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Marine Algae of the Eastern Caraga Region, Philippines, II. An Annotated List of the Green Algae (Ulvophyceae)

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ABSTRACT

The marine benthic flora of the Philippines is among the richest in the Indo-West Pacific region. However, some regions like the eastern Caraga in the northeastern section of Mindanao Island are poorly known in terms of their seaweed diversity. A survey of the published literature was conducted to compile baseline information. This report on the diversity of the marine green algae recorded a total of 62 species and one form in 25 genera, 13 families, and four orders. Many species have ecological and economic importance such as contributors to reef building, sources of valuable chemicals and food for humans. The enumeration of the marine green algae as well as those of other seaweed groups is useful for better resource management and conservation, guided extraction and sound policy formulation towards greater protection of coastal habitats and aquatic resources therein.

Keywords: biodiversity, green algae, Mindanao, phycology, seaweeds.

INTRODUCTION

Species of marine algae form shallow water communities that can support fishery activities such as seaweed culture in many tropical regions. The mass cultivation of seaweeds has provided enormous economic benefits to coastal residents of Southeast Asia, and to a certain extent, left some positive environmental impacts there by replacing destructive fishing practices such as dynamite fishing. In some areas like the Caraga region of the Philippines where biodiversity is expected to be high, baseline information on seaweed species diversity is lacking and this has caused limited use of these resources. Hence, the need for an inventory of seaweed species occurring there becomes imperative. A comprehensive survey of the literature on the marine algal species from the Caraga region was conducted. The first part of the report detailing the history of seaweed studies and an account of the species of brown seaweeds (Phaeophyceae) occurring there was published by Bataan *et al*. (2021) which reported 32 species, many of which are of potential yet untapped economic value. The present paper is the second part of the report listing the species of green seaweeds (Ulvophyceae) which also identified a number of economically important species, most of which remained poorly known for economic exploitation. One of the latest studies involved two green algae from Surigao del Sur in the southeastern section of the Caraga region wherein Magdugo *et al*. (2020) analyzed the chemicals in *Caulerpa racemosa* (Forsskål) J.Agardh and *Ulva fasciata* Delile and found high protein levels as well as essential amino acids potentially useful for the biorefinery industry. In the same study, some chemicals from *C. racemosa* were shown to exhibit antiherpetic activity without cytotoxicity. If properly exploited these species as well as other green algae may become functional foods that can contribute to the well-being of the human population in the Philippines.

MATERIALS AND METHODS

The main source of data for this report came from a comprehensive survey of the published literature. Verification of the currently used names was made following the steps outlined in Bataan *et al*. (2021). All names were verified using the Algaebase database (Guiry and Guiry, 2021) up until the time of final revision of this manuscript.

RESULTS AND DISCUSSION

The marine green algal flora of the Caraga region was surveyed and presented in this annotated checklist. A total of 62 species and one form in 25 genera, 13 families and four orders of marine green algae are accounted for. The list is presented below following the classification scheme of Dawes and Mathieson (2008). Sources of original reports are indicated inside brackets.

CHLOROPHYTA
Class ULVOPHYCEAE
Order ULVALES
Family ULVACEAE

***Ulva clathrata* (Roth) C.Agardh**
=*Enteromorpha clathrata* (Roth) Greville [Sajot, 2006; Fajardo *et al*., 2016]

***Ulva compressa* L.**
=*Enteromorpha compressa* (L.) Nees [Cordero, 1980; Trono, 2004, 2017]

Remarks: All species of *Enteromorpha* Link have been recognized as species of *Ulva* L. on the basis of molecular evidence (Hayden *et al*., 2003), although this is not recognized by Trono (2017, 2018). Various species currently recognized under *Ulva* have been conveniently grouped into morphotypes that facilitate their easier recognition in the field (Chávez-Sánchez *et al*., 2019). The genus is undergoing extensive revisions by a thorough examination of type specimens and the molecular analysis thereof (Hanyuda and Kawai, 2018; Hughey *et al*., 2019, 2021).

