Abundance and diversity of molluscs associated with *Caulerpa* (Chlorophyta) beds of Solong-on, Siquijor Island, Philippines

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Abstract. Molluscs are one of the dominant taxa inhabiting *Caulerpa* communities, serving as an important link to the food web. These organisms utilize *Caulerpa* communities as their feeding ground, shelter, breeding habitat and serve as their protection from predators. This paper surveyed the abundance and diversity of molluscs found in the *Caulerpa* beds of Solong-on embayment in northwestern Siquijor Island, central Philippines for four consecutive months (October 2017 to January 2018). Sampling methods used included 0.28 m^2 ring quadrats (N = 10 per transect) deployed in three transects. A total of 32 species of molluscs (26 species of gastropods, 6 species of bivalves) was recorded in this study. Among the sampling months, the highest number of species was recorded in January with 28 species, followed by December with 25 recorded species and lowest recorded number of species was obtained in October with only 20 species. Shannon-Wiener diversity index (H') values ranged from 2.135 to 2.688. Among sampling months, December has the highest obtained H' value (2.688) while the lowest H' (2.135) was recorded in November. The obtained H' values in this study indicate high diversity of molluscs in Solong-on Bay, Tambisan, Siquijor. Among these species, *Mitrella rorida* (687.7 individuals m^{-2}), *Eurytrochus affinis* (448.5 individuals m^{-2}) and *Cerithium punctatum* (272.46 individuals m^{-2}) were the most abundant gastropods while *Mactra violacea* (264.83 individuals m^{-2}) was the most abundant bivalve. However, *Strigatella retusa, Terebralia sulcata, Vexillum rugosum, Epitonium scalare, Cyclostremiscus beauii* and *Trivirostra oryza* were the least abundant species having 3.57 individuals m^{-2} and 12.5 individuals m^{-2}, respectively.

Key Words: *Caulerpa*, communities, bivalves, gastropoda, shells.

Introduction. *Caulerpa* species belong to Class Ulvophyceae, Order Bryopsidales, Family Caulerpaceae (Lee 2008; De Gaillande et al 2017). In some regions, *Caulerpa* is highly invasive which alters the biotic composition of the invaded area (Baig 2014; Vázquez-Luis et al 2012a, b). However, the extensive algal mats of *Caulerpa* provide habitat structures supporting diverse assemblage of marine organisms (Superales & Zafaralla 2008; Wersal & Madsen 2012). Although *Caulerpa* species produce secondary compounds, different marine species have developed various strategies to cope up with the defense mechanism of the algae (Gibson 2007; Steneck et al 2017). Molluscs, amphipods, echinoderms, and some herbivorous fishes are still abundant in algal communities which they utilize as their feeding ground, habitat, and protection from predators (Gab-Alla 2007; Davidson et al 2015).

A number of studies have focused on the invasiveness of some *Caulerpa* species and the potential effects of habitat alteration in invaded regions (Tippets 2000; Vázquez-Luis et al 2009; Baleta & Nalleb 2016), and the effects of the secondary metabolites produced by *Caulerpa* (Doty & Aguilar-Santos 1970; Lemme et al 1996; Ganteaume et al 1998; Mozzachiodi et al 2001; Gianguzza et al 2002; Gollan & Wright 2006; Box et al 2010a, b; Terlizzi et al 2011; De Gaillande et al 2017). These studies indicated that *Caulerpa* species greatly affect the community structure, interaction between organisms, and decline in the abundance and diversity of the associated fauna. Great eradications of

Caulerpa species have been done in various regions invaded by *Caulerpa* especially in California (Williams & Schroeder 2004).

Molluscs are among the dominant taxa inhabiting *Caulerpa* communities (Antit et al 2013). They utilize *Caulerpa* as their feeding grounds (Davidson et al 2015), shelter, breeding habitat (Bogut et al 2007) and refuge from predators (Bates 2009). They prove immensely beneficial to humans in terms of economic benefits (Sharma et al 2016). Ecologically, molluscs serve as an important link to the food web (Ruitton et al 2006; Gibson 2007; Vázquez-Luis et al 2010; Pati et al 2014; Zaabar et al 2015). Grazing gastropods can control epiphytic and macroalgal bloom while some bivalves consume and filter sediments, thereby recycling nutrients and help purify silted marine waters (Picardal & Dolorosa 2014). Other species are known as good water quality indicators (Ruitton et al 2006; Vázquez-Luis et al 2010; Libres 2015).

The abundance and diversity of molluscs are influenced by both biotic (Fenwick 1976; Souza et al 2008) and abiotic factors (Garg et al 2009; Jackson 2010; Wersal & Madsen 2012). These factors may include water temperature (Souza et al 2008), salinity (Murray et al 2017), wave exposure (Higgins 2010) and dissolved oxygen (Kuk-Dzul & Diaz-Castaneda 2016). Macroinvertebrates associated with *Caulerpa* are well documented worldwide (Ruitton et al 2006; Gab-Alla 2007; Gibson 2007; Tippets 2000; Vázquez-Luis et al 2009; Baleta & Nalleb 2016).

It can be re-called that in Siquijor Island, there are about seven species of *Caulerpa* (Alcala et al 1972; Meñez & Calumpong 1982), of which fisherfolk communities in Solong-on harvest mainly *C. racemosa* and *C. lentillifera* for household and municipal markets (Wagey & Bucol 2014). The shallow water of Solong-on Bay has been supplying fresh *Caulerpa* (locally known as *lato*) to the Dumaguete Market since the 1980s (Calumpong 1984; Wagey & Bucol 2014, 2016). In addition, *Caulerpa*'s associated molluscs are mostly collected for human consumption and some are sold not only in the island but also in Negros (Wagey et al 2017).

