

Biomass and phytal animals of floating

Abstract

The biomass and phytal animals of floating *Sargassum* were studied in two stations Lugait (S1) and Naawan (S2), Misamis Oriental on August 14, 2008. Two traps were constructed in S1 and S2 to collect the floating *Sargassum* and to remove the phytal animals by using glass slide, forceps and brushing technique. Wet and dry weight biomasses of the *Sargassum* thalli were determined. Physico-chemical parameters such as salinity, temperature and depth were noted in both S1 and S2. The results showed that five groups of phytal animals were identified: foraminifera's (28 ind kg⁻¹ *Sargassum* thalli), shrimp post larvae (6 ind kg⁻¹ *Sargassum* thalli), sponges (4 ind kg⁻¹ *Sargassum* thalli), gastropods (3 ind kg⁻¹ *Sargassum* thalli) and polychaetes (2 ind kg⁻¹ *Sargassum* thalli) in S1. Foraminifera's (44 ind kg⁻¹ *Sargassum* thalli), shrimp post larvae (3 ind kg⁻¹ *Sargassum* thalli), sponges (2 ind kg⁻¹ *Sargassum* thalli), gastropods (1 ind kg⁻¹ *Sargassum* thalli) and polychaetes (1 ind kg⁻¹ *Sargassum* thalli) in S2. Relative abundance of the phytal animals yielded foraminifera's as the highest range from 67% (S1) to 90% (S2).

This was followed by shrimp post larvae with a range from 5% (S2) to 13% (S1). The remaining phytal animals were at low relative abundance with ranges from 3% (S2) to 9% (S1) for sponges; from 1% (S2) to 6% (S1) for gastropods; and from 1% (S2) to 5% (S1) for polychaetes. The WW biomass of *Sargassum* thalli minus the phytal animals were 4.75 WW kg⁻¹ (S1) and 4.25 WW kg⁻¹ (S2). S1 had high evenness (0.6627) accounting to high diversity (0.4632) with low dominance (0.4816). Whereas in S2 evenness was low (0.2747), with high dominance (0.8162) characterizing low diversity (0.1920) in the area. The importance of the phytal animals on floating *Sargassum* in the marine ecosystem must be considered in the formulation of pelagic environment conservation measures and policies.

Keywords: Biomass, *Sargassum* spp, Floating, Phytal animals

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Introduction

Rationale

The Philippines is an archipelagic nation where it is composed of 7,105 islands and islets. These islands and islets are surrounded by coastlines which have a general total area of 18,000 km². These coastal areas are distinct which have a particular combination of different environmental factors that create localized effects that affect the community composition of different ecosystem. In such communities different species survive the environment they are accustomed to inhabit, and sometimes are subjected to habitat fragmentation which are usually caused by human alteration,¹ and this includes *Sargassum* beds which house unique and unusual animals.²

In South Africa, *Sargassum* has high productive capacity during the autumn and winter months and only average in the warmer months³ and have attained a maximum sustainable yield (MSY) that is estimated to be 100,000 metric tons wet weight per year.⁴ Aside from that, floating *Sargassum* and *Sargassum* beds are one of the diverse ecosystems in the marine environment, where it is home to some species in the sea and it is a breeding, spawning, hiding and eating ground for young fishes and sea turtles. In fact in Mississippi, a species of juvenile fishes, jacks and trigger fish are found beneath these beds.⁵ The *Sargassum* also house the suitable attachment for epiphytes that carry with them while floating.⁶ The importance of this floating *Sargassum* have different significant in its destination, like for landward, it helps the beaches and dunes as a natural barriers against storm flooding and beach erosion. The organism in the thalli can be also a fertilizer. In seaward, young tuna, marlin, game fish and jellyfish swim with it and sometimes it can be a food for them.⁵

However this seaweed is in the state of threat due to its excessive harvest for feeds, fertilizer and alginate. Moreover, live *Sargassum* reflect the result of anthropogenic activity, like the siltation inflow from upland, including various wastes from factories that degrade this *Sargassum*. Ecological importance of the epiphytes attached to *Sargassum* is recognized. Thus this study will provide the awareness on how to protect and prevent the *Sargassum* against destructions which contains the biota load that is ecologically important.

