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Inventory of Benthic Macroalgae in Pristine and Clear Waters of the Island Towns of Northern Samar, Philippines

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Divina M. Galenzoga[1,2]

1Marine Biology Program, College of Science, University of Eastern Philippines, Catarman, Northern Samar 6400
2University Research Office, University of Eastern Philippines, Catarman, Northern Samar 6400
Email of the corresponding author: galenzoga@yahoo.com

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macroalgae, pristine and clear waters, anthropogenic factors, Northern Samar

Abstract

This study conducted a comprehensive investigation to examine the species composition, abundance, classification, anthropogenic threats, economic uses, and ethnobotanical practices associated with benthic macroalgae in the pristine and clear waters of the island towns in Northern Samar. A thorough reconnaissance survey was conducted in the study areas during the summer months of April to June over a five-year period from 2015 to 2019. Data on macroalgae growth, abundance, and usage were gathered through a range of techniques, such as quadrat sampling, transect walks, the line intercept method, ocular inspection, interviews, focus group discussions, and snorkeling. A total of 112 macroalgae species were identified, representing three classes, 17 orders, 28 families, and 53 genera. Among these species, Sargassum oligocystum Montagne, a brown alga, was the most abundant and widely distributed. The study revealed the presence of 11 species of Sargassum, 8 species of Caulerpa, 7 species of Halimeda, 6 species of Gracilaria, and 4 species of Ulva. The family Sargassaceae exhibited the highest abundance among the seaweed families assessed. The macroalgae were found to serve various purposes including food, medicine, income generation, soil fertilizer, fish bait, animal feed, insect repellent, packaging material, and protection of fish and marine products during transportation to the market. Additionally, the study documented important ethnobotanical practices related to macroalgae usage. It was observed that pregnant women were advised against consuming algae, red algae were not suitable for domestic animal consumption, fresh macroalgae were preferred for consumption, selected species were recommended for children, sick individuals, and older people, and the collection of algae after a typhoon was prohibited. This research provides valuable insights into the diversity and ecological significance of benthic macroalgae in the study areas, highlighting the socio-economic importance and cultural practices associated with their utilization. The findings underscore the need for sustainable management and conservation strategies to safeguard these valuable resources and protect them from the identified anthropogenic threats.

1. Introduction

Macroalgae are large marine organisms that can be categorized based on the color of their thallus, namely green, brown, and red. Their primary photosynthetic pigment is chlorophyll a, and they do not have a surrounding layer of protective cells around their reproductive cells. Unlike land plants, they do not possess true roots, stems, and leaves. These macroalgae thrive in abundance, particularly in tropical climates, and many of them are safe for human consumption. The Philippines, known for its high population and biodiversity, faces significant pressure to exploit these marine resources for economic development and poverty alleviation. Consequently, the conservation and preservation of these resources are crucial.

Studies conducted by Wilson and Pimm indicate that a 1% extinction rate could lead to the disappearance of a quarter of the world's current plant and animal species by 2050. Myers further warns that human activities are rapidly depleting the biosphere. Species characterized by sparse population densities and organisms limited to confined areas, such as islands, face heightened susceptibility to extinction. This is due to the fact that any alteration in their habitat can lead to their total eradication.

The diverse range of algae offers numerous industrial and traditional applications in human society. Algae

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cultivation has long been practiced in East Asian food cultures, and they are also used in animal feeds, medicine, bioremediation, and various industrial, medical, and scientific applications.

The complex interconnections among organisms frequently astound us when seemingly inconspicuous members of biological communities are eliminated. This underscores the significance of preserving biodiversity to safeguard crucial biological and ecological services. Hence, the objective of this research focusing on benthic macroalgae in the island towns of Northern Samar province is to advocate for conservation and preservation measures for these marine plants. Such initiatives will bring benefits to both present and future generations. Given the diverse benefits these marine plants offer, further research and investigation into these unique organisms are timely and relevant.

2. Materials and Methods

In the province of Northern Samar, there are a total of 24 towns, which are categorized into various regions. These regions consist of Balicuatro, Central, and Pacific. Within these towns, there are 15 coastal towns, 5 island towns, and 4 interior towns. Specifically, the Balicuatro area of the province is home to the five island towns of Biri, Capul, San Antonio, and San Vicente. Laoang, on the other hand, is the sole island town situated in the Pacific area. It is worth noting that no island town exists in the Central area, despite the presence of numerous islands and islets.