This study was conducted to determine the abundance and diversity of molluscs associated with *Caulerpa* communities in Solong-on Bay, Tambisan, Siquijor, Philippines with the following specific objectives: to identify the molluscs associated with *Caulerpa* communities; to quantify the molluscs associated with *Caulerpa* communities in Solong-on Bay; to measure certain environmental parameters (e.g., temperature, salinity, pH and type of substrate) in Solong-on Bay; and to determine the influence of environmental factors to the abundance and diversity of molluscs associated with the *Caulerpa* communities in Solong-on Bay using multivariate canonical correspondence analysis (CCA).

Material and Method

Description of the study sites. The study was carried out in the intertidal area of Solong-on Bay (9°13'00″N, 123°27'30″E), Tambisan, Siquijor, Siquijor Island (Figures 1 and 2). The overall shallow marine ecosystem in the area comprise coral reef, seagrass beds, and *Caulerpa* (lato) communities. The intertidal to subtidal is adjacent to mangrove communities and composed of sandy to muddy substrate, dominated by the green alga *Caulerpa* spp. with seagrass, *Enhalus acoroides*. The main livelihood includes fishing and harvesting edible sea molluscs and *Caulerpa* locally sold either locally or to other neighboring islands such as in Dumaguete City, Negros Oriental.

Sampling design. The collection of data was done from October 2017 to January 2018. Sampling was conducted once a month, during daytime. Systematic sampling design (Figure 3) was used in this study since the substrate is more or less homogenous and there was no zonation observed. Three replicate transects measuring 100 m long were established perpendicular to the shore, with 100 m from each other. An iron ring quadrat (following Alcala et al 1972) with attached fine-mesh net having an area of 0.28 m^2 (0.60 m in diameter) was laid along the transect line with 10-m interval from each other.

Figure 1. Map showing the location of the study site. Map of the Philippines (upper left). Map of Siquijor (lower left). Map of Tambisan, Siquijor, Siquijor (right). Location of transects shown in red rectangle (Sources: Google Earth, Google Map).

Figure 2. Location of the sampling site showing the intertidal area in Solong-on Bay, Tambisan, Siquijor municipality, Siquijor province.

Sampling procedure for abundance and diversity. Samples were obtained by scraping off the algal cover inside the iron ring (approximately 2 inches below) and emptied to the fine-meshed net attached to the iron ring. From the iron ring, samples were transferred into the labeled net bags. Labels of each net bag correspond to the iron ring quadrat number and transect. After which, all the samples were brought to Negros Oriental State University Main Campus I, Dumaguete City Biology Laboratory for sorting of associated molluscs and further taxonomic identification.

In the laboratory, *Caulerpa* samples were placed in a basin and washed with tap water. After other particles (e.g. seagrass, *Enteromorpha* sp., sand, and rocks) were removed, the associated molluscs were then sorted and placed in a labelled zip lock with 10% diluted formalin as preservative.

The sampled molluscs were measured using a Vernier caliper. Samples measuring < 0.5 cm were excluded and not counted due to difficulty in identification. Molluscs exceeding from 0.5 cm were viewed under a dissecting microscope (BioLab microscope). Samples were photographed using digital camera (Sony Cybershot) for proper documentation and for further verification.

Taxonomic identification of the mollusks. The collected molluscs were identified up to the highest possible level (genus and species). Identification of samples was based on morphological characteristics described by taxonomic reference (Abbott & Dance 2000).

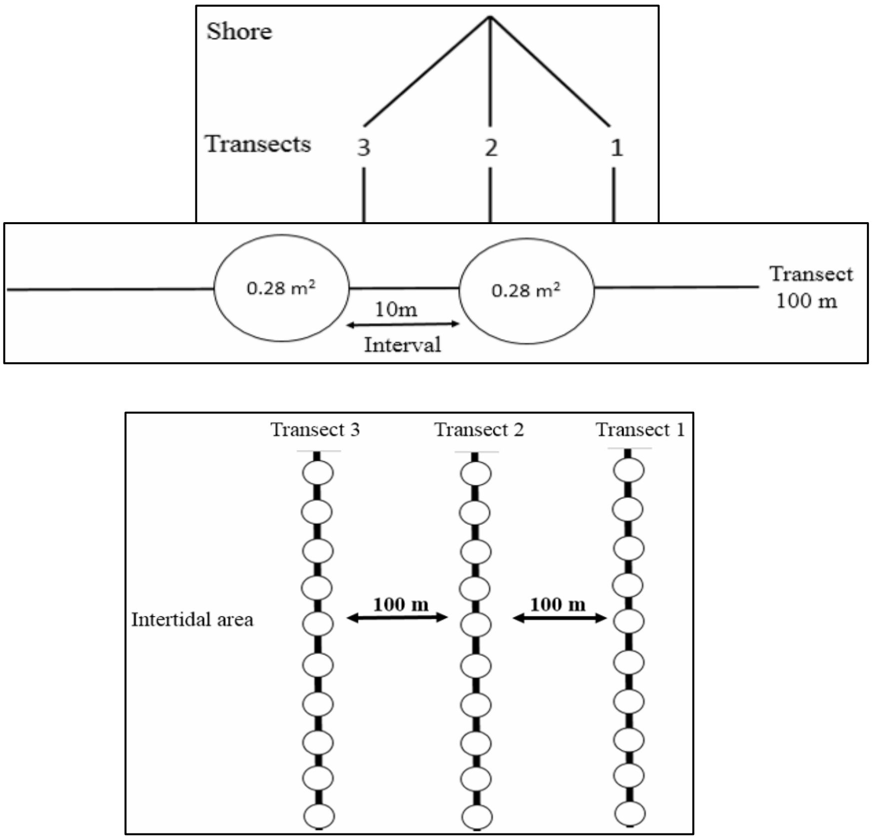

Figure 3. Systematic sampling design showing the iron-ring transect method.