***Ulva intestinalis* L.** [Fajardo *et al*., 2016; Trono, 2018]
=*Enteromorpha intestinalis* (L.) Nees [Sajot, 2006]

Remarks: Together with *Ulva clathrata*, this species has been identified as one of the species responsible for massive "green tide" blooms recorded in northern Mindanao specifically in Misamis Oriental province located directly west of the Caraga region by Villaluz *et al*. (2016).

***Ulva kylinii* (Bliding) H.S. Hayden, Blomster, Maggs, P.C. Silva, Stanhope and Waaland**
=*Enteromorpha kylinii* Bliding [Trono, 2018]

***Ulva lactuca* L.** [Trono, 2018]
=*Ulva fasciata* Delile [Trono, 2018; Magdugo *et al*., 2020]

Remarks: The synonymy of *U. fasciata* under *U. lactuca* has been proposed by Hughey *et al*. (2019) based on molecular and phytogeographic grounds. The same study also provided evidence that *U. lactuca* may actually be a tropical species contrary to widely held views that it is a mainly temperate European species.

***Ulva reticulata* Forsskål** [Cordero, 1980; Trono, 1997, 2018]

Remarks: The presence of this species together with other *Ulva* species listed above seem to suggest a deteriorating condition of the coastal areas brought about by eutrophication similar to the condition observed by Villaluz *et al*. (2016), Song *et al*. (2019), among others. The distinctively netted appearance of this species makes it one of the easiest to identify.

Order CLADOPHORALES
Family ANADYOMENACEAE

***Anadyomene plicata* C. Agardh** [Trono, 2018]

Family BOODLEACEAE

***Boodlea composita* (Harvey) Brand** [Trono, 2018]

***Cladophoropsis vaucheriiformis* (Areschoug) Papenfuss** [Trono, 2018]

Remarks: The tightly intertwined filaments form erect protuberances arising from a decumbent base that mimic sponges, likely for chemical defense purposes. This sponge-mimicking gross morphology led many to classify it as a species of *Spongocladia*, a name that has since been synonymized. Papenfuss (1950) clarified some aspects of the taxonomy and unique biology of this species.

***Struvea okamurae* Leliaert** [Trono, 2018]

Remarks: This is the new name of the distinctively capituliform and stipitate species formerly known as *Chamaedoris orientalis* Okamura and Higashi. Its recognition as a species of *Struvea* is mainly supported by molecular evidence (Leliaert *et al*., 2007).

Family CLADOPHORACEAE

***Chaetomorpha linum* (O.F. Müller) Kützing** [Fajardo *et al*., 2016]

Family SIPHONOCLADACEAE
***Boergesenia forbesii* Harvey** [Sajot, 2006; Fajardo *et al*., 2016; Trono, 2018]

***Dictyosphaeria cavernosa* (Forsskål) Børgesen** [Cordero, 1980; Trono, 1997, 2017, 2018]

***Dictyosphaeria versluysii* Weber Bosse** [Trono, 2018]
Family VALONIACEAE

***Valonia aegagropila* C. Agardh** [Sajot, 2006; Trono, 2018]

***Valonia ventricosa* J. Agardh** [Trono, 2018]

Order BRYOPSIDALES
Family BRYOPSIDACEAE

***Bryopsis plumosa* (Hudson) C. Agardh** [Trono, 2018]

Remarks: Records of this species in the Philippines need to be reviewed as this species appears to be of cold temperate distribution. Besides being one of the components of green algal blooms (Song *et al*., 2019), species of *Bryopsis* can also be tapped for its many biological and chemical attributes (Contreras *et al*., 2019).

Family CAULERPACEAE

***Caulerpa brachypus* Harvey** [Taylor, 1977; Trono, 1997]

Remarks: This species with typically strap-shaped assimilators is often misidentified with a similar looking species, *C. prolifera* (Forsskål) Lamouroux originally described from the eastern Mediterranean coast of Egypt, as noted by Belleza and Liao (2007). Ortega *et al*. (1974) reported it as *C. prolifera* growing together with other *Caulerpa* species in central Philippines, while Trono (2004) listed it as occurring in various sites in Luzon. His Figure 14 suggested *C. brachypus*. An actual examination of their samples will likely prove that those were erroneous determinations and that *C. prolifera* should be excluded from the marine flora of the Philippines with certainty.