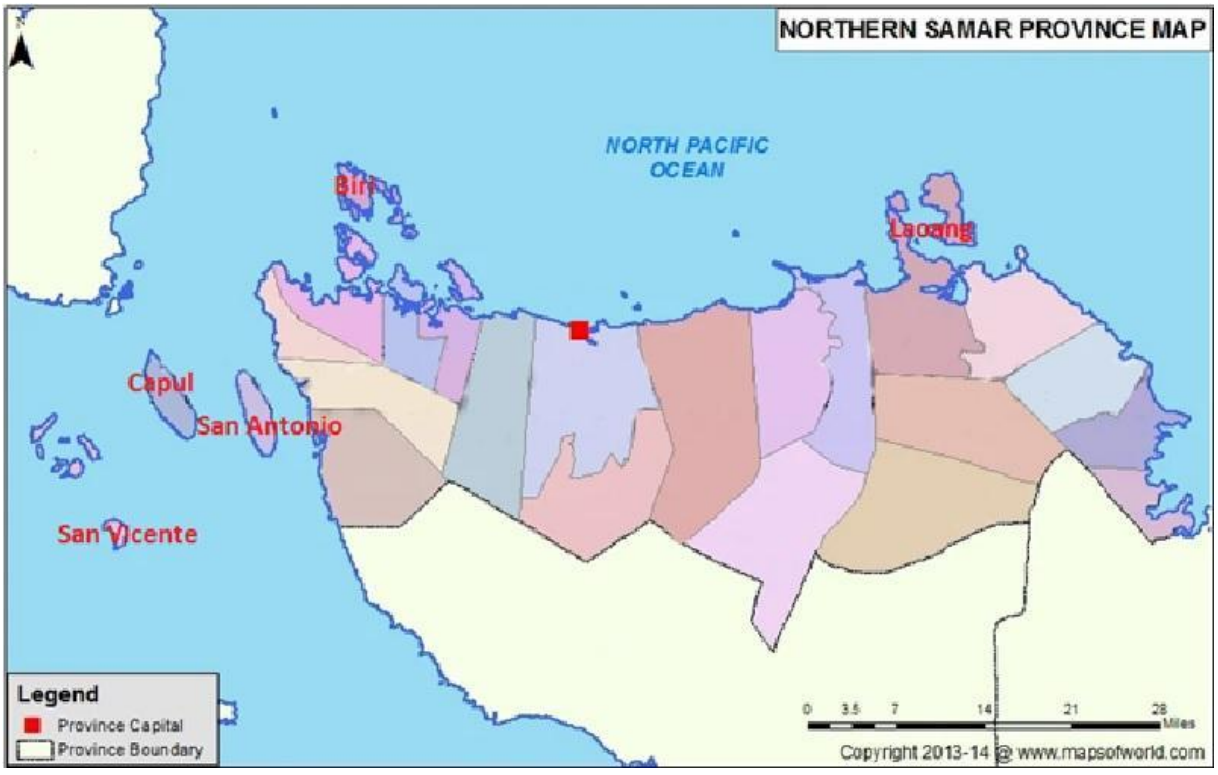

Figure 1. Map of Northern Samar showing the 5 study areas

A reconnaissance survey was done at the study areas to determine the presence of growth and abundance of algae. Permission was sent to the Municipal Mayors and Barangay Captains to allow the research study to take place. The research was done from April-June (summer months) for 5 years (2015-2019). Summer months were chosen for still waters going to island towns and for collection of specimens in pristine and clear waters.

To identify the species composition, a transect line of 50m from landward to seaward was secured. Five quadrats of 1m x 1m was placed with interval of 10m. The species gathered were classified according to classes, orders, families, and genera using various textbooks, references, manuals, field guides, and handbooks; and with the help of experts from the department/college

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and a friend taxonomist/systematist from Japan (identified species from Biri). The study employed various methods, including transect walks, the line intercept method, ocular inspection, and snorkeling (up to a depth of 1m). The primary criterion for assessing macroalgae abundance was the presence of frequently observed species that were found in large quantities across all sampling sites.

All benthic macroalgae collected from the island towns were preserved using 70% ethyl alcohol. All the collected specimens were placed in the College of Science Marine Biology Laboratory Room.

To determine the anthropogenic factors (threats); economic uses, and ethnobotanical practices; interviews with the coastal residents was done using an interview guide translated in Samarnon dialect. The guide composed of four parts: Part I- Profile of Respondents; Part II- Anthropogenic Factors; Part III- Economic Uses; and Part IV – Ethnobotanical Practices. A Focus Group Discussion (FGD) was also done to record observations and recommendations; and to verify answers to questions on Parts II, III, and IV. Further ocular inspection/observation was made at the study sites/areas.

3. Results and Discussion

Species Composition of Benthic Macroalgae

Algae are primarily categorized based on distinct morphological traits. These traits encompass: (a) the composition of pigments within the cell; (b) the chemical composition of stored food substances; (c) the characteristics of flagella on motile cells, including their type, number, location, and relative length; (d) the chemical composition of the cell wall; and (e) the presence or absence of a well-defined nucleus within the cell, along with other notable features of cell structure.

Majority of the study areas have good condition with their algae. It is observed that study areas mostly facing the Pacific Ocean, i.e., side of the island facing east have fair or poor condition. On the other hand, study areas facing west have excellent or good condition. This is because, those study areas facing east where the set of the Pacific Ocean have more strong winds and waves, whereas those study areas facing west have weaker winds and waves. Current is strong and seaweeds cannot reproduce more. However, waters on these areas will become clear and calm during summertime (i.e., April-June). More algae will thrive in pristine and clear waters.

It is also observed that study areas with muddy to sandy substrates have fair or poor condition/abundance of algae. Whereas study areas with sandy to rocky substrates have excellent or good condition. This is because algae inhabit more the sandy to rocky substrates where they can have a foothold of the substrates. Moreover, algae grow more abundantly in areas with more nutrients absorbed from the substrates and where other marine plants and animals also inhabit. There is less nutrients from the muddy to sandy substrates, so algae cannot reproduce more. Besides that, the pH, temperature, and salinity is higher in the muddy substrates where water is trapped by the mud especially those in the intertidal and sub tidal zones of the seashore. Other environmental conditions do not favor the growth and development of algae in the muddy substrates.

The latest inventory of macroalgae was done by Lastomoso and Santianez in 2020 where they enumerated 272 species of green macroalgae (Class Chlorophyceae) in the Philippines. Green algae are mostly predominant in freshwater but also have a diverse marine representative which includes *Caulerpa*, *Ulva*, *Halimeda*, and others. In marine ecosystem, green macroalgae can be found in upper to lower intertidal zone, tide pools, rocky shores attached to rocks, corals, shells, and other macroalgae.

Brown macroalgae (Class Phaeophyceae) constituted 193 species out of the total 1,065 algae in the country. Brown algae are strictly marine, and they are most abundant and diverse in cool temperate regions than in warm tropics. Brown algae such as *Sargassum sp*. are found mostly in lower intertidal zone and reef edges; and they are commonly found washed ashore in the beaches due to strong current and wave action.

