum cristaeifolium*; 5 = *Turbinaria ornata*; 6 = *Padina tenuis*; 7 = *Valonia aegagropila*; 8 = *Dictyosphaeria*; *Halimeda* spp.; *Caulerpa* spp.; 9 = *Codium geppii*.

the South Pacific Regional Herbarium at the University of the South Pacific. Nomenclature used in the systematic list of species follows that of Silva et al. (1987). General observations were made of the reef platform at a number of other sites around the island; on the basis of these observations we conclude that the Meneng and Anabare sites are representative of the general reef environment of Nauru.

Results

A general profile of the Nauru reef is given in Figure 2, where the approximate horizontal ranges of the most conspicuous organisms are shown. The principal algae in the upper intertidal zone are beds of *Padina* sp., especially in the more sheltered locations, and large masses of *Valonia aegagropila* in shallow pools at the bases of the coral pinnacles, and along the water line of the numerous shallow, warm tide pools. In the mid-littoral the *Padina* is replaced by an extensive turf of *Jania adhaerens*, sometimes mixed with or overgrowing the *Valonia*. Frequent tufts of *Chlorodesmis fastigiata* are present in the more surge-influenced places, and in the vicinity of channels cut into the platform, where a strong outward flow of water occurs during low tide. At Meneng, beds of *Sargassum* are present on the reef crest, and are replaced by *Turbinaria ornata* in pools. The *Sargassum* is absent, however, from most other sites on the island. Living coral heads are

exposed at the extreme low tide, and between and among them a turf of algae is present. At wave-exposed sites there is a predominance of *Dictyosphaeria*, and scattered clumps of *Halimeda* are found in depressions and surge channels. *Caulerpa* is frequent in sandier sites. Rarely, *Codium geppii* is present at the bases of the coral heads, where some protection from grazing is afforded. Beneath and among the corals is a fine turf of *Jania* sp., and various cryptic growths of filamentous Rhodophyta, including *Gelidium*, *Herposiphonia* and *Leveillea jungermannioides*.

The Meneng site, at the SE of Nauru (Fig. 1) receives greater exposure to wave action than at Anabare. The platform is somewhat narrower, and in the upper littoral is dominated by coral pinnacles and shallow tide pools. Extensive growths of *Valonia aegagropila* occur in the mid-upper intertidal, along the water line of pools at the bases of the pinnacles. In shallow sandy pools significant growths of *Padina* form the only other conspicuous algal growth. With progression seawards, and on the shoreward face of the reef crest, populations of *Turbinaria ornata* occur in the tide pools. At the reef crest, *Turbinaria* gives way to *Sargassum*. These large brown algae form a conspicuous sward along the reef crest at Meneng (cf. the observation of Lili 1988). A turf of smaller Rhodophyta and Chlorophyta occurs beneath the *Sargassum*, and in the numerous crevices among these are *Jania*, iridescent *Dictyota*, and *Gelidiopsis*. Towards the seaward edge of the reef, where wave action is continuous, the large brown algae are absent and the algal turf is restricted to the bases of the corals and to undercuts and irregularities in the eroded coral surface. Occasional patches of *Halimeda* and *Caulerpa* occur and, in the most exposed sites, *Codium geppii* is found.

At Anabare the reef flat is somewhat broader than at Meneng, with a less accentuated ridge; the coral pinnacles characteristic for Meneng are absent, and there is a sparsity of pools. As a consequence, the conditions at Anabare are considerably less favourable for attached algae, and there is a noticeable reduction in species diversity. *Padina* still predominates on the reef flat, although it is reduced in quantity; *Valonia aegagropila*, which is conspicuous at Meneng is reduced to scattered clumps. The most noticeable difference at Anabare, however, is the complete absence of the brown algal band characteristic of Meneng; both species of *Sargassum* are entirely absent, and *Turbinaria ornata* is restricted to isolated plants in shallow pools on the leeward face of the reef ridge. The sandier nature of the Anabare reef crest provides favourable attachment for *Caulerpa* species, and for greater numbers of *Dictyosphaeria versluysii* than at Meneng.

Systematic List of Benthic Algae

DIVISION CHLOROPHYTA

Order Ulotrichales

Enteromorpha clathrata (Roth) Greville

Meneng and Anabare. Attached to sand in shallow upper intertidal pools; epiphytic on *Padina tenuis* (Anabare); locally abundant.