***Caulerpa chemnitzia* (Esper) Lamouroux**
=*Caulerpa racemosa* var. *turbinata* (J. Agardh) Eubank [Belleza and Liao, 2007]

Remarks: In an elegant study of the morphologically complex *Caulerpa racemosa* group, Belton *et al*. (2014) provided detailed molecular and morphological evidence recognizing eleven lineages within this large assemblage. One of them (Lineage 6) is composed of plants variously recognized as three varieties of *Caulerpa racemosa* namely, *C. racemosa* var. *turbinata* (J. Agardh) Eubank, *C. racemosa* var. *occidentalis* (J. Agardh) Børgesen and *C. racemosa* var. *laetevirens* (Montagne) Weber Bosse. Another species, *C. imbricata* Murray has also been included into this particular lineage which is herein recognized at the species level using the earliest available name, *C. chemnitzia*.

***Caulerpa cupressoides* (Vahl) C. Agardh var. cupressoides** [Trono, 2018]
=*Caulerpa cupressoides* var. *lycopodium* f. *elegans* (Crouan and Crouan) Weber Bosse [Belleza and Liao, 2007]

Remarks: The designation of forms within the genus is likely unconventional these days due to many studies showing much phenotypic plasticity among species of *Caulerpa* on which these form names are based. This name should therefore be best treated as tentative.

***Caulerpa lamourouxii* (Turner) C. Agardh**
=*Caulerpa racemosa* var. *lamourouxii* (Turner) Weber Bosse [Cordero, 1980]

Remarks: In the same study of the morphologically complex *Caulerpa racemosa* group, Belton *et al*. (2014) provided detailed molecular and morphological information defining Lineage 2 which included this particular variety of *C. racemosa*. Another small group of plants identified under the same name has been recognized at the species level in the same study under the name *Caulerpa oligophylla* Montagne after comparison with its type specimen.

***Caulerpa lentillifera* J. Agardh** [Sajot, 2006; Trono, 2018]

Remarks: The presence of this species presents a potential source of income for the coastal inhabitants as this is mass cultured for human consumption in other parts of the country (Calumpong and Meñez, 1997).

***Caulerpa racemosa* (Forsskål) J. Agardh** [Trono, 1997, 2018; Belleza and Liao, 2007; Magdugo et al., 2020]

Remarks: This species is particularly notorious for its phenotypic plasticity. Belton *et al*. (2014) have used molecular and morphological characters to clarify the phylogenetic positions of its various varieties and forms. The reports cited above have not indicated the particular subspecific type from this region. Many varieties of this species are harvested from the wild in Siargao Island and sold in local markets there and in Surigao City. One variety collected from Bislig in Surigao del Sur has been shown to yield minerals, essential amino acids, fatty acids, and it is suggested as a possible food supplement (Magdugo *et al*., 2020). Surprisingly, *C. lentillifera* is not among those found in the market survey (Kurotaka, 2018). The latter is mostly produced using earthen pond cultivation techniques such as those found in Cebu (Horstmann, 1976, misidentified as *C. racemosa*) and is the most sought after variety that is exported to Japan.

***Caulerpa serrulata* (Forsskål) J. Agardh** [Belleza and Liao, 2007; Trono, 2018]

***Caulerpa sertularioides* (Gmelin) Howe** [Sajot, 2006;

Trono, 2018]

Remarks: This species and other congeners have many bioactive metabolites (Nagaraj and Osborne, 2014) which could control bacteria such as those causing high mortalities in shrimp aquaculture (Esquer-Miranda *et al*., 2016). The prospect of its medicinal applications has not been fully explored.

***Caulerpa taxifolia* (Vahl) C. Agardh** [Trono, 2018]

***Caulerpa urvilleana* Montagne** [Trono, 2018]

Remarks: This species was recently recognized as a variety of *C. cupressoides* by Hodgson *et al*. (2004) and Price (2011), which however did not gain much support among latter workers.