There were about 600 species of red macroalgae (Class Rhodophyceae) in the Philippines which accounts for more than 56% of the total number of seaweeds in the country. In terms of numbers, they are more diverse as compared to brown and green macroalge. Red macroalgae are diverse in tidal exposed areas where nutrients are abundant due to swift wave actions and current. Typically, they exhibit a red coloration, particularly in habitats at greater depths. However, in shallow intertidal zones, they can occasionally display shades ranging from light to dark green or even dark

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brown to black. Several red algae are traditionally used commercially especially the *Kappaphycus, Gracilaria, Gelideilla, and Eucheuma. Sargassum oligocystum* Montagne, a brown alga, was the most abundant species found frequently in all the sampling sites in large quantities.

Table 1. Species composition of Benthic Macroalgae

Species	**1**	**2**	**3**	**4**	**5**
Class Chlorophyceae					
1. *Enteromorpha clathrata* (Roth) Greville	/	/	/	/	/
2. *Enteromorpha intestinalis* (Linnaeus) Nees	/	/	/	/	/
3. *Ulva fasciata* Delile	/	/	/	/	/
4. *Ulva lactuca* Linnaeus	/	/	/	/	/
5. *Ulva pertusa* Kjellman	/	/	/	/	/
6. *Ulva reticulata* Forsskal	/	/	/	/	/
7. *Anadyomene plicata* C. Agardh	x	/	x	x	/
8. *Chaetomorpha crassa* (C. Agardh) Kutzing	/	/	/	/	x
9. *Boergesenia forbesii* (Harvey) J. Feldmann	/	/	x	x	x
10.*Boodlea composita* (Harvey) Bran	/	/	/	/	x
11.*Dictyosphaeria cavernosa* (Forsskal) Borgesen	/	/	x	/	/
12.*Valonia aegagropila* C. Agardh	/	/	x	/	x
13.*Valonia fastigiata* Harvey ex. J. Agardh	/	/	x	/	/
14.*Valonia ventricosa* J. Agardh	/	/	x	/	x
15.*Caulerpa cupressoides* (Vahl) C. Agardh	/	/	/	x	/
16.*Caulerpa lentillifera* J. Agardh	/	/	x	/	x
17.*Caulerpa peltata* Lamouroux	/	/	/	/	/
18.*Caulerpa racemosa* (Forsskal) J. Agardh	/	/	/	x	/
19.*Caulerpa serrulata* J. Agardh	/	/	/	/	x
20.*Caulerpa sertularioides* (S.G.Gmelin) Howe	/	/	x	/	/
21.*Caulerpa taxifolia* (Vahl) C. Agardh	/	/	/	/	x
22.*Caulerpa verticillata* J. Agardh	/	/	x	/	/
23.*Codium edule* P.C. Silva	/	x	/	x	x
24.*Halimeda cylindracea* Decaisne	/	/	x	/	/
25.*Halimeda discoidea* Decaisne	/	/	x	/	/
26.*Halimeda frigilis* W.R. Taylor	/	/	/	/	/
27.*Halimeda macroloba* Decaisne	/	/	/	/	

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28.*Halimeda opuntia* (Linnaeus) Lamouroux	/	/	/	x	/
29.*Halimeda simulans* Howe	/	/	x	/	
30.*Halimeda velasquezi*i W.R. Taylor	/	/	/	/	/
31.*Avrainvillea erecta* (Berkeley) A. Gepp and E.S. Gepp	/	/	x	/	/
32.*Avrainvillea lacerate* Harvey ex. J. Agardh	/	/	x	/	x
33.*Chlorodesmis fastigiata* (C. Agardh) Ducker	/	/	x	/	x
34.*Chlorodesmis hildebrandtii* A. Gepp and E.S. Gepp	/	x	x	x	/
35.*Tydemania expeditionis* Weber-van-Bosse	/	/	x	/	x
36.*Udotea orientalis* A. Gepp and E.S. Gepp	/	/	x	/	/
37.*Bornetella oligospora* Solms-Laubach	/	/	/	/	/
38.*Neomeris annulata* Dickie	/	/	x	/	/
39.*Neomeris vanbosseae* Howe	/	/	x	/	x
40.*Acetabularia dentata* Solms-Laubach	x	/	/	x	/
41.*Halicoryne wrightii* Harvey	/	/	x	/	/
Class Phaeophyceae					
42.*Sphacelaria rigidula* Kutzing	/	/	/	/	/
43.*Sphacelaria tribuloides* Meneghini	/	/	x	/	x
44.*Dictyopteris jamaicensis* W.R. Taylor	/	/	x	x	/
45.*Dictyota cervicornis* Kutzing	/	/	x	/	/
46.*Dictyota dichotoma* (Hudson) Lamouroux	/	/	x	/	x
47.*Dictyota friabilis* Setchell	/	x	/	/	x
48.*Padina australis* Hauck	/	/	/	x	/
49.*Padina japonica* Yamada	/	/	/	/	/
50.*Padina minor* Yamada	/	/	/	/	/
51.*Hydroclathrus clathratus* (C. Agardh) Howe	/	/	x	/	x
52.*Hydroclathrus tenuis* Tseng et Lu	/	/	x	/	/
53.*Hormophysa cuneiformis* (J.F. Gmelin) P.C. Silva	x	/	x	/	x
54.*Sargassum binderi* Sonder in J. G. Agardh	/	/	/	/	/
55.*Sargassum crassifolium* J. G. Agardh	/	/	/	/	/
56.*Sargassum cristaefolium* C.A. Agardh	/	/	/	/	/
57.*Sargassum gracillimum* Reinbold	/	/	/	/	/
58.*Sargassum hemiphyllum* C.A. Agardh	/	/	/	/	/
59.*Sargassum ilicifolium* (Turner) C.A. Agardh	/	/	/	/	/