Sampling procedure for environmental parameters. During each sampling, the following environmental parameters were measured: sub-surface water temperature using a field mercury thermometer, salinity using a hand-held refractometer, pH using a portable pH meter. Temperature, salinity, and pH, were measured thrice at 10:00 AM, 1:00 PM, and 4:00 PM. The average of each environmental parameter was calculated and recorded.

Water temperature. Water temperature was measured using a thermometer. The tip of the thermometer was immersed into the water for at least 3 minutes before reading the temperature. Obtained reading was recorded in degree Celsius. Three readings were made in the morning and afternoon.

Salinity. Salinity was measured using a hand-held refractometer. One drop of water sample (approximately 1 mL) was placed on the daylight plate. Readings were recorded in terms of ppt (parts per thousand).

pH. Water pH was measured using purchased Verigrow LCD Digital pH Water Meter Tester Pen Type. A water sample (500 mL) was collected and placed in a container. The sensor tip of the pH meter was immersed until it reached the maximum level. It was gently stirred until the display stabilizes and readings were recorded.

Type of substrate. Collection of substrate samples was adopted from the methods of Taft & Jones (2001). About 150 grams of sample was collected within the iron-ring and emptied into a plastic bag. Prior to sieving, samples were air dried for almost a month until completely dried. Sieving of samples was done using different mesh sieve size (i.e. 2.35 mm, 500 µm, 355 µm, 150 µm, and 106 µm). The collected sieved samples were identified based on its particle size using the Wenthworth Grade Scale (Table 1) as described by English et al (1997).

Air dried sample of 100 g was weighed in an analytical balance. The sample was placed at the top of stacked mesh sieve. Mesh sieves were arranged according to their size in an ascending order. The mesh sieves were shaken for 10-15 minutes. When sieving was completed, the contents of each mesh sieve were emptied into a paper container and weighed in an analytical balance. The percentage composition for each type of substrate was computed.

Table 1

Wenthworth Grade Scale (adopted from English et al 1997)

Description		Grade limits	
		mm	*µm*
Gravel	Boulder, cobble, pebble, granule	> 256 - 2	
Sand	Very coarse sand	2 - 1	2000 - 1000
	Coarse sand	1 - 0.5	1000 - 500
	Medium sand	0.5 - .25	500 - 250
	Fine sand	0.25 - 0.125	250 - 125
	Very fine sand	0.125 - 0.062	125 - 62
Mud	Silt, clay	0.062 - < 0.0039	62 - < 3.9

Data analysis. Abundance was expressed as density (number of individuals divided by 0.28 m^2). Two-way analysis of variance with repeated measure (ANOVA) was used to evaluate significant differences in abundance of molluscs between sampling months. The analysis was used because this study surveyed permanent transects throughout the sampling period from October 2017 to January 2018. The analyses were carried out after verifying normality (Anderson-Darling normality test) assumptions. Data were log-transformed to conform parametric assumptions.

The diversity of molluscs was determined using Shannon-Wiener diversity index (H'), utilizing the formula below:

$$H' = -\sum_{i=1}^{s} pi \ln pi$$

where, **p** is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), **ln** is the natural log, **Σ** is the sum of the calculations, **s** is the number of species. H' < 1.0 indicates low diversity while H' > 2.0 indicates high diversity.

Species richness was determined by counting the number of species present in each month. Data was tested using Kruskal-Wallis test to determine the difference in species richness between the sampling months.

To determine influence of environmental parameters on the abundance of molluscs, multivariate Canonical Correspondence Analysis (CCA) was performed using community analyses package *vegan* in R (R Core Development 2013). Generalized linear model was used to relate the influence of environmental variables to the diversity of molluscs.

Results

Abundance. Table 2 shows the total number of individuals collected during the months of October to January. A total of 32 species were collected throughout the sampling. Of these, 26 species were gastropods belonging to 20 families and six species were bivalves belonging to six families.

The abundance was expressed as mean density (number of individuals m^{-2}). The maximum density of molluscs in the study area ranged from 3.57 to 687.70 individuals m^{-2} as shown in Table 2. The most abundant species was *Mitrella rorida* with 687.70 individuals m^{-2}, followed by *Eurytrochus affinis* with 448.50 individuals m^{-2}, *Cerithium citrinum* with 272.46 individuals m^{-2} and *Cerithium punctatum* with 241.90 individuals m^{-2}. However, some species were seldom found like *Terebralia sulcata, Trivirostra oryza, Cyclostremiscus beauii, Epitonium scalare, Trochus* sp. and *Strigatella retusa* with values ranging from 3.57 to 12.5 individuals m^{-2}, respectively.

Table 2

Mean density (number of individuals m^{-2}) and total number of molluscs collected from the study area during the sampling period

Molluscs	*Family*	*Species*	*No. of individuals*	*Density*
Bivalves	Arcidae	*Anadara scapha*	4	12.5
	Mactridae	*Mactra violacea*	222	264.83
	Placunidae	*Placuna sella*	9	21.42
	Pinnidae	*Pinna* sp.	18	36.3
	Carditidae	*Cardita crassicosta*	7	13.09
	Cardiidae	*Fragum unedo*	4	12.5
Gastropods	Neritidae	*Nerita polita*	331	172.58
	Strombidae	*Canarium mutabile*	8	28.57
		Canarium urceus	6	10.71
	Columbellidae	*Mitrella rorida*	1085	687.7
		Mitrella sp.	34	15.22
	Potamididae	*Terebralia sulcata*	2	7.14
	Cypraeidae	*Eclogavena dayritiana*	5	8.92
		Monetaria annulus	21	12.75
	Trochidae	*Eurytrochus affinis*	623	448.5
		Trochus sp.	2	7.14
	Triviidae	*Trivirostra oryza*	1	3.57
	Conidae	*Conus sulcatus*	40	52.33
	Epitoniidae	*Epitonium scalare*	2	7.14
	Nassariidae	*Nassarius livescens*	231	142.27
	Marginellidae	*Volvarina philippinarum*	114	43.28
	Naticidae	*Notocochlis gualtieriana*	50	32.58
		Mammilla sebae	2	7.14
	Ranellidae	*Monoplex pilearis*	52	57.96
	Cerithiidae	*Cerithium citrinum*	361	272.46
		Cerithium punctatum	412	241.9
	Eulimidae	*Niso marmorata*	3	10.71
	Phasianellidae	*Phasianella solida*	9	17.26
	Haminoeidae	*Aliculastrum cylindricus*	15	25.44
	Costellariidae	*Vexillum rugosum*	6	7.14
	Tornidae	*Cyclostremiscus beauii*	1	3.57
	Mitridae	*Strigatella retusa*	4	12.5
Total			3684	2697.12