Family CODIACEAE

***Codium arabicum* Kützing** [Trono 2018]

Remarks: The amorphous nature of this species makes it easier to identify among congeners occurring in the Philippines. A more critical evaluation is needed as a species complex comprising a number of amorphous species distributed throughout the Indo-Pacific has been suggested (Kraft, 2007).

***Codium edule* Silva** [Sajot 2006; Trono 2018]

Remarks: This prostrate species with cylindrical branches is widely distributed in the Pacific Islands (Huisman *et al*., 2007) where they are often used as human food. In the Philippines, it was reported mainly from the province of Ilocos Norte (Silva *et al*., 1987) where the human consumption of seaweeds is well documented, and only lately from islands farther south in the central Philippines (Trono, 1997). Surprisingly, this is not among those species recognized by Cordero (1980, 2005) as having any culinary value, a confusion that probably arose due to the poor taxonomic knowledge of Philippine species of *Codium*. It is likely that this species has been confused with *C. geppiorum* Schmidt, also a prostrate species with cylindrical branches like *C. edule* but which can be separated based on utricle morphology. Clearly, the taxonomy of *Codium* in the Philippines is in need of revisions as cryptic species are common (Verbruggen *et al*., 2007).

***Codium tenue* (Kützing) Kützing** [Trono, 2018]

Remarks: This species is restricted to the estuaries of South Africa and reported lately from Western Australia (Huisman *et al*., 2015). Philippine plants reported under this name will need to be studied further as first suggested by Silva *et al*. (1987: 113). Sequences obtained from a sample identified as *Codium tenue* from Cebu Island (GenBank EF108091) were very different from those of authentic *C. tenue* from South Africa and Australia (Huisman *et al*., 2015), and it is highly possible that the *C. tenue* records from the Philippines belong to another species. Indeed, Silva *et al*. (1997: 26) reexamined samples identified as *C. tenue* from southwestern Japan and found them to be similar to *C. barbatum* Okamura, which was originally described from Hachijo-jima located further to the northeast along the pathway of the warm Kuroshio Current. Authentic *C. barbatum* has subsequently been confirmed from southern Kyushu in Japan (Praseptiangga *et al*., 2012). Philippine records of this species should be treated with caution until detailed morphological studies supported by molecular data will allow its correct identification under another name.

Family HALIMEDACEAE

***Halimeda cuneata* Hering** [Cordero, 1980]

Remarks: This species is proving to be a pantropical species found from both extremes of the Indo-Pacific region and many points in between. It has recently been reported from Brazil by Bandeira-Pedrosa *et al*. (2004), marking the first time this species was ever recorded from the Atlantic with certainty. An obscure record from France (Inventaire National du Patrimoine Naturel - https://inpn.mnhn.fr/espece/cd_nom/650706) turned out to be from the French overseas territory of Réunion in the western Indian Ocean.

***Halimeda cylindracea* Decaisne** [Trono, 2018]

Remarks: This massive species with cylindrical segments is among those found growing on bottoms of clear lagoons, and may be useful as a biological indicator species.

***Halimeda discoidea* Decaisne** [Sajot, 2006; Trono, 2018]

Remarks: This species is often confused with the superficially similar *H. cuneata* Hering as noted by Evangelista *et al*. (2015).

***Halimeda incrassata* (Ellis) Lamouroux** [Sajot, 2006; Trono, 2018]

***Halimeda macroloba* Decaisne** [Cordero, 1980; Trono, 1997, 2018; Sajot, 2006; Fajardo *et al*., 2016]

Remarks: This species is one of the common elements found in sandy to muddy bottoms due to its single bulbous holdfast. In external morphology, it can easily be confused with another superficially similar species, *H. borneensis* Taylor, first described from the southwestern Sulu Sea off the coast of eastern Sabah in Malaysia and subsequently reported from an unspecified locality in

the Philippines for the first time by Kooistra (2002).