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60.*Sargassum oligocystum* Montagne	/	/	/	/	/
61.*Sargassum paniculatum* J. G. Agardh	/	/	/	/	/
62.*Sargassum polycystum* C. A. Agardh	/	/	/	/	/
63.*Sargassum siliquosum* J. G. Agardh	/	/	/	/	/
64.*Sargassum turbinarioides* Grunow	/	/	/	/	/
65.*Turbinaria conoides* (J. Agardh) Kutzing	/	/	/	x	/
66.*Turbinaria decurrens* Bory de Saint-Vincent	/	/	x	/	x
67.*Turbinaria ornata* (Turner) J. Agardh	/	/	x	/	/
Class Rhodophyceae					
68.*Liagoropsis schrammii* (Borgesern) Doty and Abbott	/	x	/	/	x
69.*Liagora ceranoides* Lamouroux	/	/	x	x	/
70.*Liagora farinose* Lamnouroux	/	/	/	/	x
71.*Galaxaura apiculata* Kjellman	/	/	/	x	/
72.*Galaxaura oblongata* (Ellis and Solander) Lamouroux	/	/	x	/	x
73.*Scinaia hormoides* Setchell	x	x	/	/	/
74.*Gelidiella acerosa* (Forsskal) Feldmann and Hamel	/	/	x	/	/
75.*Grateloupia filicina* (Lamouroux) C. Agardh	x	x	x	/	/.
76.*Halymenia durvillaei* Bory de Saint-Vincent	/	/	/	/	x
77.*Amphiroa foliacea* Lamouroux	/	/	x	/	/
78.*Amphiroa fragilissima* (Linnaeus) Lamouroux	x	/	/	x	x
79.*Jania decussato-dichotoma* (Yendo) Yendo	/	x	x	x	x
80.*Jania tenella* (Kutzing) Grunow	/	/	/	/	/
81.*Jania ungulata* (Yendo) Yendo	/	/	x	/	x
82.*Mastophora rosea* (C. Agardh) Setchell	/	x	x	/	/
83.*Portieria hornemannii* (lyngbye) P.C. Silva	x	/	/	/	x
84.*Ceratodictyon spongiosum* Zanardini	/	x	x	/	/
85.*Gracilaria arcuate* Zanardini	/	/	/	x	/
86.*Gracilaria edulis* (S.G. Gmelin) P.C. Silva	/	/	x	/	x
87.*Gracilaria eucheumoides* Harvey	/	/	/	x	/
88.*Gracilaria firma* Zhang et Xia	/	/	x	/	x
89.*Gracilaria manilaensis* Yamamoto and Trono	/	/	/	/	/
90.*Gracilaria salicornia* (C. Agardh) Dawson	/	/	x	x	/
91.*Eucheuma arnoldii* Weber-van Bosse	/	/	/	x	x

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92.*Eucheuma denticulatum* (N.L. Burman) Collins and Hervey	/	/	/	/	x
93.*Eucheuma gelatinae* J. Agardh	/	/	x	x	/
94.*Kappaphycus alvarezii* (Doty) Doty	/	/	/	/	
95.*Kappaphycus cottonii* (Weber-van Bosse) Doty	/	/	x	/	/
96.*Kappaphycus striatum* (Schmitz) Doty	/	/	/	/	x
97.*Hypnea cervicornis* J. Agardh	/	/	x	/	/
98.*Hypnea valentiae* (Turner) Montagne	/	/	/	x	/
99.*Coelothrix irregularis* (Harvey) Borgesen	/	x	/	/	x
100.*Spyridia filamentosa* (Wulfen) Harvey	/	/	x	x	/
101.*Caloglossas leprieurii* (Montagne) J. Agardh	/	x	x	x	x
102.*Acanthopora muscoides* (Linnaeus) Bory de Saint-Vincent	/	x	/	/	/
103.*Acanthopora spicifera* (Vahl) Borgesen	x	x	x	x	x
104.*Amansia glomerata* C. Agardh	/	x	/	/	x
105. *Bostrychia binderi* Harvey	x	x	x	/	/
106. *Bostrychia tenella* (Lamouroux) J. Agardh	/	x	x	/	x
107. *Chondria armata* (Kutzing) Okamura	x	/	/	/	/
108. *Digenea simplex* (Wulfen) C. Agardh	/	/	x	/	x
109.*Laurencia cartilaginea* Yamada	/	/	x	x	/
110.*Laurencia nidifica* J. Agardh	/	/	x	/	/
111.*Laurencia papillosa* (C. Agardh) Greville	/	x	x	/	/
112.*Neurymenia fraxinifolia* (Mertens ex Turner) J. Agardh	/	/	/	x	/

Legend: / - present x - absent

1 – Biri

2 – Capul

3 – Laoang

4 – San Antonio

5 – San Vicente

Classification of seaweeds according to classes, orders, families, and genera

There were 112 species of algae which belonged to 3 classes; 17 orders; 28 families; and 53 genera. There were 11 species of *Sargassum*; 8 species of *Caulerpa;* and 7 species of *Halimeda;* 6 species of *Gracilaria* and 4 species of *Ulva*. Family *Sargassaceae* was the most abundant family of algae assessed. There were 44 species of *Rhodophytes;* 41 species of *Chlorophytes;* and 27 species of *Phaeophytes*. *Sargassum oligocystum* Montagne was the most abundant species

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found and were abundantly and frequently found in all the sampling sites.