Figure 4 shows the abundance of bivalves across the sampling months. Among bivalves, *Mactra violacea* had the highest number of individuals with 31.69 individuals m^{-2} in January. It was followed by *Placuna sella*, which had the highest recorded number in December. However *Anadara scapha* and *Fragum unedo* were rarely found, which was only present in December and January. *Cardita crassicosta* was present only in months of October and December.

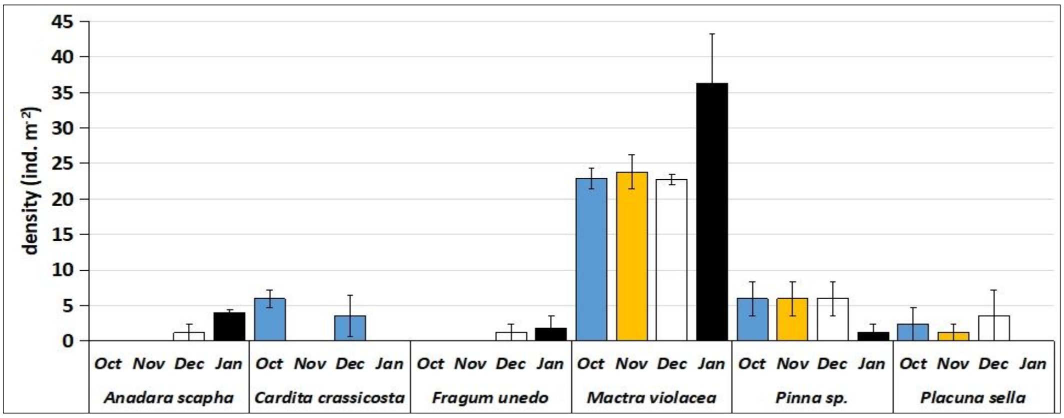

Figure 4. Density (mean individuals m^{-2}) of bivalves across sampling months. Error bar = standard error (SE) of the means.

Figure 5 shows the abundance of gastropods across the sampling months. Generally, *Mitrella rorida* had the highest density recorded in the month of January with 24.53 to 55.47 individuals m^{-2}. It was followed by *Eurytrochus affinis* with 8.67 to 51.84 individuals m^{-2} in January 2018, followed by *Cerithium punctatum* with the highest number of individuals in January 2018.