***Halimeda macrophysa* Askenasy** [Sajot, 2006; Trono, 2018]

Remarks: This species appears to be rare in the Philippines. It has previously been reported from only three sites along the Pacific coast (Silva *et al*., 1987; Trono, 1997) including one record from the Turtle Islands off the coast of eastern Sabah (Taylor, 1966).

***Halimeda opuntia* (L.) Lamouroux** [Trono, 1997, 2018; Sajot, 2006; Fajardo et al., 2016]

Remarks: Due to its cosmopolitan distribution throughout the shallow water tropical waters, *H. opuntia* is considered an important sediment builder and a significant contributor to the carbonate budget of the world's coral reefs (Wizemann *et al*., 2014). Often, it is one of the few species found in degraded coral reefs. Experiments have shown that coral planulae settled on its blades (Nugues and Szmant, 2006) despite reports of allelopathic chemicals being associated with it (Paul and van Alstyne, 1992) or as a vector for the bacterial pathogen potentially causing white plague disease (WPD) among Caribbean corals (Nugues *et al*., 2004). As a possible provider of coral settlement surface, *H. opuntia* may offer recovery chances for algal-dominated coral reef through the recruitment of coral juveniles. Because of this and its widespread distribution, this species appears to be one of the most important elements supporting the physical and biological make-up of tropical reefs.

***Halimeda simulans* Howe** [Trono, 2018]

***Halimeda tuna* (Ellis and Solander) Lamouroux** [Cordero, 1980; Trono, 1997, 2018]

Remarks: This medium-sized species is often encountered in small spaces and crevices in coral reefs. Among the key external characters of this species are the slightly thickened margins of segments which are sometimes undulate.

***Halimeda velasquezii* Taylor** [Sajot, 2006; Trono, 2018]

Remarks: Among species of *Halimeda*, this one is small, fragile, with clean reniform segments neatly arranged to form a fan-shaped thallus that is attached by a small, stupose stipe and base.

***Halimeda* sp.** [Sajot, 2006]

Family UDOTEACEAE

***Avrainvillea erecta* (Berkeley) Gepp and Gepp** [Fajardo *et al*., 2016; Trono, 2018]

***Avrainvillea lacerata* Harvey ex J. Agardh** [Trono, 2018]

***Avrainvillea nigricans* Decaisne** [Trono, 2018]

***Chlorodesmis fastigiata* (C. Agardh) Ducker** [Trono, 2018]

Remarks: This species and its congeners contain many bioactive metabolites with anti-herbivory properties (Paul and Fenical, 1985) that are avoided by fish but not by certain crabs and gastropods (Hay *et al*., 1989).

***Glaukea argentea* (Zanardini) Lagourgue and Payri**
=*Udotea argentea* Zanardini [Trono, 2018]

Remarks: This massive flabellate species grows in lagoon environments with clear to moderately clear waters. Recently, Lagourgue and Payri (2021) segregated and designated it as the type species of the new genus *Glaukea* Lagourgue and Payri on morphological and molecular grounds. The proposed new combination however is invalid as the exact page of the publication of the basionym was not stated in their paper as prescribed in Chapter V, Section 3, Article 41.5 of the International Code of Nomenclature for Algae, Fungi, and Plants (Turland *et al*., 2018). In Note 1 of Article 41.5, it was pointed out that valid publication is effected with a "reference to the page or pages on which the basionym or replaced synonym was validly published…., but not to the pagination of the whole publication…." In the publication of Lagourgue and Payri (2021), the pagination of the entire publication was cited, rendering the proposed name invalid. The new combination is hereby validated below: *Glaukea argentea* (Zanardini) Lagourgue and Payri, comb.nov. [basionym: *Udotea argentea* Zanardini 1857: 290, figs. 1a-b].

***Rhipiliopsis carolyniae* Kraft** [Kraft, 1986]
=*Rhipiliopsis peltata* [sensu Gilbert and Doty, 1969]

Remarks: This species was first identified as *Rhipiliopsis peltata* (J.Agardh) Gepp and Gepp based on samples from Surigao del Sur, but later identified by Kraft (1986) as a distinct, new species that is known only from the Pacific seaboard of the Philippines (Gilbert and Doty, 1969; Dumilag *et al*., 2000).