Enteromorpha intestinalis (Lyngbye) Nees

Meneng. On sand, on the inner reef platform. Uncommon.

Order Siphonales

- Avrainvillea* sp. aff. *A. erecta* (Berkeley) A. & E.S. Gepp
Meneng. Old plants, possibly referable to this species, occasional in sandy pools behind the reef crest.
- Boodlea coacta* (Dickie) Murray et De Toni
Meneng and Anabare. Probably abundant, intermixed with other algae, especially *Jania*.
- Bryopsis* sp.
Meneng. On shells and coral fragments on the reef flat. Insufficient material for species identification.
- Caulerpa cupressoides* (Vahl) C. Agardh
Meneng and Anabare. The most frequent *Caulerpa* on the reef crest and seaward side of the reef, in constant surf.
- Caulerpa peltata* Lamouroux
Meneng. Rare, growing among *Jania* and between dead or living coral on the seaward face of the reef.
- Caulerpa racemosa* (Forsskal) J. Agardh var. *macrophysa* (Kützing) W.R. Taylor
Meneng and Anabare. Relatively common on the reef crest and the seaward edge of the reef, in surf.
- Chlorodesmis fastigiata* (C. Agardh) Ducker
Meneng and Anabare. Abundant on the reef flat and back reef, attached to shells, coralline algae, and coral rubble.
- Codium geppii* O.C. Schmidt
Meneng and Anabare. Infrequent, attached to the bases of living corals at low tide level on the outer reef, in surf.
- Dictyosphaeria cavernosa* (Forsskal) Boergesen
Meneng. Uncommon, on the reef crest and seaward side, in depressions among corals.
- Dictyosphaeria versluysii* Weber van Bosse
Meneng and Anabare. Abundant, at or below low tide level in surf; in crevices among corals.
- Halimeda simulans* Howe
Meneng. Rare, in pools on the reef crest and to below low tide, in surf.
- Halimeda tuna* (Ellis et Solander) Lamouroux
Meneng. Rare, in pools in the reef crest and to below low tide, in surf.
- Valonia aegagropila* C. Agardh
Meneng and Anabare. Very abundant along the edges of pools and coating the bases of coral pinnacles in the mid to upper intertidal. Extensive cushions follow the contours of the substratum, and are up to 20 cm in diameter and 8 cm in height. The size of plants of this species appears to be larger than recorded elsewhere in the Central Pacific.
- Valonia utricularis* (Roth) C. Agardh
Meneng. Scattered clumps, mostly entangled among coralline algae (*Jania* sp.) and other turf-forming rhodophytes.

DIVISION PHAEOPHYTA

Order Ectocarpales

Feldmannia indica (Sonder) Womersley et Bailey

Meneng. Locally abundant among *Jania* turf. Plants closely resemble the description given in Womersley and Bailey (1970).

Hinksia breviarticulata (J. Agardh) P.C. Silva.

Meneng and Anabare. Frequent as an epiphyte on the terminal 'leaves' of *Turbinaria ornata*. Bearing numerous plurilocular sporangia.

Order Dictyotales

Dictyota bartayresii Lamouroux

Meneng. Frequent on the reef crest and seaward facing ridge, in constant turf.

Padina tenuis Boergesen

Meneng and Anabare. Very abundant in pools on the inner reef flat, especially in sand-covered areas.

Order Fucales

Sargassum cristaefolium C. Agardh

Meneng; forming a distinct band on the leeward side of the reef crest, occasionally mixed with *Turbinaria ornata*, but usually replaced by the latter species on the reef crest and in pools.

Sargassum sp. aff. *S. schwartzii* (Turner) C. Agardh

Meneng. This Nauru *Sargassum* does not easily fit descriptions of other *Sargassum* species known from the Central Pacific (see Tsuda and Wray, 1977 for list of species). Further study may clarify the identity. This *Sargassum* is much less abundant than *S. cristaefolium* on Nauru, occurs higher on the reef crest, and is intermixed with *Turbinaria ornata* in the most wave impacted sites.