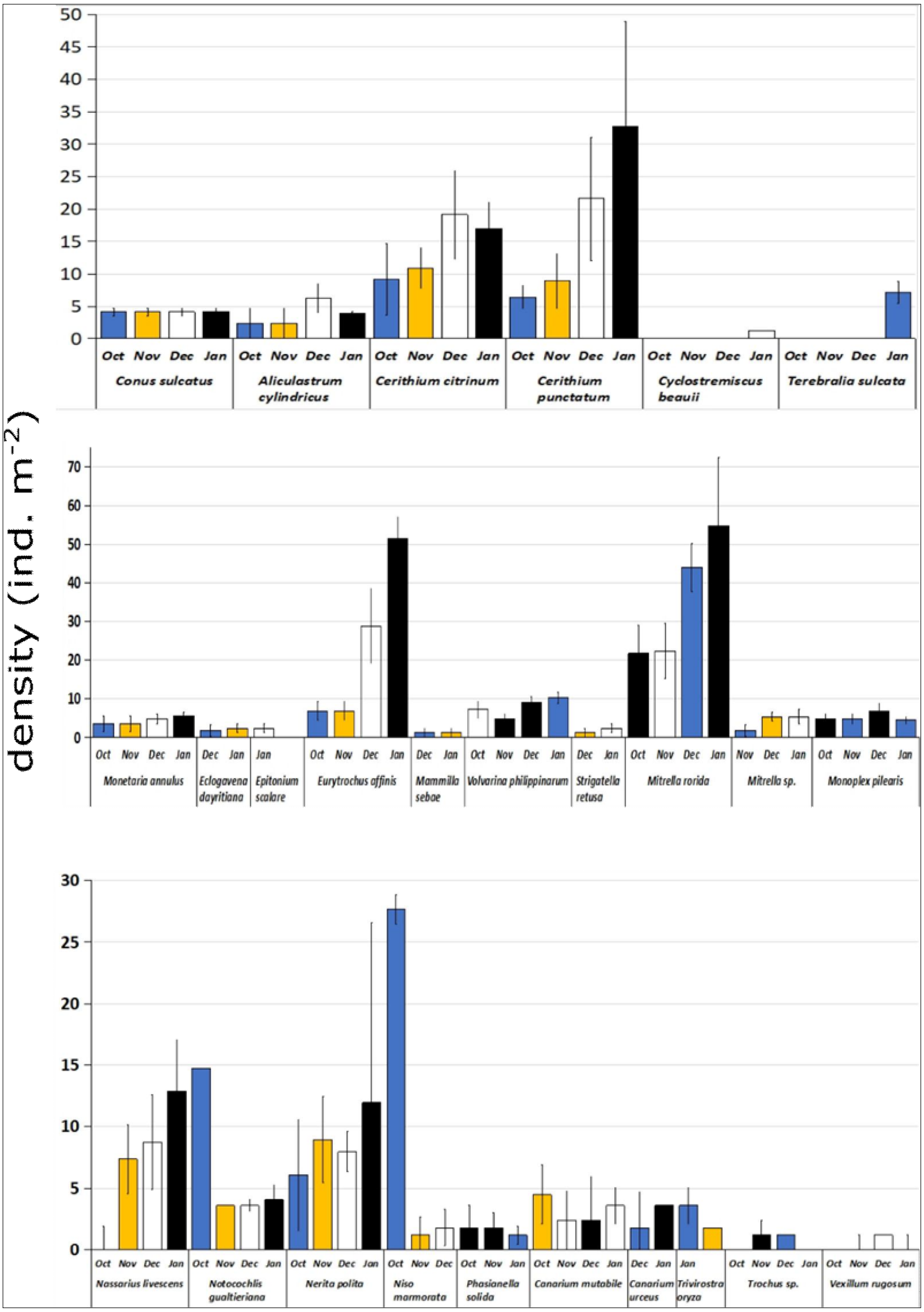

Figure 5. Density (mean individuals m^{-2}) of gastropods in Solong-on Bay across sampling months. Error bar = standard error (SE) of the means.

Seriation plot (Figure 6) shows the occurrence of molluscs species (abbreviated) across sampling months. Black squares indicate the presence of an individual while white squares indicate the absence of an individual in a month. As shown in the figure, *Mitrella rorida, Eurytrochus affinis, Conus sulcatus, Aliculastrum cylindricum, Mactra violacea, Volvarina philippinarum*, *Nassarius livescens, Notocochlis gualtieriana, Nerita polita, Pinna* sp. and *Cerithium* species were always present throughout the sampling period. However, some species were rarely seen such as *Epitonium scalare, Trivirostra oryza, Terebralia sulcata, Trochus* sp. which were present only in January, *Anadara scapha*, which was present in January and December, *Vexillum rugosum* which was present in November and January and *Canarium urceus* which was present in December 2017 and January 2018.

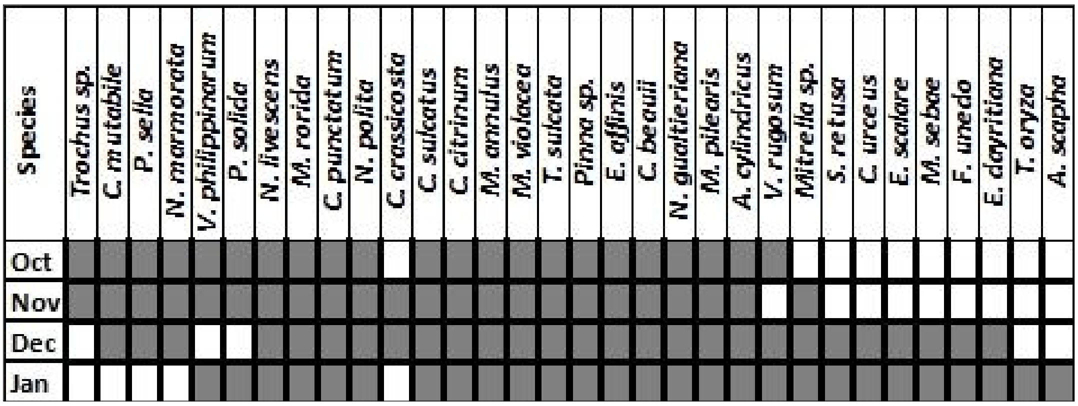

Figure 6. Multivariate seriation plot of molluscs in Solong-on between sampling months.

Diversity. Figure 7 shows the number of species occurring within the study site (species richness) between sampling months. A total of 32 species of molluscs were recorded in the study. There were 26 species of gastropods while there were 6 species of bivalves. Between sampling months, molluscs' richness varied from 20 to 28 species. The highest number of species was recorded in January with 28 species, followed by December with 25 recorded species. However, lowest recorded number of species was obtained in October having 20 species.

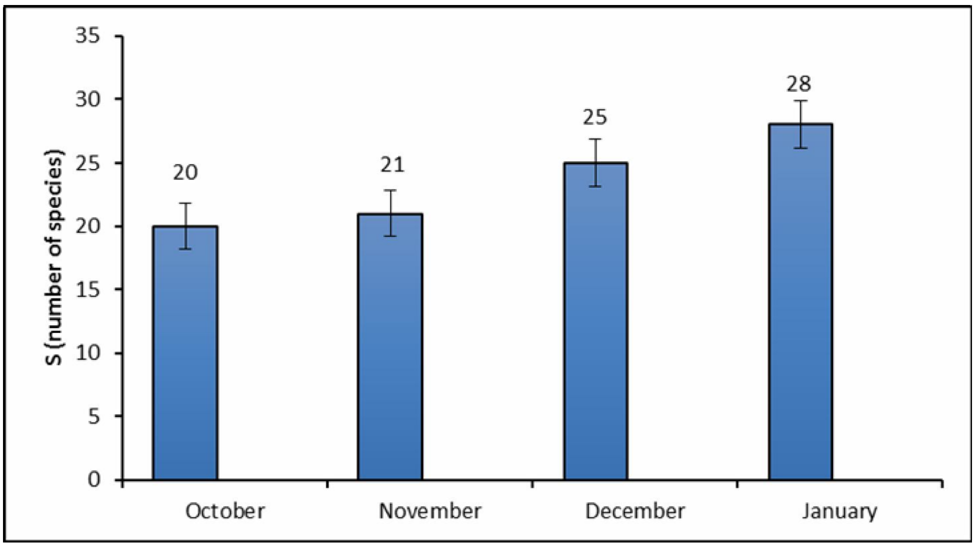

Figure 7. Species richness between sampling months.