This study is conceptualized based on the following hypothesis:

- i. There is no significant difference of *Sargassum* that floats in the two selected areas;
- ii. There is no significant difference of biota load in the two selected areas; and
- iii. There is no significant difference of biomass in two selected areas.

Over the period of years, there is a poor understanding regarding the *Sargassum* spp. The knowledge of these species is essential particularly the floating *Sargassum* to further emphasize in fisheries production.

Objective of the study

General objective: The study generically aims to examine and compare the biota animals an biomass of floating *Sargassum* spp. in Lugait and Naawan, Misamis Oriental.

Specific objective: To determine and compare the presence and abundance of phytal animals in floating *Sargassum* spp. in the

collected thalli in the two selected areas. To determine and compare the biomass of floating *Sargassum spp.* in the two selected areas.

Significance of the study: The result of the study shall provide baseline information on the current condition of floating *Sargassum* in terms of their biota and biomass in Lugait and Naawan, Misamis Oriental. Furthermore, the result shall provide environmental advice on how to manage *Sargassum* beds to support fisheries production.

Scope and limitation of the study: The study was focus only on the macrofaunal biota and the biomass of floating *Sargassum spp.* The phytal animals identified from *Sargassum spp* thalli were counted in which the biota was classified according to their major groups due to the unavailability of related resources.

Definition of terms

Biomass: Biomass is the total weight of all organisms in a given area or volume.⁷

Biota: Biota refers to all the living organisms occurring within a certain area or region. It is also called epiphytes that are usually present on leaf surface of submerged aquatic macrophytes. The term epiphytes refer to heterotrophic and autotrophic organisms composing diverse communities.⁸

Floating: Floating *Sargassum* is free floating seaweed found throughout the blue waters of the south atlantic from extensive commercial harvest.⁴

Macrofauna: Macrofauna refers to animals whose shortest dimension is greater than or equal to 0.5mm.⁹

Phytal animals: A Phytal animal refers to animals that inhabit the thalli of *Sargassum spp.*^{10,11}

Salinity: Salinity refers to number of grams of dissolved salts in 1000g of sea water.⁹

Review of related literature

Sargassum spp is a type of algae which has a small air bladder called vesicles that contains carbon dioxide which makes them to float.¹² Even if the thalli detach from its holdfast and it floats, it is still capable to survive.¹³ Thus, it is one source of organic matter in the pelagic community. Floating *Sargassum spp* is a floatsam.¹⁴ The significance of this floating *Sargassum* has relevance to its destinations. For landward, Sargssum helps to build strong sand dunes against storm flooding and beach erosions.¹² For seaward, it provides a habitat for pelagic organisms, thereby forming large mats¹⁴ where organisms swim with it and can be a potential step for fish trading.¹⁵ A particular fish,¹⁶ which mimics the colour of weed, was discovered from the drifting *Sargassum* weed in India.¹⁷

Sargassum is one of the most diverse ecosystems, because it is considered as home for other organisms in the sea.⁴ It houses the epiphytes carried with them while floating.⁶ The biota of *Sargassum* largely composed of diatoms which have a >93% of the total population.¹⁸ He also mentioned that during the development of this biota community, the density and the biomass of the attached organisms' increases on the older part thallus compared to the younger part. Many organisms were more abundant on plant part taken closer to the water surface than on plant part taken from deeper water. It is said that organisms living in this algae provide habitat complexity.¹⁹ The *Sargassum* and the epiphytes can benefit the flow of energy and the cycle of matter.²⁰

Sargassum has different seasonality in biomass production. It was stated that *S. baccularia* attained high biomass during January.

while *S. binderi* attained high biomass during April.⁷ Both species are highly correlated in the length of the thallus with rainfall.³