Turbinaria ornata (Turner) J. Agardh

Meneng and Anabare. Abundant at Meneng, ranging from mid-platform pools, where very small, stunted plants occur, to the reef crest, where it forms a well developed band. Plants are very rare at Anabare, with only isolated, stunted individuals occurring, not forming a distinct band.

DIVISION RHODOPHYTA

Order Nemiales

Audouinella sp.

Meneng. Sterile, poorly developed plants, epiphytic on *Gelidiopsis intricata*. Probably common.

Gelidiella acerosa (Forsskal) J. Feldmann et Hamel

Meneng and Anabare. Frequent, intertwined in clumps of *Jania* sp. on the reef flat.

Gelidium pusillum (Stackhouse) Le Jolis

Meneng and Anabare. Small specimens, intertwined in clumps of *Jania* sp. on the reef flat.

Heteroderma sp.

Meneng; epiphytic on the leaves of *Sargassum cristaefolium*.

Jania adhaerens Lamouroux

Meneng and Anabare. The dominant alga of the reef flat, forming extensive cushions or ball-like growths in pools and on the coral rubble surface.

Peyssonnelia sp. aff. *P. conchicola* Piccone et Grunow.

Meneng; attached to old coral fragments.

Pseudolithophyllum sp. aff. *P. samoense* (Foslie) Adey

Meneng; forming encrustations on small gastropod mollusc shells; uncommon.

Order Gigartinales

Gelidiopsis intricata (C. Agardh) Vickers

Meneng and Anabare. Common, interlaced with *Jania* sp. on the reef flat.

Order Rhodymeniales

Lomentaria hakodatensis Yendo

Meneng; uncommon, growing cryptically in tufts of *Jania*.

Order Ceramiales

Centroceras apiculatum Yendo

Anabare; growing cryptically in *Jania* clumps on the leeward side of the reef crest. Probably quite abundant.

Ceramium mazatlanense Dawson

Anabare; rare, in the *Jania* turf on the leeward side of the reef crest. Closely fits the description in Dawson (1962).

Ceramium sp. aff. *tenuissimum*

Meneng; closely resembles this species as described in Dawson (1962). Grows among *Jania* on the leeward side of the reef crest.

Ceramium sp.

Meneng; a species with incomplete cortication and non-forcipate apices. Insufficient material for species identification.

Herposiphonia tenella (C. Agardh) Nägeli

Meneng; growing cryptically in *Jania* tufts and among other turf-forming species. Several indeterminate *Herposiphonia* specimens were found in the collections and it is likely that other species are represented.

Laurencia sp.

Meneng; rare, small specimens, sterile, inadequate for species determination.

Leveillea jungermannioides (Hering et Martens) Harvey

Meneng and Anabare. This is by far the most abundant cryptic rhodophyte on Nauru, occurring in the *Jania* turf, but also in more open habitats such as the bases of *Halimeda* and other larger algae. All of the specimens examined were sterile.

Lophosiphonia sp.

Meneng; rare, a few specimens present in *Jania* clumps, insufficient for species determination.

Discussion

While the collections reported here resulted from a short period of field investigation, it seems likely that the flora of Nauru is impoverished compared with that of other equatorial regions of the Central Pacific (see Tsuda & Wray 1977 for references). The small size and isolation of the island, together with a lack of variety in habitats, may be contributing factors. Our observations during snorkeling excursions during the incoming tidal flood revealed a high incidence of fish grazing over the reef flat.

Collections made at other times of the year, and from the subtidal, will add substantially to the Nauru flora; diving is, however, relatively dangerous because of surf, currents and abundant sharks. In the intertidal there is a clear contrast between the sites visited, with the richer flora present on the more complex and varied shore at Meneng. The presence of a wide band of large fucoid algae on the reef crest at Meneng is surprising in view of the general absence of these algae in low island habitats in the tropical and equatorial Pacific (Tsuda 1976), but the patchiness of its occurrence is indicative of the limited conditions for its survival.

Additional features of Nauru include the extensive development of *Valonia aegagropila* in the upper intertidal at Meneng, and the large beds of *Jania adhaerens* which provide the single most important grazing refugium for small algae, especially the rhodophytes.

These preliminary observations on the marine algae of Nauru suggest that this small, isolated equatorial island deserves further study; more in-depth collections of its apparently impoverished flora may provide valuable insights into the ecology and distribution of equatorial benthic flora.

Acknowledgements

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