To determine whether or not there was significant difference between gastropod richness across sampling months, Kruskal-Wallis test was performed. The non-parametric analysis demonstrated that there is no significant difference between sample medians to sampling months ($p = 0.07047$). The overall bivalve richness (Figure 8) in the study ranged from two to four species. December has the highest richness which varied from 2 to 5 species. Among the rest, October has the least recorded species with 3-4 species.

Figure 9 shows gastropod richness during the study. Kruskal-Wallis test showed no significant difference between sample medians to sampling months ($p = 0.4596$). The overall gastropod richness between sampling months ranged from 10 to 20 species. As shown in the Figure 9, January has the highest recorded gastropod species ranging from 17 to 20 species. It was followed by December, ranging from 14 to 16 species.

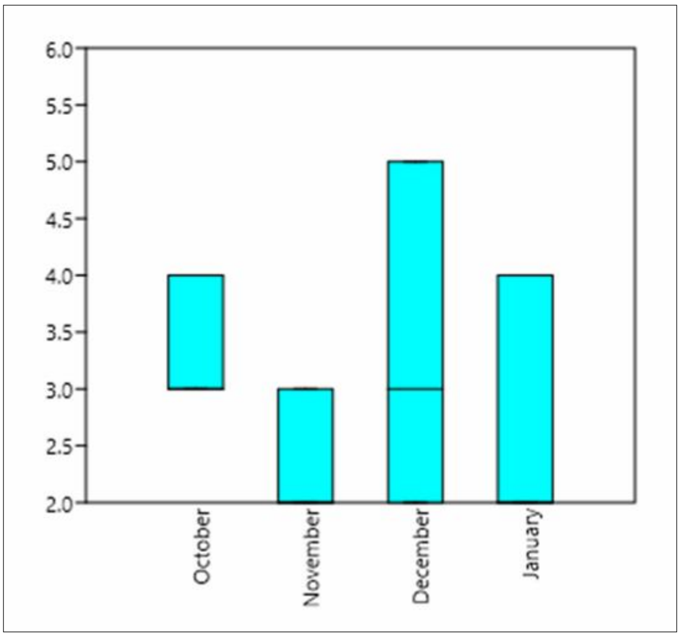

Figure 8. Box-plot diagram of bivalve richness between sampling months.

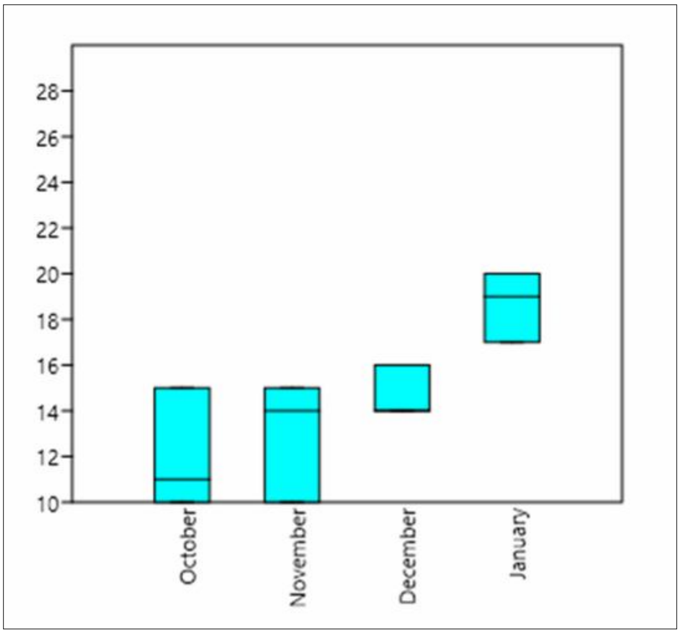

Figure 9. Box-plot diagram of gastropod richness between sampling months.

Diversity indices calculated using the Shannon-Wiener formula (H') are summarized in Figure 10. The H' value in this study ranged from 2.135 to 2.688. Among sampling months, December has the highest obtained H' value (2.688) while the lowest H' (2.135) was recorded in November. The obtained H' values in this study indicate high diversity of molluscs in Solong-on Bay, Tambisan, Siquijor.

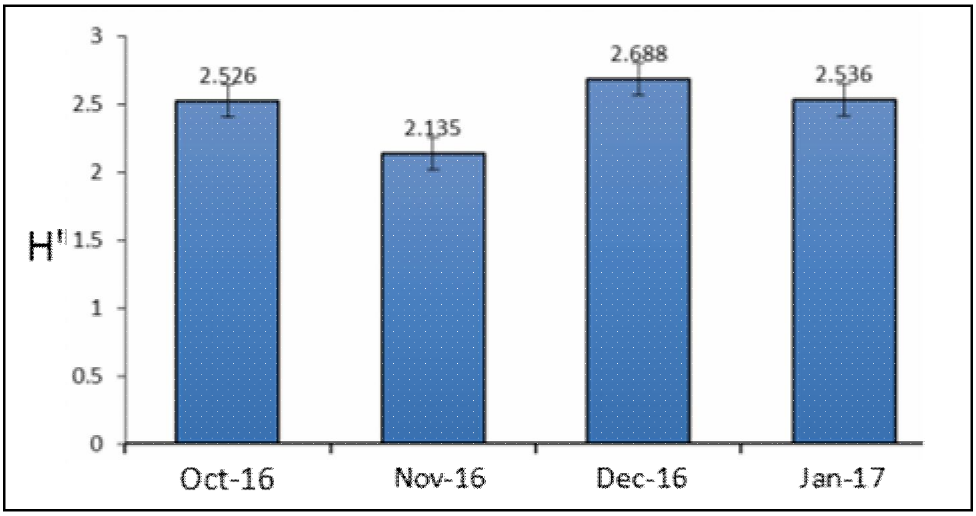

Figure 10. H' values of molluscs between sampling months.