Aside from its habitat importance, *Sargassum spp* is utilized as feeds and fertilizers.⁷ It is good source of alginate which is used as thickener, emulsifier, stabilizer.³ It is a multifunctional food for maintaining health because it is rich in minerals, vitamins and dietary fiber. In Japan, it is used as savory food.⁶ *Sargassum spp.* biomass has been used for the removal of metal waste water since it is a biosorbent.²¹ According to Karthikeyan et al.²² this biosorption technology uses a much cheaper material like the *Sargassum spp.* *Sargassum spp* algae contains mainly the polysaccharide alginate, usually calcium and sodium alginate, that is said to have the high potentials for the accumulation of heavy dissolved metals in the different water system.²² The biosorbent with high adsorption process is generally rapid and it is suitable for the great extraction of metal ions from large volumes of water that is already accumulated.⁷ A particular *Sargassum* species, *S. muticum* which is considered an invasive species is said to be the most accurate to use in the binding analysis with non great deal thermodynamically consistent absorption because of its high content of alginate.²⁴ In the light of above mentioned studies, the floating *Sargassum spp* and the biota composition will be investigated so as to understand its implication to the environment.

Materials and methods

Study area

The study was conducted in the two stations: Poblacion, Lugait, Misamis (S1) Oriental and in Poblacion, Naawan, Misamis Oriental (S2). The stations were established by using the GPS (Global Positioning System) (Figure 1) (Table 1).

Table 1 Geographical location of the traps in Lugait (S1) and Naawan (S2), Misamis Oriental

	Lugait		Naawan	
	North	East	North	East
Trap 1	08°20' 40.1"	124°15' 27.6"	08°25' 52.4"	124°17' 12.0"
Trap 2	08°20' 41.3"	124°15' 51.1"	08°25' 51.1"	124°17' 10.7"

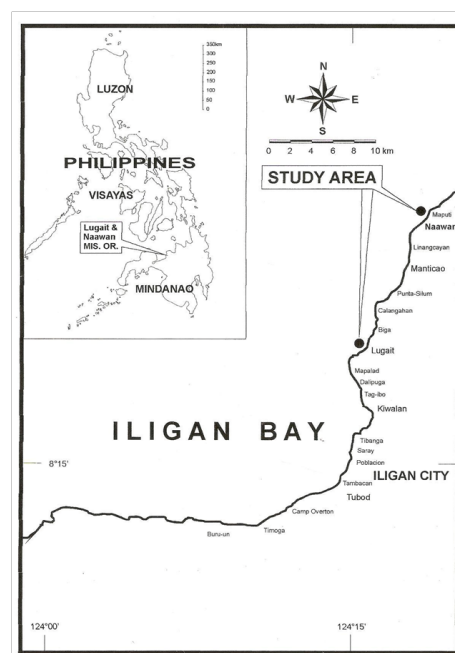


Figure 1 The study area and the sampling stations in Lugait and Naawan, Misamis Oriental.

Description of the *Sargassum* spp.

Sargassum spp, is a member of brown algae in Class Phaeophyta.⁵ Its life cycle consist only of large pseudo-perennial plant,¹³ which reproduced by means of receptacles born in the secondary branches and contains both oogonia and antheridia.²⁵ The distinct characteristics that differ them to other seaweed, is the small air bladder called vesicles that contains carbon dioxide which makes them to float¹² and can make them stand upright in the water while they are still attached in the bottom (Figure 2). Sampling time and frequency



Figure 2 Floating *Sargassum* spp drifted on shores of Lugait and Naawan, Misamis Oriental.

Sampling was done on August 14, 2008 simultaneously for 24 hr in S1 and S2 to obtain the same weather condition that controls the floating *Sargassum* spp. 3.4. Field activities

Collection of floating *Sargassum* spp.

Two traps (Figure 3) were installed in every station.²⁶ The trap was 3m x 3 m in length and width. The net stretched up to 3 m with a mesh size of 1.2 cm. It was made up of bamboo poles and plastic nylon net. The trap was installed in the *Sargassum* bed by digging two - three meter distant holes to erect the bamboo poles. The net was tied in both poles and the tail part of the net was anchored for stretching.

