First Report of *Yamadaella caenomyce* (Liagoraceae, Rhodophyta) from the Atlantic Ocean, with Descriptive Notes and Comments on Nomenclature

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ABSTRACT.—Specimens of a liagoroid red alga forming imbricating clusters in the shallow subtidal at Boca Chica, Bahía de Andrés, Dominican Republic, are described and identified as *Yamadaella caenomyce* (Decne.) I. A. Abbott (Liagoraceae, Nemaliales). *Yamadaella* is a monotypic genus with the following distinguishing features: inflated terminal cortical cells, straight, three-celled carpogonial branches, and diffuse gonimoblast filaments. *Yamadaella caenomyce* has a wide distribution throughout the tropical Indo-Pacific Ocean, but its presence in the Atlantic Ocean was not previously confirmed.

INTRODUCTION

The benthic marine algae of the Caribbean are known from the works of Taylor (1960), Littler et al. (1989), and Wynne (1986, 1998). The species occurring in the Dominican Republic are known from the accounts by Boring (1924), Almodóvar and Bonnelly de Calventi (1977), Diaz-Piferrer (1978), Almodóvar and Álvarez (1980), Montero et al. (1982, 1983), and Rosado (1993). The red algal genus *Yamadaella*, a member of the Liagoraceae (Nemaliales), was thought to be restricted to the tropical/subtropical Indian and western Pacific Oceans (Kraft, 1989). An indication that the genus might occur outside its reported distribution was the identification of a syntype specimen of *Liagora annulata* J. Agardh from Guadeloupe as *Y. caenomyce* (Decne.) I. A. Abbott by Abbott (1990), but she questioned the provenance of the specimen, thus discounting the occurrence of *Yamadaella* from the Atlantic. The discovery of a population of *Y. caenomyce* growing in a shallow water habitat of the Dominican Republic is thus significant and establishes the occurrence of the genus outside of the Indo-Pacific.

MATERIALS AND METHODS

Collection information is the following: Boca Chica, Bahía de Andrés, 26 km east of Santo Domingo, Dominican Republic (Greater Antilles): 30.ix.1993, legit M. J. Wynne 9846, monoecious, in shallow subtidal (1 m depth).

Voucher specimens deposited in the following herbaria: MSM, MICH, MURU, PC, and US.

The specimens were initially preserved in 5% formalin/sea-water and later processed as herbarium specimens. Portions of plants were removed and decalcified in dilute acetic acid, then washed, and stained in a mixture of 1% aniline blue/1% acetic acid/60% Karo syrup/38% distilled water. The extremely tough consistency of the decalcified thalli required that the axes be squashed between two glass slides in order to separate the filaments. Whole-plant photographs (Figs. 1, 2) were taken with a 35-mm camera using Kodak T-MAX 100 film. The line-drawings (Figs. 3–7) were prepared with the aid of a camera-lucida. Herbarium abbreviations are according to Holmgren et al. (1990), whereas MURU refers to the herbarium of Murdoch University, Australia. Authors of cited species are according to Brummitt and Powell (1992).


**OBSERVATIONS**

The specimens form imbricating, decumbent clusters in the shallow subtidal. Individual clumps (Figs. 1, 2) measure approximately 3.0-4.5 cm in extent and consist of dichotomously branched, divaricate, three-dimensionally oriented axes, which become connate by frequent secondary connections. The rigid axes are about 1.0 mm diam. in older regions, tapering to 0.5-0.75 mm diam. near the apices. Axes are cylindrical (somewhat compressed when dried) and are heavily calcified with a thick chalky whitish limestone in older regions, but are pinkish to reddish in the less heavily calcified distal portions. The calcification is confined to the cortical regions (assimilatory filaments) of the axes. A conspicuous feature of the axes is their transversely rugose nature, that is, the axes showed annular constrictions in both young and mature portions. Cortical filaments are dichotomously branched, with narrow elongate cells terminating in swollen, tear-drop-shaped cells (Fig. 3), 8-10 µm in width and 16-20 µm in length. These terminal cells are distally enlarged.