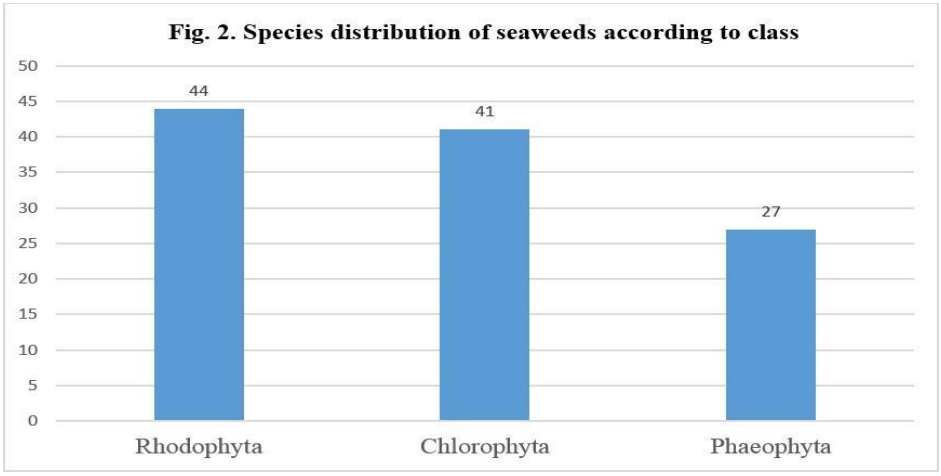

Figure 2. Species Distribution According to Class

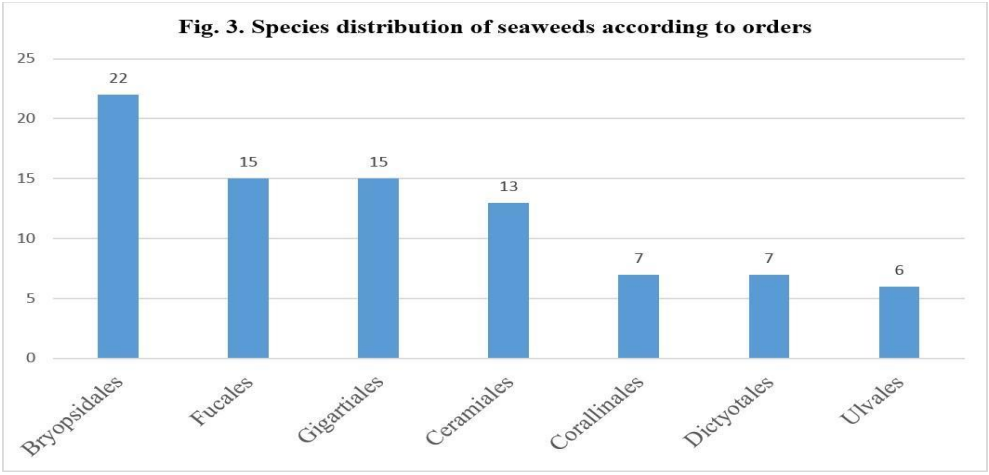

Figure 3. Species Distribution According to Orders

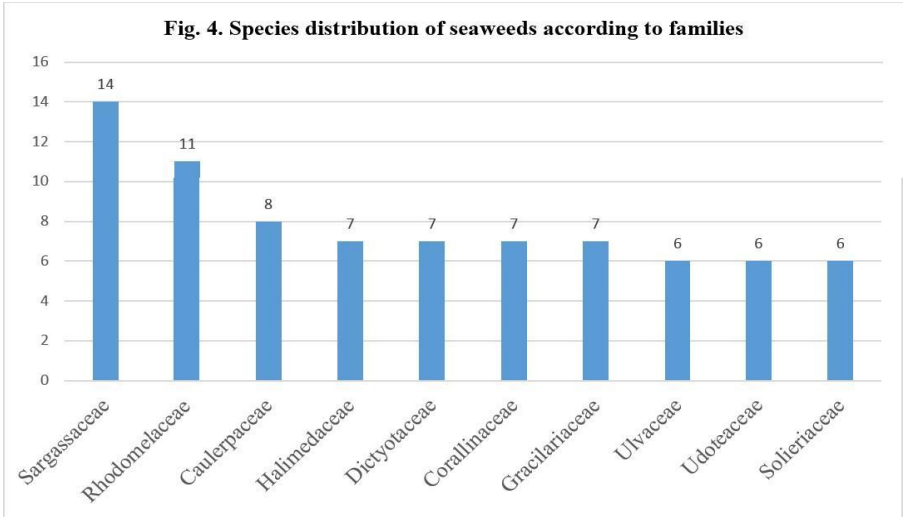

Figure 4. Species Distribution According to Families

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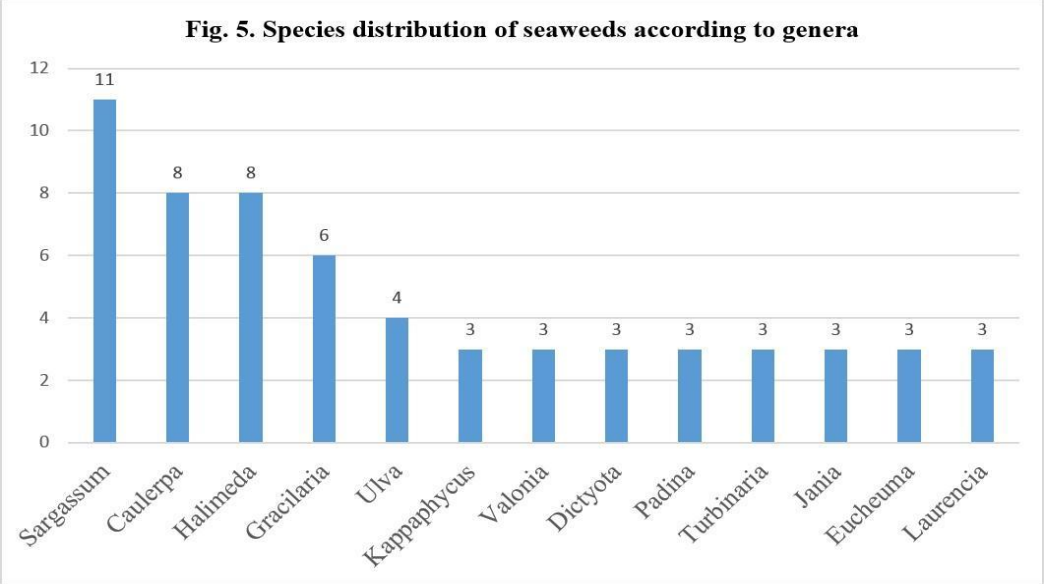

Figure.5. Species Distribution According to Genera

Anthropogenic Factors (threats) Affecting the Abundance and Distribution

Just like seagrasses, which serve as ecosystem engineers, pastures of the sea, nutrient sinks, food and shelter other marine organisms, algae are also threatened on their different roles and functions. Majority of the respondents enumerated the anthropogenic activities that affect the abundance and distribution of algae in their island town:

Destructive tourism activities – Northern Samar has admitted local and foreign tourists to the scenic and pristine island towns of the province. Such admittance of people can cause some destructive practices.

Biri is now a famous tourist destination. Both local and foreign tourists visit the island to see the Magasang rock formations, found north side of the island. Visitors can do some water activities in the island, such as swimming, climbing the rock formations, snorkeling, fishing, collecting shells (photodocumentation only), surfing, kayaking, and other activities. This island paradise can be reached 60-120 min from the mainland.

Capul is a serene island with pristine waters along its shores. Tourists/visitors of the island visit the parola (lighthouse), which is found on the northern tip of the island, the mountain found at the center of the island, and its caves, ie. Beto caves (small and large). There is greater biodiversity of plant and animal life on the island because of good soil and good freshwater resources, i.e. presence of spring and waterfalls coming from the mountain. This island can be reached 60-120 min from the mainland.

Laoang can be reached by riding a ferry/motorboat from Rawis in 10-15 min. The center of the town has a rocky paved road; but good soil can be found in the barangays where you can find rice fields and coconut plantations. Tourists/visitors visit an island barangay 20-30 min ride in ferry/motor boat called Barangay Salvacion. There is a church where the presence of the Virgin Mary is felt. People pray for thanksgiving, forgiveness of sins, and for saving them from sins and diseases. The place has a religious ambiance.

San Antonio is also a tourist site for visitors. Tourists visit the different beach resorts where they can choose for a one star, two stars, three stars resorts depending upon their ability to pay.

The soil in this island town is sandy. Biodiversity is not much in this island paradise. It takes only 10-20 min ride from the mainland. Visitors/tourists visit the church of the miraculous San Antonio especially during its feast day- June 12.

San Vicente is a C-shaped island some far away from the mainland. It takes around 120 – 180 min to reach the island. The soil is loamy and quite diverse in flora and fauna. Tourists/visitors visit the famous pink beach, which is found in one of the island barangays of the island town. It takes another 60 min to reach the pink beach. The beach is pink colored due to the presence of shells with pink hue. Other reason is that the beach has a lot of pink/red colored seaweeds/algae.