Environmental parameters and substrate composition. Detailed data on the environmental parameters in each sampling month were summarized in Table 3. The recorded data for sub-surface temperature (^oC) ranged from 29±0.57 (SE) to 35.53±0.57^{o}C. The warmest was recorded in January (35.53±0.57) while lowest value was recorded in November (29±0.57). Salinity ranged from 35±0.57 to 35.66±0.33 ppt. The highest mean values were recorded in the months of December and January (35.66±0.33). For the pH, minimal variation was observed between the sampling months. The average pH recorded in the area ranged from 8.06±0.06 to 8.1±0.03. The highest average pH was observed in the month of November (8.1±0.05) while the lowest data occurred at the months of October, December and January.

In this study, coarse sand obtained the highest mean percentage composition for transect 1 (T1), transect 2 (T2) and transect 3 (T3) with values ranging from 26.16 to 28.87, respectively throughout the sampling period. However, gravel obtained the least mean percentage composition for T1, T2 and T3 with values 14.415, 14.66 and 16.06, respectively (Figure 11).

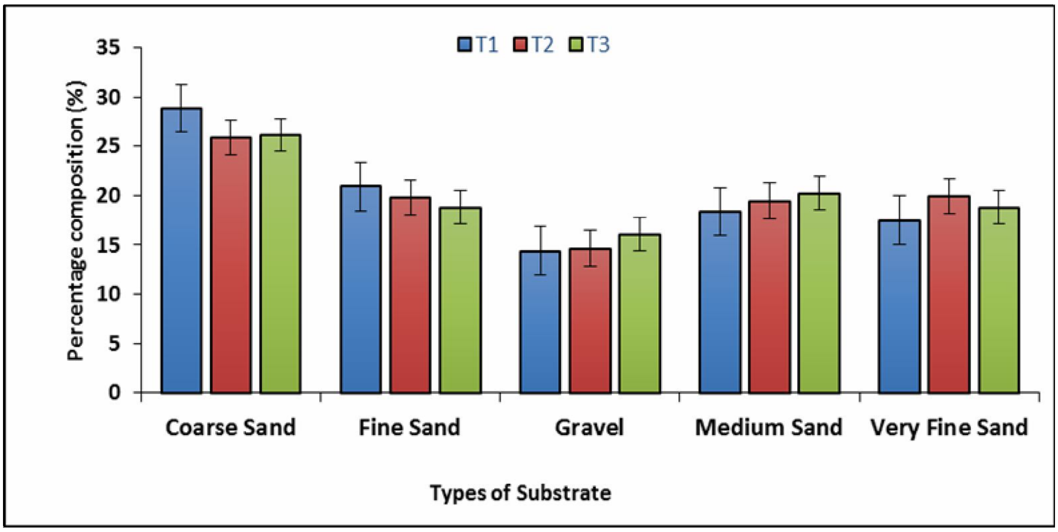

Figure 11. Percentage composition of type of substrate in each transect.

Table 3

Mean±SE of the physico-chemical parameters recorded during the months of October 2017 to January 2018 in Solong-on Bay, Tambisan, Siquijor municipality, Siquijor province

Environmental parameters	*October*	*November*	*December*	*January*
Subsurface temperature (^oC)	35.3±0.47	29±0.57	35±0.57	35.53±0.57
Salinity (ppt)	35±0.57	35.16±0.60	35.66±0.33	35.66±0.33
pH	8.06±0.06	8.1±0.05	8.06±0.03	8.06±0.03

Influence of environmental variables to abundance of molluscs*.* Canonical Correspondence Analysis (CCA) was used to assess the influence of environmental variables to the abundance of molluscs. In this study, there were only 8 environmental variables and 11 out of 32 species were included in the analysis since rare species were excluded. The Eigenvalue in axis 1 (0.2113) indicate a relatively low gradient while axis 2 (0.083) is much weaker. The first ordination axis explained 47.55% of the variation and second ordination axis explained 18.71 % of the variation. As shown in the Figure 12, salinity influence the abundance of molluscs (first axis) while pH and temperature are negatively correlated to the abundance of molluscs. Only few species in the first axis were influenced by salinity, coarse sand and fine.