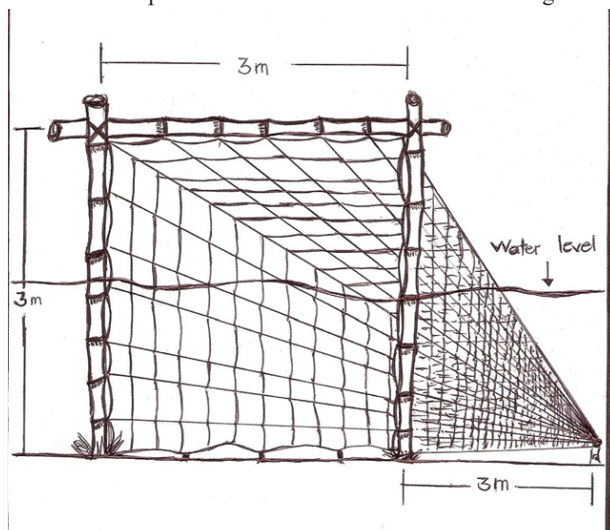


Figure 3 The trap for floating *Sargassum* spp.

The trap in Lugait was installed in the morning of August 13, 2008 and this was followed by the installation of the trap in Naawan in the afternoon. Collection of *Sargassum* in the traps at 1 kg trap-1 was done for *Sargassum* spp biomass determination.

Biota and biomass determination

The trapped *Sargassum* thalli at 1 kg trap-1 were placed in pre-labelled sealable bottles which contained 5% buffered formalin to preserve the phytal organisms and the *Sargassum* for biota and biomass determination, respectively.

Laboratory activities

Floating *Sargassum*: After the sampling, the collected samples was then weighed using the Ohaus triple beam balance and prepared for phytal animals and biomass determination. After the removal of the phytal animals, the thalli were processed for wet weight (WW) determination.

Biota determination: At MSU Naawan laboratory, the collected samples (Figure 4) were washed inside a sieve with mesh size of 20 μ m (Figure 5). The removal of the phytal animals was done by using the brushing technique²⁷ (Figure 6). Phytal animals that were not removed from the thalli were scraped by using a glass slide (Figure 7)²⁸ or by using forceps (Figure 8 & 9).¹⁴ All collected organisms per 1 kg of *Sargassum* were placed in the pre-labelled bottle with 5% buffered formalin. Photomicrographs of the removed phytal animals were taken by using a Kodak digital camera. The biota per 1 kg of *Sargassum* was observed with the aid of a Swift light microscope and the species were counted and categorized according to major groups. The *Sargassum* spp were dried and weighed to constant weight for biomass determination which was expressed in DW biomass¹⁵



Figure 4 The collected *Sargassum* spp with other laboratory apparatus used in the study.



Figure 5 Washing of the thalli *Sargassum* spp with sieve having 20 μ m mesh size.

Physical parameters

Aside from the WW and DW determination of *Sargassum* thalli other parameters determined were tides, depth, temperature and salinity. Tide cycle was obtained from a calendar which was used as the basis for the stretching of the trap. Water samples were collected

for salinity analysis by using the ATAGO refract meter (Figure 10). Temperature readings were obtained by using a mercury filled thermometer. The depth was obtained by using a calibrated post of each trap.



Figure 6 Removal of phytal animals using a brushing technique.



Figure 7 Removal of phytal animals using a glass slides.



Figure 8 Removal of phytal animals by using forceps.



Figure 9 Oven dried *Sargassum* spp thalli.



Figure 10 Salinity determination by using a refract meter.