***Tydemania expeditionis* Weber Bosse** [Trono, 2018]

Remarks: Many bioactive metabolites have been isolated from this distinctive species (Paul and Fenical, 1985), some of which have anti-fungal (Jiang *et al*., 2008) and cytotoxic properties (Zhang *et al*., 2012).

***Udotea geppiorum* Yamada** [as *geppii*, Fajardo *et al*., 2016; Trono, 2018]

Remarks: This is among the largest and most robust species of *Udotea*, easily distinguishable by its heavily calcified, branching, flabellate blades with distinct concentric bands demarcated by deeply set grooves. In addition, the single bulbous holdfast coated with fine sand is another characteristic allowing it to grow in sandy to muddy bottoms. A related species, *U. flabellum* (Ellis and Solander) Howe, has been found to yield chemicals with anticoagulant and antitumor properties (Marques *et al*., 2019).

***Ventalia orientalis* (Gepp and Gepp) Lagourgue and Payri**
=*Udotea orientalis* Gepp and Gepp [Gilbert and Doty, 1969; Trono, 1997, 2018]

Remarks: This species is more commonly encountered in Philippine waters than the preceding species. It is a medium-sized species, with mostly single, lightly calcified flabellate blades supported by a long, slender stipe that is anchored to the bottom by an inconspicuous fibrous holdfast. A superficially similar species, *U. polychotomis* Cordero, was reported by Liao (1997) from the Cuyo Islands, Palawan province which is differentiated from it by having trichotomous medullary filaments as opposed to dichotomous filaments in *V. orientalis*. The possession of dichotomous and trichotomous filaments in these species needs to be re-evaluated for their taxonomic significance.

Using morphological and molecular analysis, Lagourgue and Payri (2021) transferred this species into the new genus *Ventalia* Lagourgue and Payri. Unfortunately, the new combination did not satisfy the requirements of the International Code of Nomenclature for Algae, Fungi, and Plants (Turland *et al*., 2018) similar to the case cited earlier involving *Glaukea argentea*. The new combination is hereby validated below: *Ventalia orientalis* (Gepp and Gepp) Lagourgue and Payri, comb. nov. [basionym: *Udotea orientalis* Gepp and Gepp 1911: 119, pl. I, figs. 1, 4, pl. VI, figs. 47, 48a-b]. Two other species of *Ventalia* with incomplete references though not encountered in the current study need to be validated as well: *Ventalia indica* (Gepp and Gepp) Lagourgue and Payri, comb.nov. [basionym: *Udotea indica* Gepp and Gepp 1911: 121, pl. II, figs. 13, 14, pl. VI, figs. 52a-b, 53] and *Ventalia papillosa* (Gepp and Gepp) Lagourgue and Payri, comb.nov. [basionym: *Udotea papillosa* Gepp and Gepp 1911: 111, pl. II, figs. 17, 20a-b, pl. III, figs. 24a-d, pl. V, figs. 37, 38]. Another newly recognized species of *Rhipidosiphon* also needs to be validated: *Rhipidosiphon glaucescens* (Harvey ex J. Agardh) Lagourgue and Payri, comb.nov. [basionym: *Udotea glaucescens* Harvey ex J. Agardh 1887: 70].

Order DASYCLADALES
Family DASYCLADACEAE

***Bornetella nitida* Munier-Chalmas ex Sonder** [Trono, 2018]

***Bornetella oligospora* Solms-Laubach** [Trono, 2018]

***Bornetella sphaerica* (Zanardini) Solms-Laubach** [Sajot, 2006; Trono, 2018]

***Cymopolia vanbosseae* Solms-Laubach** [Gilbert and Doty, 1969; Trono, 1997]

***Cymopolia* sp.** [Sajot, 2006]

Remarks: This report almost certainly pertains to C. vanbosseae which is found throughout the western Pacific. The only other known species and generitype is C. barbata (L.) Lamouroux and is very distinctly different in having branched segments, whereas *C. vanbosseae* is never branched. The former is also restricted to the Caribbean and the western Atlantic (Taylor, 1960) extending into the Canary Islands (John *et al*., 2004).