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Destructive fishing practices – coastal residents disturb the seaweed areas by treading the seaweeds and wading in the water every day; trawling, mooring and other practices.

Coastal development – development of shorelines, such as construction of beach resorts, roads, hotels, restaurants, building channels and docks, and the like.

Pollution, poor sewage treatment, solid waste – due to some tourist activities, marine pollution is heightened in the areas where seaweeds occupy. Plastic bottles, one-use plastics, Styrofoam, rubber and rubber materials, domestic wastes, agricultural wastes are dumped to the sea polluting the sea water.

Damage by effects of climate change and excessive collection – the marine animals also serve as food for the island residents. The marine animals are collected almost always on a daily basis. The areas where the seaweeds grow are disturbed. Some seaweeds are delicate and they vacate the areas where there are lots of disturbances. Seaweeds grow usually in pristine areas, with little waves, and normal pH and salinity levels of the sea water.

Damage by motorboat propellers – increase tourist inflow also increase then number of motorboats passing the motor ways in the sea distracting/disturbing the growth of seaweeds in the area.

Table 3. Anthropogenic Factors (Threats) Affecting Abundance and Distribution

Island town	Tourism activities	Destructive fishing practices	Coastal development	Pollution, poor sewage treatment, Solid waste	Damage by the effects of climate change and excessive marine organism collection	Damage by boat propellers
Biri	/	/	/	/	/	/
Capul	/	/				/
Laoang	/	/	/	/		/
San Antonio	/	/	/		/	/
San Vicente	/	/				/

Economic Uses of Algae in the Study Areas

Algae have some economic uses to the people in the study areas. Foremost of which is for food: as salad, pickled, dried, beverage (juice), dessert (as sweetened treat) , as garnishing, spices, and some condiments. For use as medicine, seaweeds are prepared either by decoction, boiled, dried, or also eaten raw to cure for some illness. They serve as antibacterial, antifungal, or

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antimicrobial. It is not yet proven to be effective as antiviral. They can also be used as soil fertilizer. They are dried, powdered and mix with the soil to serve as fertilizer for flower and vegetable gardens. They are also effective fertilizers for root crops, herbal plants, and shrub plants. Only two families of algae in the island towns are sold in bulk to businessmen as raw materials for industrial and commercial products, i.e., families *Sargassaceae* and *Gracilariaceae*. They are also used as insect repellents, animal feeds, fish baits, and prepared as raw fresh material, cooked, or dried, whatever the case may be. Other uses of algae are for pollution indicator in the oceans and seas, for ethnobotanical studies, used in rituals, customs, and traditions, and for research studies. Algae indeed are both ecologically and economically important to humans, animals, and plants. It is imperative that we study them, assess, and determine their biology, abundance and distribution.