Data management

Diversity indices: Species diversity was determined using the following formula by Pielou.²⁹

Index of dominance:

$$C = \sum (n_i / N)^2$$

Where:

n_i is the importance value of each taxa

N is the total importance value of all taxa

Shannon-Weaver index of general diversity (H'):

$$H' = -\sum (n_i / N) \log n_i / N$$

Where:

n_i is the total importance value of each taxa

N is the total number of individuals identified per unit area

Index of evenness(e):

$$E = (H' / \log S)$$

Where:

H' is the Shannon-Weaver index

S is the total number of species

Index of similarity

$$S = 2C / A+B$$

Where:

A is the number of species in sample A

B is the number of species in sample B

C is the number of species common to both A and B

Relative abundance

The relative abundance of biota and biomass was calculated using the formula by Odum.³⁰

$$\text{Relative abundance (\%)} = \frac{\text{Number of individuals}}{\text{Total number of individuals}} \times 100$$

Results and discussion

Abundance of phytal animals in floating *Sargassum* spp.

In Lugait, there were 5 groups of phytal animals identified, namely: shrimp post larvae, sponges, foraminifera's, gastropods and polychaetes. Among the 5 groups, the foraminifera's showed the greatest number of individuals which had a total mean population density of 28 ind kg^{-1} *Sargassum* spp thalli followed by shrimp post larvae (6 ind kg^{-1} *Sargassum* thalli), sponges (4 ind kg^{-1} *Sargassum* thalli), gastropod (3 ind kg^{-1} *Sargassum* thalli) and polychaetes (2 ind kg^{-1} *Sargassum* thalli).

In Naawan, 5 groups of phytal animals were observed with foraminifera's which had a population density of 44 ind kg^{-1} *Sargassum* thalli as the most abundant. Shrimp post larvae (3 ind kg^{-1} *Sargassum* thalli), sponges (2 ind kg^{-1} *Sargassum* thalli), polychaetes (1 ind kg^{-1} *Sargassum* thalli) and gastropod (1 ind kg^{-1} *Sargassum* thalli) were present in low population densities (Table 2) (Appendices).

Table 2 Phytal animals identified and their mean densities in S1 (Lugait, Misamis Oriental) and S2 (Naawan, Misamis Oriental) on August 14, 2008

Phytal animals	Mean densities(ind kg^{-1} <i>Sargassum</i> thalli)			
	Lugait	%	Naawan	%
Foraminiferans	28	65	44	86
Shrimp post larvae	6	14	3	6
Sponges	4	9	2	4
Gastropods	3	7	1	2
Polychaetes	2	5	1	2

Biomass of floating *Sargassum* spp.

The total WW of floating *Sargassum* trapped in S1 and S2 yielded to 4.75 kg and 4.25 kg, respectively. In Lugait, 3.25 kg (First trap) and 1.5 kg (second trap) were collected which totalled to 4.75 kg WW. In Naawan, the first trap had 3.5 kg and the second trap had 0.75 kg which totalled to 4.25 kg (Table 3). The differences in the WW of *Sargassum* spp could be attributed to the position of the trap wherein the trap was installed facing perpendicular to the current. The opening of the trap was not intended to trap floating *Sargassum* spp which drift with the current but to trap floating *Sargassum* during flooding high tide and low tide. It was observed that the first trap in both stations got the highest value of captured biomass; this was observed because the first trap was located in accordance to the direction of the current. The current was moving towards northeast or southeast which was relatively going to the east based on the drift bottle technique used in the study.

Table 3 WW and DW biomass of *Sargassum* spp per trap in kg in Lugait and Naawan, Misamis Oriental on August 14, 2008

Station	1 Trap		2 Trap		Total	
	WW	DW	WW	DW	WW	DW
Lugait	3.25	0.2128	1.5	0.4522	4.75	0.665
Naawan	3.5	0.1301	0.75	0.5929	4.25	0.723

The DW biomass of *Sargassum* in Lugait was 0.665, that is, about 86% of water was lost from the original weight of 4.75 kg whereas 83% of water was lost in the DW of *Sargassum* in Naawan from 4.25 kg WW to 0.723 kg DW.