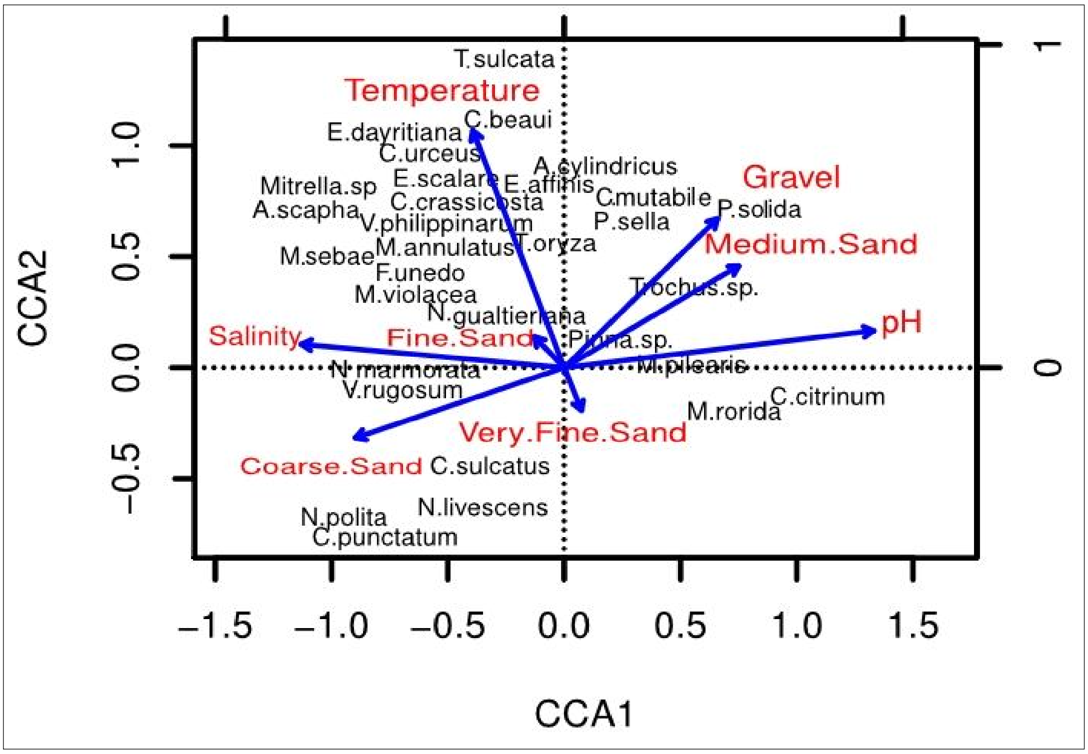

Figure 12. Canonical correspondence analysis (CCA) biplot showing the relationship of environmental variables on abundance of each species.

Discussion. The *Caulerpa* beds in Solong-on Bay, Tambisan, Siquijor host a diverse assemblage of molluscs, comparable to other studies. A study by Sanchez-Moyano et al (2001) and another by Baig (2014) indicated that macrofauna associated with the green alga *Caulerpa* were dominated by molluscs. Box et al (2007) tallied a total of 27 gastropods and 26 bivalve species inhabiting *Caulerpa* beds in Balearic Islands. In addition to this, a study by Kuk-Dzul & Diaz-Castaneda (2016) identified 27 genera of gastropods and 8 genera of bivalves. According to Superales & Zafaralla (2008), high diversity indicated that the niche space, habitat, food sources, less disturbance and tolerable environmental conditions are adequate for the survival of molluscs.

The associations of aquatic animals with *Caulerpa* communities in Solong-on Bay, Tambisan, Siquijor was first studied by Alcala et al (1972). Majority of the molluscan fauna observed were mostly opisthobranchs, with an average biomass of 1.0-13 g m^{-2}. In the present study, however, gastropods and bivalves were the most abundant.

Studies by Murty (1983), Gab-Alla (2007), and Antit et al (2013) indicated that gastropods are one of the most dominant group associated with *Caulerpa.* According to Sarma & Ganapati (1972), and Sarma (1974), seaweed communities provide an abundant supply of oxygen, microhabitats, and protection from biotic and abiotic factors. In parallel, these factors favor the growth and survival of associated inhabiting molluscs. Queiroz & Diaz (2014) also added that *Caulerpa* beds provide enough food resource for molluscs since it harbors different invertebrates such as sponges, tunicates, polychaetes and ophiuroids.

This study also found that abundance of molluscs significantly varied with sampling months. However, due to the limited duration of sampling (four months only), it is very early to assume seasonality in the variation observed. For example, in other studies done elsewhere (e.g. Sarma 1974), January to April was considered as the breeding season of some molluscs. Although it was found out by this study (see CCA biplot) that salinity may have influenced the abundance of molluscs, the researchers assert that there are certain caveats. In the present work, salinity ranged only from 35 to 35.66 ppt. Although salinity has been known to affect the survival rate of majority of molluscs, ranging from 5 to 35 ppt (Beasley et al 2005). Some molluscs are described as stenohaline which cannot cope up with large salinity fluctuations while others are euryhaline which can tolerate wide range of salinities (Kennedy 2017).

Although the present study indicated negative influence of temperature to the abundance and diversity of molluscs, other studies have indicated the effects of temperature to the growth and survival of molluscs. According to Jackson (2010), an increase in water temperature induces the metabolism of molluscs while decrease in water temperature slows its rate of metabolism. Among the molluscan group, bivalves are mostly influenced by fluctuations in temperature. In this study, the average water temperature ranged from 29 to 35.53^{o}C. According to Weber et al (2007), bivalves are subject to temperature stress, wherein some species can only tolerate from 16 to 27°C. Over this range, pumping rates, feeding rates, growth and other activities are at their maximum, thus affecting its survival. On the other hand, pH values were consistent at 8.0. Guerra-Garcia et al (2011) demonstrated the effects of pH in molluscs and obtained pH values ranging from 8 to 8.33. In relation to this, higher abundance of molluscs is associated with neutral pH. As mentioned in their study, abundance and diversity of molluscs are independent to the fluctuations of pH. This result was supported by Sharma et al (2016), which indicated the negative relationship between the fluctuations of pH in the abundance and diversity of molluscs.

Conclusion and recommendations. Solong-on Bay, Tambisan, Siquijor encompasses a rich and diverse assemblage of molluscs as indicated in the diversity index values of 2.13-2.68. There were 32 identified species recorded throughout the sampling period. Of these, 26 species were gastropods while 6 species were bivalves. *Mitrella rorida* (687.7 individuals m^{-2}), *Eurytrochus affinis* (448.5 individuals m^{-2}) and *Cerithium punctatum* (272.46 individuals m^{-2}) were the most abundant gastropods, while *Mactra violacea* (264.83 individuals m^{-2}) was the most abundant bivalve. However, *Strigatella retusa, Terebralia sulcata, Vexillum rugosum, Epitonium scalare, Cyclostremiscus beauii* and *Trivirostra oryza* were the least abundant species having 3.57 individuals m^{-2} to 12.5 individuals m^{-2}, respectively. This study found no significant difference in species richness between sampling months. Results in CCA found that salinity has an influence on the abundance of molluscs while results in generalized linear model revealed that no environmental variable affects the diversity of molluscs.

Since this study is limited only to four months, it would be desirable to conduct longer temporal scales to gather more information on the population ecology of these species. The influence of biotic factors to the abundance and diversity of molluscs associated with *Caulerpa* should be taken into account since it was not included in the present study. Moreover, nutrient analysis, dissolved oxygen and light intensity should be measured as part of the abiotic factors.

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