Table 4. Economic Uses of Seaweeds in the Study Areas

Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. *Enteromorpha clathrata* (Roth) Greville	/	/	/			/	/	
2. *Enteromorpha intestinalis* (Linnaues) Nees	/	/	/			/	/	
3. *Ulva fasciata* Delile	/	/				/	/	
4. *Ulva lactuca* Linnaeus	/	/				/	/	
5. *Ulva pertusa* Kjellman	/	/						
6. *Ulva reticulata* Forsskal	/	/				/	/	
7. *Anadyomene plicata* C. Agardh								/
8. *Chaetomorpha crassa* (C. Agardh) Kutzing	/					/	/	
9. *Boergesenia forbesii* (Harvey) J. Feldmann								/

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10.*Boodlea composita* (Harvey) Brand								/
11.*Dictyosphaeria cavernosa* (Forsskal) Borgesen	/	/				/	/	/
12.*Valonia aegagropila* C. Agardh	/	/						/
13.*Valonia fastigiata* Harvey ex. J. Agardh	/	/						/
14.*Valonia ventricosa* J. Agardh	/	/						/
15.*Caulerpa cupressoides* (Vahl) C. Agardh	/	/		/				
16.*Caulerpa lentillifera* J. Agardh	/	/		/				
17.*Caulerpa peltata* Lamouroux	/	/		/				
18.*Caulerpa racemosa* (Forsskal) J. Agardh	/	/		/				
19.*Caulerpa serrulata* J. Agardh	/	/		/				
20.*Caulerpa sertularioides* (S.G.Gmelin) Howe	/	/		/				
21.*Caulerpa taxifolia* (Vahl) C. Agardh	/	/		/				
22.*Caulerpa verticillata* J. Agardh 23.*Codium edule* P.C. Silva	/	/ /		/	/ /	/ /		
24.*Halimeda cylindracea* Decaisne		/	/					
		/	/					

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25.*Halimeda discoidea* Decaisne								
26.*Halimeda frigilis* W.R. Taylor		/	/					
27.*Halimeda macroloba* Decaisne		/	/					
28.*Halimeda opuntia* (Linnaeus) Lamouroux		/	/					
29.*Halimeda simulans* Howe		/	/					
30.*Halimeda velasquezi*i W.R. Taylor		/	/					
31.*Avrainvillea erecta* (Berkeley) A. Gepp and E.S. Gepp		/						
32.*Avrainvillea lacerate* Harvey ex. J. Agardh		/						
33.*Chlorodesmis fastigiata* (C. Agardh) Ducker		/						/
34.*Chlorodesmis hildebrandtii* A. Gepp and E.S. Gepp		/						/
35.*Tydemania expeditionis* Weber-van-Bosse		/						/
36.*Udotea orientalis* A. Gepp and E.S. Gepp		/						/
37.*Bornetella oligospora* Solms-Laubach		/						/
38.*Neomeris annulata* Dickie		/						
39.*Neomeris vanbosseae* Howe		/						

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40.*Acetabularia dentata* Solms-Laubach		/						
41.*Halicoryne wrightii* Harvey		/						
42.*Sphacelaria rigidula* Kutzing	/	/						
43.*Sphacelaria tribuloides* Meneghini	/	/						
44.*Dictyopteris jamaicensis* W.R. Taylor	/	/				/		
45.*Dictyota cervicornis* Kutzing	/	/				/		
46.*Dictyota dichotoma* (Hudson) Lamouroux	/	/				/		
47.*Dictyota friabilis* Setchell	/	/				/		
48.*Padina australis* Hauck		/						/
49.*Padina japonica* Yamada		/						/
50.*Padina minor* Yamada		/				/		/
51.*Hydroclathrus clathratus* (C. Agardh) Howe	/	/	/		/	/		
52.*Hydroclathrus tenuis* Tseng et Lu	/	/	/		/	/		
53.*Hormophysa cuneiformis* (J.F. Gmelin) P.C. Silva			/		/	/		

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54.*Sargassum binderi* Sonder in J. G. Agardh	/	/	/		/	/	/	
55.*Sargassum crassifolium* J. G. Agardh	/	/	/		/	/	/	
56.*Sargassum cristaefolium* C.A. Agardh	/	/	/		/	/	/	
57.*Sargassum gracillimum* Reinbold	/	/	/		/	/	/	
58.*Sargassum hemiphyllum* C.A. Agardh	/	/	/		/	/	/	
59.*Sargassum ilicifolium* (Turner) C.A. Agardh	/	/	/		/	/	/	
60.*Sargassum oligocystum* Montagne	/	/	/		/	/	/	
61.*Sargassum paniculatum* J. G. Agardh	/	/	/		/	/	/	
62.*Sargassum polycystum* C. A. Agardh	/	/	/		/	/	/	
63.*Sargassum siliquosum* J. G. Agardh	/	/	/		/	/	/	
64.*Sargassum turbinarioides* Grunow	/	/	/		/	/	/	
65.*Turbinaria conoides* (J. Agardh) Kutzing	/	/	/		/	/	/	
66.*Turbinaria decurrens* Bory de Saint-Vincent	/	/	/		/	/	/	
67.*Turbinaria ornata* (Turner) J. Agardh	/	/	/		/	/	/	
	/	/			/			