Relative abundance of phytal animals in floating *Sargassum* spp in Lugait and Naawan, Misamis Oriental on August 14, 2008

Result of the relative abundance of biota S1 (Lugait) and S2

(Naawan), showed that foraminifera's (Figure 11) were the most abundant in both stations. Among the 5 groups of phytal animals identified, shrimp post larvae (13%) (Figure 12), sponges (9%), gastropods (6%) (Figure 13) and polychaetes (1%) (Figure 14) in Naawan were higher in abundance in Lugait station, compared to shrimp post larvae (5%), sponges (3%), gastropods (1%) and polychaetes (1%) in Naawan station. However, foraminifera's (67%) in Lugait station was lower in comparison to the foraminifera's (90%) in Naawan Station (Figure 15 & 16). The dominance of biota of certain phytal animals in floating *Sargassum* spp indicated that floating *Sargassum* spp is the habitat of some pelagic and benthic marine organisms.²

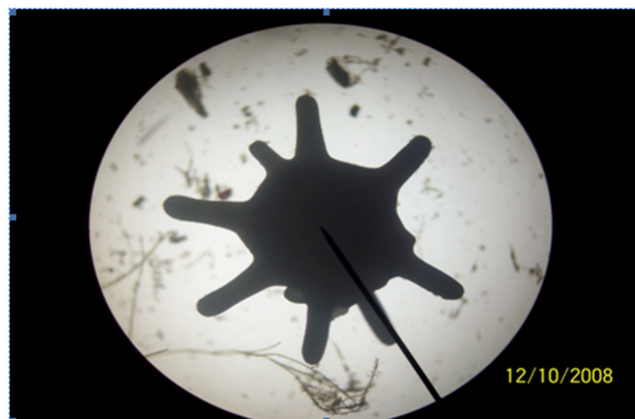


Figure 11 A foraminifera's specimen.



Figure 12 A shrimp post larvae specimen.

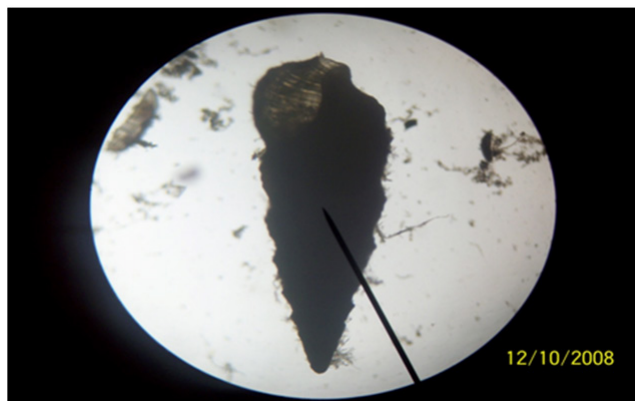


Figure 13 A Gastropods Specimen.

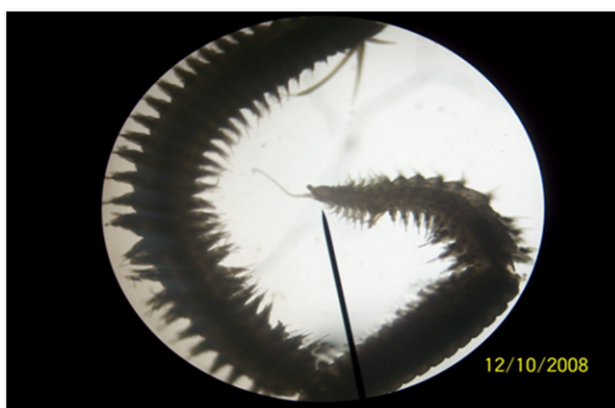


Figure 14 A Polychaetes specimen.

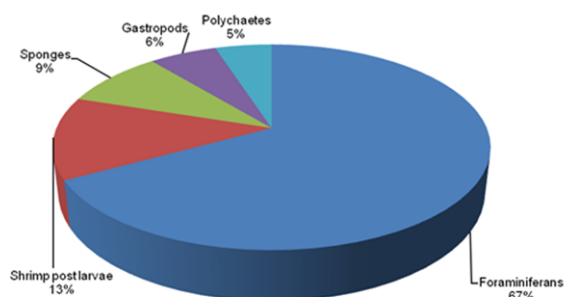


Figure 15 Relative abundance of phytal animal's infloating *Sargassum* spp in Lugait, Misamis Oriental.