***Halicoryne wrightii* Harvey** [Trono, 2018]

***Neomeris annulata* Dickie** [Sajot, 2006]

Remarks: This species is easily distinguished from its congeners, even in the field, by the presence of calcified sporangia that form concentric rings on the proximal parts of the thallus, as opposed to randomly distributed sporangia as seen in *N. vanbosseae* Howe. However, another species superficially similar to *N. vanbosseae* is *N. bilimbata* Koster with which it differs in the arrangement of sporangia.

***Neomeris vanbosseae* Howe** [Sajot, 2006; Trono, 2018]

***Neomeris* sp.** [Fajardo *et al*., 2016]

Family POLYPHYSACEAE

***Acetabularia dentata* Solms-Laubach** [Gilbert and Doty, 1969; Trono, 1997, 2017; Sajot, 2006]

Remarks: This species is small (<10 mm tall), occurring in groups on rock surfaces and with whitish gametangial rays as a result of heavy calcification.

***Acetabularia major* Martens** [Sajot, 2006]

Remarks: This species is among the largest members of the genus (>60 mm tall) with slightly calcified gametangial rays that appear greenish. Another superficially similar and large species is *A. ryukyuensis* Okamura and Yamada under which two other large

Philippine species, *A. philippinensis* Gilbert and *A. roxasii* Trono, Santiago and Ganzon-Fortes, have been synonymized.

***Acetabularia* sp.** [Sajot, 2006]

Remarks: More careful morphological examination of these acetabuliform species is needed due to the recent recognition of superficially similar genera like *Polyphysa* Lamarck and *Parvocaulis* Berger, Fettweiss, Gleissberg, Liddle, Richter, Sawitzky and Zuccarello.

CONCLUSION

The marine green algal flora of the eastern Caraga region revealed an assemblage that is typically representative of most tropical marine ecosystems. There are fairly many representatives of the reef-building genus *Halimeda*, lagoon and reef dwelling *Caulerpa*, calcareous species of the Dasycladales and the Udoteaceae as well as fleshy members of the Ulvaceae and Cladophorales. Obviously unaccounted for are microscopic, endophytic and epiphytic members of the Ulvellaceae, Phaeophilaceae, *etc*. which are ubiquitous members of tropical marine floras (*e.g*., Dawes and Mathieson, 2008, Norris *et al*., 2017). The total number enumerated in this report (62 species) was comparable to that found in Catanduanes, another site facing the Pacific located about 400 km NNW which has 68 species (Evangelista *et al*., 2015) and that of the Balabac Islands (70 species) located about 900 km WSW (Santiañez *et al*., 2015). Like eastern Caraga, both Catanduanes and Balabac are characterized by low human population and minimal development. Recently, however, portions of the eastern Caraga like the islands of Siargao and Bucas Grande and a few large land tracts bordering the coasts of Mindanao have been subjected to growing tourism development and open pit mining, respectively, and their impact on the marine flora needs to be assessed.

The assemblage of marine green algae documented in this study included species with untapped economic potential. Many species of *Caulerpa* are edible and subjected to some degree of commercial exploitation (Kurotaka, 2018). Some *Caulerpa* and species of the Udoteaceae contain bioactive metabolites (Paul and Fenical, 1985; Nagaraj and Osborne, 2014) that may be tapped as antibiotics (Paul and van Alstyne, 1982; Jiang *et al*., 2008; Esquer-Miranda *et al*., 2016). Others may have medicinal properties such as antitumor (Zhang *et al*., 2012), antiherpetic (Magdugo *et al*., 2020) and anticoagulant agents (Marques *et al*., 2019). On the other hand, the presence of large *Ulva* species may be indicative of localized eutrophication and habitat degradation (Villaluz *et al*., 2016) and should therefore be studied further for their potential environmental impact.

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