The specimens are monoecious. One to several spermatangial mother cells are produced from the subterminal cell in the cortical filaments. The spermatangial mother cells bear one to several spermatangia (Fig. 4). Carpogonial branches (Fig. 5) are three-celled, straight, and borne on inner cortical supporting cells. Although the carpogonial branches are not abundant, their relatively large cell size makes them easy to detect. Gonimoblast filaments arise directly from the fertilized carpogonium (Fig. 6), and a diffuse system of gonimoblast filaments develops. No subsidiary sterile or involucral filaments are associated with these spreading gonimoblast filaments, which terminate in single carposporangia (Fig. 7), 8-10 µm in width and 10-14 µm in length. Gonimoblast filaments are distinguishable from cortical filaments due to their constituent cells being broader and not as elongate as those of the cortical filaments, and the cells (Fig. 7) that bear the carposporangia being distally truncate.

**DISCUSSION**

*Yamadaella* was established by Abbott (1970) on the basis of a unique combination of features. Its heavily calcified thallus is similar to that of some species of *Liagora*, but *Yamadaella* differs in the production of a straight three-celled carpogonial branch that is apparently a modified vegetative filament, as opposed to the mostly curved, accessory carpogonial branches of *Liagora*. The abundant calcification separates *Yamadaella* from the non-calcified *Nemalion*, which has similar straight carpogonial branches invariably more than three cells in length (Kraft, 1989). Perhaps the most strik-
FIGS. 3-7. *Yamadaella caenomyce*. Fig. 3. Medullary filament and cortical fascicle with inflated terminal cells. Fig. 4. Spermatangia borne singly or in pairs on elongate spermatangial mother cells. Fig. 5. Three-celled carpogonal branch. Fig. 6. Gonimoblast filaments arising from the carpogonium. Arrow indicates attachment point of the trichogyne. Fig. 7. Diffuse gonimoblast filaments with immature, terminal carposporangia. All drawings from MW 9846, #4. Abbreviations: c.br: carpogonal branch; c.f: cortical fascicle; g: gonimoblast filament; m.f: medullary filament; sp: spermatangia; sp.m: spermatangial mother cell; su: supporting cell; tr: trichogyne.
ing feature of *Yamadaella* is seen following fertilization, when the carpogonium produces a loose system of branching gonimoblast filaments without any associated sterile filaments. Spermatangia are also produced in a distinctive manner, namely, from stalk cells (= spermatangial mother cells) produced on the subapical cells of the cortical filaments. In addition to these distinctive reproductive features, *Yamadaella* is unique among the calcified Liagoraceae in the presence of relatively enlarged and clavate or wedge-shaped terminal cells of cortical filaments.

In addition to the detailed study of *Yamadaella caenomyce* provided by Abbott (1970), Yoshizaki (1980) also followed the pre- and post-fertilization development in some detail. His account essentially agreed with that of Abbott, differing only in one detail. Instead of the carpotetrasporangia reported by Abbott, Yoshizaki observed that the loosely organized gonimoblast filaments terminated in carposporangia. Although some authors (Abbott, 1945; Yoshizaki, 1980) have described this alga as being dioecious, other authors (Abbott, 1970; Kraft, 1989) have observed this taxon to be monoecious, or “protrandrous”. Our observations showed it to be monoecious.

According to Jaasund (1977), *Yamadaella caenomyce* in Tanzania occurs in the intertidal zone at a higher level than species of *Liagora*, and it can be recognized in the microscope by the terminal cell of assimilatory filaments being relatively large and triangular in profile. Cribb (1983) stated that Great Barrier Reef populations occur on boulders and are never permanently submerged. Kraft (1989) referred to *Yamadaella* as forming pulvinate, mat-forming thalli anchored by numerous holdfasts on mid- to high-intertidal reef flats. These depictions of this species are certainly true for the material from the Dominican Republic. Our material agrees with the descriptions of Yamada (1938), Tseng (1941), Abbott (1970), and Cribb (1983), who characterized the surface of *Y. caenomyce* as being transversely rugose or with annulations. The specific epithets of *L. rugosa* and *L. annulata* (the former regarded by Abbott (1970) as conspecific with *Y. caenomyce*, the latter regarded herein as a “tax. syn. pro parte” (see below)] allude to the surface appearance.