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68.*Liagoropsis schrammii* (Borgesern) Doty and Abbott								
69.*Liagora ceranoides* Lamouroux	/	/			/			
70.*Liagora farinose* Lamnouroux	/	/			/			
71.*Galaxaura apiculata* Kjellman		/	/		/	/		
72.*Galaxaura oblongata* (Ellis and Solander) Lamouroux		/	/		/	/		
73.*Scinaia hormoides* Setchell		/	/		/	/		
74.*Gelidiella acerosa* (Forsskal) Feldmann and Hamel		/	/		/	/		
75.*Grateloupia filicina* (Lamouroux) C. Agardh		/	/		/	/		
76.*Halymenia durvillaei* Bory de Saint-Vincent	/	/				/		
77.*Amphiroa foliacea* Lamouroux	/	/				/		
78.*Amphiroa fragilissima* (Linnaeus) Lamouroux	/	/				/		
79.*Jania decussato-dichotoma* (Yendo) Yendo		/						
80.*Jania tenella* (Kutzing) Grunow		/						

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81.*Jania ungulata* (Yendo) Yendo		/						
82.*Mastophora rosea* (C. Agardh) Setchell		/						
83.*Portieria hornemannii* (lyngbye) P.C. Silva		/						
84.*Ceratodictyon spongiosum* Zanardini								
85.*Gracilaria arcuate* Zanardini	/	/	/	/		/		
86.*Gracilaria edulis* (S.G. Gmelin) P.C. Silva	/	/	/	/		/		
87.*Gracilaria eucheumoides* Harvey	/	/	/	/		/		
88.*Gracilaria firma* Zhang et Xia	/	/	/	/		/		
89.*Gracilaria manilaensis* Yamamoto and Trono	/	/	/	/		/		
90.*Gracilaria salicornia* (C. Agardh) Dawson	/	/	/	/		/		
91.*Eucheuma arnoldii* Weber-van Bosse	/	/	/	/		/		
92.*Eucheuma denticulatum* (N.L. Burman) Collins and Hervey	/	/	/	/		/		
93.*Eucheuma gelatinae* J. Agardh	/	/	/	/		/		
94.*Kappaphycus alvarezii* (Doty) Doty	/	/	/	/		/		

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95.*Kappaphycus cottonii* (Weber-van Bosse) Doty	/	/	/	/		/		
96.*Kappaphycus striatum* (Schmitz) Doty	/	/	/	/		/		
97.*Hypnea cervicornis* J. Agardh	/	/	/		/	/		
98.*Hypnea valentiae* (Turner) Montagne	/	/	/		/	/		
99.*Coelothrix irregularis* (Harvey) Borgesen	/	/	/		/	/		
100.*Spyridia filamentosa* (Wulfen) Harvey	/	/	/		/	/		
101.*Caloglossas leprieurii* (Montagne) J. Agardh	/	/						
102.*Acanthopora muscoides* (Linnaeus) Bory de Saint-Vincent	/	/						
103.*Acanthopora spicifera* (Vahl) Borgesen	/	/						
104.*Amansia glomerata* C. Agardh	/	/						
105.*Bostrychia binderi* Harvey	/	/	/					
106.*Bostrychia tenella* J. Agardh	/	/	/					
107. *Chondria armata* (Kutzing) Okamura	/	/	/					
108.*Digenea simplex* (Wulfen) C. Agardh	/	/	/					
109.*Laurencia cartilaginea* Yamada	/	/	/					

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110.*Laurencia nidifica* J. Agardh	/	/	/					
111.*Laurencia papillosa* (C. Agardh) Greville	/	/	/					
112.*Neurymenia fraxinifolia* (Mertens ex Turner) J. Agardh	/	/	/					

Legend: (Economic uses of seaweeds to people in study areas)

1 – human food (eaten as fresh, dessert as sweetened treat, beverage as juice, in salads, cooked, dried, pickled)

2 – medicine (antibacterial, antifungal, antimicrobial)

3 – soil fertilizer for vegetable and flower gardens (dried and powdered)

4 – sold to businessmen in bulk (as raw material for industrial products)

5 – insect repellent (dried and powdered, mix with coconut oil)

6 - domestic animal feeds (raw, cooked, dried)

7 - fish bait (used as bait for smaller fishes)

8 - others (pollution indicator, used for ethnobotanical studies, used in rituals, customs, for research studies)

Ethnobotanical Practices

People in the island towns of Northern believe in some traditional/cultural beliefs related to using/consuming algae. Some of the practices may be weird or queer to some people; but these beliefs are not necessarily harmful to their lives. Eating them may not be permitted for pregnant women. Domestic animals should not consume red algae. Only fresh algae are suitable for consumption. Selected algae can be consumed by children, sick individuals, and older people. Gathering algae after a typhoon is strictly prohibited.

4. Conclusions and Recommendations

Algae are present in the island towns of Northern Samar because of the good environmental factors for them to inhabit, such as pristine waters, tropical weather, clear and calm seas. They are important both ecologically and economically to the people in the study areas. They are potential for bioprospecting for natural products (use in the development and potential production of new drugs/medicines especially for cancer and COVID) based on their chemical composition and biodiversity. *Sargassum oligocystum* Montagne, a brown, algae, was the most abundant species found frequently and abundantly in all the sampling sites. Cultivation of selected species of algae can be done by government and non-government agencies to alleviate the economic state of the island people. There is a dearth of basic information on the abundance, distribution, utilization, and kinds of algae in the province; hence, there is a need to collate all the studies about phycology in the province for its database.

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