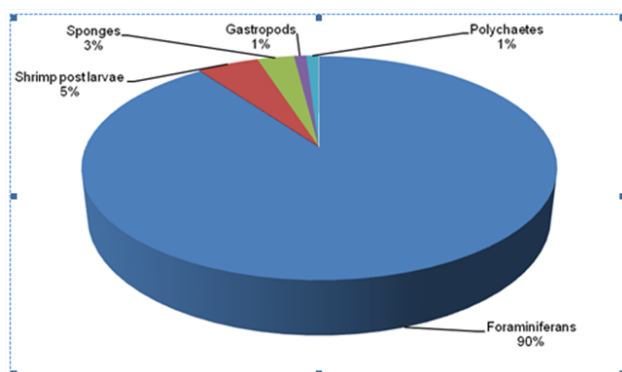


Figure 16 Relative abundance of phytal animals in floating *Sargassum* spp in Naawan, Misamis Oriental.

Relative Abundance of WW biomass of floating *Sargassum* spp in Lugait and Naawan, Misamis Oriental

The relative abundance of WW biomass of floating *Sargassum* spp showed that the first trap got the highest trapped biomass (82%) than second trap (18%) in Naawan. While in Lugait, the first trap (68%) obtained the highest value in comparison to the second trap (32%). However, the first trap in Lugait had lower WW biomass in comparison to the first trap in Naawan, and the second trap in Lugait had higher WW biomass in comparison to the second trap in Naawan (Figures 17 & 18). This indicates that there was slight difference of drifted *Sargassum* spp in the two stations regardless of the location and direction of the traps installed.

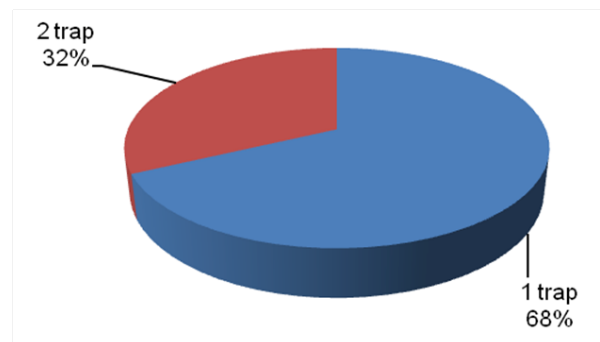


Figure 17 Relative abundance of the WW biomass in SI (Lugait, Misamis Oriental).

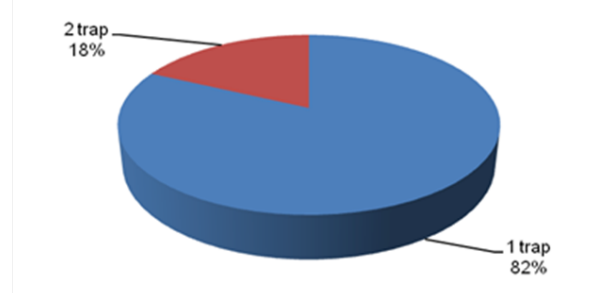


Figure 18 Relative abundance of the WW biomass in S2 (Naawan, Misamis Oriental).

Diversity Indices

Diversity indices showed that in Lugait, the index of dominance (C) was 0.4816, the Shannon-Weaver index of general diversity (H') was 0.4632 and the index of Evenness (e) was 0.6627. In Naawan, the index of dominance (C) was 0.8162, the Shannon-Weaver index of general diversity (H') was 0.1920 and index of evenness was 0.2747. These results indicate that diversity was high in Lugait with high evenness and low dominance. In Naawan there was dominance of one species so the diversity was lower in comparison to that of Lugait (Table 3). The index of similarity was 1 which could be attributed to the presence of similar species identified in both stations.