The Dominican Republic specimens agree with these published descriptions in most respects, differing only from that of Abbott (1970) (but not of Yoshizaki, 1980) in the production of carpotetrasporangia as opposed to carposporangia. Given the overriding similarities between all published descriptions, it seems likely that this feature is variable between populations.

Weber-van Bosse (1921) reported a “co-type” of *Liagora caenomyce* (in the Hauck Herbarium), comparing it with specimens collected on the Siboga Expedition which she assigned to this species. She stated that the species was distinguishable by the rugose, annulate fronds with smooth, non-powdery calcification, and that sections of the frond showed uniform, cylindrical, not very broad filaments with relatively thick walls in the central portion. She pointed out that the same structure occurred in *L. rugosa* Zanardini (Zanardini, 1851), in material assigned to *L. annulata* J. Agardh (J. Agardh, 1876) by Grunow, and also in Harvey’s Friendly Island Exsicc. No. 47 (as “L. viscida”). Abbott (1990) later discovered that this Harvey’s Friendly Island Exsic. No. 47 was part of J. Agardh’s syntype of his *L. annulata* (J. Agardh, 1876) (see below). Yamada (1938) treated *L. intricata* Butters (Butters, 1911) and *L. holstii* Zeh (Zeh, 1912) as conspecific with *Yamadaella [Liagora] caenomyce*. At the same time Yamada placed *L. rugosa* Zanardini (Zanardini, 1851) and *L. annulata* J. Agardh (J. Agardh, 1876) as possible taxonomic synonyms. Børgesen (1942, 1952) recognized *Liagora rugosa* from Mauritius but did not agree with the suggestion made by Weber-van Bosse (1921), and later by Yamada (1938), that *L. rugosa* was probably conspecific with *L. caenomyce*.

In her designation of a lectotype for *Liagora annulata*, Abbott (1990) said that the choice of a suitable specimen was difficult because of J. Agardh’s vague reference to the syntype localities being “ad insulas Indiae occidentalis et in calidore pacifica”. No specimen had been labelled as type in the Agardh Herbarium in LD. According to Abbott, a syntype specimen (LD 32413) from Guadeloupe is identifiable as
Yamadaella caenomyce. Because that species (and genus) was not known outside of the Indian and Pacific Oceans, she doubted the provenance of the collection. Because the syntype specimen from the South Pacific (Harvey’s Friendly Is. exsiccat. no. 47) was monocious, she discounted that specimen from consideration, regarding it as conforming to her concept of “L. fragilis Zanardini” [= L. valida Harv.]. She selected an old and “decomposed” specimen collected by Mrs. F. Curtiss from Florida as the lectotype of L. annulata. The determination of the present collection from the Dominican Republic as Y. caenomyce supports the acceptance of the provenance of one of the syntypes of L. annulata as being from the West Indies (Guadeloupe) and the treatment of J. Agardh’s (1876) L. annulata as being based upon disparate elements (Liagora valida and Yamadaella caenomyce). The following treatment incorporates the taxonomic judgments of Yamada (1938) and Abbott (1970):

Yamadaella caenomyce (Dec.) I. A. Abbott (1970)
Basionym: Liagora caenomyce Decne. (Decaisne, 1842)
tax. syns.: L. rugosa Zanardinii (1851), fide Abbott (1970)
L. annulata J. Agardh (1876), pro parte (specimen from Guadeloupe, LD 32413), fide Abbott (1970)
L. intricata Butters (1911), fide Yamada (1938)
L. holstii Zeh (1912), fide Yamada (1938)

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LITERATURE CITED