Bio-physico-chemical parameters

Results of the environmental parameters in Lugait and Naawan, showed that 29.60C reading of water temperature in Lugait was higher in comparison to Naawan which was 28.90C. Water salinity was 32 0/00 for Naawan which was higher than that of Lugait which was 29 0/00. The Lugait estuary was located in the western portion of the study site while the Naawan estuary was located in eastern portion of the study site. Every time fresh water flowed in the open water, this was carried by the current which moved relatively to the east, and the Lugait study site was affected with this mixture of water than the study site in Naawan which was not affected by this water flow system. Thus, both stations had different water salinity. Water depths gathered were 1.2 m in Lugait and 1 m in Naawan (Table 4 & 5).

Table 4 Diversity of phytal animals collected from floating *Sargassum* thalli in Lugait and Naawan, Misamis Oriental

Station	C	H'	E
Lugait	0.4816	0.4632	0.6627
Naawan	0.8162	0.192	0.2747

Table 5 Physico-chemical parameters determined in Lugait and Naawan, Misamis Oriental

Station	Temperature (0C)	Salinity (0/00)	Depth (m)
Lugait	29.6	29	1.2
Naawan	28.9	32	1

Summary and conclusion

Biomass and phytal animals of floating *Sargassum* in Lugait (S1) and Naawan (S2) in the province of Misamis Oriental were studied simultaneously last August 14, 2008 with the use of traps to capture floating *Sargassum*. Glass slide, forceps and brushing technique were used to remove the attached organisms on the *Sargassum* spp thalli. Floating *Sargassum* collected in each trap was analyzed for WW and DW biomass.

There were 5 groups of phytal animals identified in the two stations, namely: Shrimp post larvae, sponges, foraminifera's, gastropods and polychaetes. The result showed that the population densities of foraminifera's were high in both areas. In Lugait, the shrimp post larvae, sponges, gastropods and polychaetes were high in population densities in comparison to Naawan. However, the foraminifera's in Lugait had lower population densities in comparison to Naawan. The index of dominance (C) was 0.4816, Shannon-Weaver index of general diversity (H') was 0.4632 and the index of evenness (e) was 0.6627 in Lugait. In Naawan, the index of general diversity (H') was 0.1920; index of dominance (C) was 0.8162, and the index of evenness was 0.2747. This result suggests that diversity was high in Lugait in comparison to Naawan. In Naawan, there was greater dominance of foraminifera's in comparison to Lugait, thus the low diversity in the area. The index of similarity of the phytal animals in both stations was 1 which indicated that both S1 and S2 had high similarity in species composition.

The foraminifera's were the most abundant in both areas. Shrimp post larvae 13%, sponges 9%, gastropods 6% and polychaetes 5% were of high percentages in Lugait in comparison to Naawan which had relative abundance values of 5% for shrimp post larvae, 3% for sponges, 1% for gastropods and 1% for polychaetes. However, foraminifera's with 67% in Lugait was lower in relative abundance in comparison to that of Naawan which was 90%.

The WW biomass of floating *Sargassum* spp. showed that, in Naawan, the first trap had 82% which was higher in comparison to the second trap with 18% only. In Lugait, the first trap got 68% which was also a higher value of collected biomass in comparison to that of the second trap which had only 32%. Environmental parameters gathered showed 29.6°C for water temperature, 29 ‰ for water salinity and 1.2 m for water depth in Lugait. In Naawan, 28.9°C was the water temperature, 32 ‰ was the salinity and 1 m was the water depth.

Implication and recommendation

- The floating *Sargassum* spp is considered to be home of some diverse marine phytal animals. These organisms contribute to the linkage of food chain and direct receiver of organic matter produced by this floating *Sargassum* spp.
- The biomass of floating *Sargassum* spp in WW and DW had indicated the relatively more chances of the biota will live and survive within their thalli no matter where they are drifted.
- Proper management on floating *Sargassum* spp is recommended including the awareness on the ways and means to protect,

conserve, development and sustainability. These aspects should be included in the community based-coastal resource management.

Acknowledgments

None.

Conflicts of interest

None.

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