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Species composition and abundance of seashells in the intertidal zone of Tubalan cove, municipality of Malita, Davao occidental province, Philippines

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Abstract
The study determined the seashells' species composition, relative abundance, population density, species diversity, substrate types and the gleaners' socio economic-profiles in the intertidal zone of Brgy. Tubalan, Municipality of Malita, Davao Occidental Province, The Philippines.
Eight seashell species were identified in the study area namely: *Anodontia edentula, Anadara antiquata, Cerastoderma edule, Lutraria australis, Nerita undata, Paphia amabilis, Strombus urceus* and *Terebralia sulcata.* Among the stations, *Cerastoderma edule* had the highest number of relative abundance with 35.42 in Station 2, while the *Anodontia edentula* with 5.21 is exhibited lowest value (Station 1). For population density, the highest value was with *Cerastoderma edule* accounted 55 individuals/m^2, while the lowest is *Anodontia edentula* with 5 individuals' species/m^2. In terms of species diversity, Station 2 had the highest number with 3.737, and the lowest was in Station 1 with 2.376. The result on the substrate type characterization revealed that fine sand to medium sand substrates were observed in all stations.
Collected seashells by the local gleaners will usually sell it in their public market, others are in their neighbours. To most gleaners, gleaning activity is considered as their main source of income to sustain daily needs.
Statistically, the T-test results revealed no significant differences for abundance with the value 0.795 and for population density with the value of 0.379 among the two stations; this implies that tabulated value of 0.05 is lesser than the calculated value. For the number of species in relation to abundance with 0.03 and population density with 0.023, tabulated value of 0.05 was greater than the calculated value which implies that the null hypothesis on the number of species in terms of abundance and population density among two stations was rejected.
It is recommended to conduct further study in other barangays, highlighting the inclusion of physico-chemical parameters factors affecting species composition and abundance of seashells.

Keywords: Seashells, species composition, relative abundance, gleaners

Introduction
Seashells are soft-bodied organisms that live mostly in marine environments, other in freshwater environments and land (Edgar, 2005) [5]. Mollusks, a diverse community of marine animals that includes clams, mussels, and oysters, produce the majority of seashells as a protective outer covering. Shells are made mainly of calcium carbonate and excreted from the animal's outer skin, known as the mantle (Tucker and Dance, 1998) [17]. Seashells are also good indicators of localized conditions and are regularly used as bio-indicators of aquatic healthy (Aiken and Waddy, 1993) [1].
Seashells are also important ecosystem-constituents and frequently support valuable fisheries. In many near shore areas, human disturbance-including declining habitat and water quality - can affect the distribution and abundance of bivalve populations, and complicate ecosystem and fishery management assessments. In faunal bivalves, in particular, are frequently cryptic and difficult to detect; thus, assessing potential impacts on their populations requires suitable, scalable methods for estimating abundance and distribution (Mcdonald *et al.*, 2015) [7].
Moreover, the Philippine archipelago is very rich with sandy beaches, shallow waters, deep seas, coral reefs, rocks and boulders that harbour several thousand species of seashells (Anonuevo and Zaragosa, 1986) [2]. A conservative estimate of 5,000 species of mollusks are found in the Philippines, which probably represents the highest diversity of mollusk in any one country; and some 1,500 these species are involved in the shell trade.

(Springsteen and Leobrera, 1986) [16]. This remarkable diversity of mollusk could be largely due to the vast number and complexity of habitats available among 7,100 islands, which could lead to the isolation of organisms and subsequent speciation, as well as being located on the Indo-pacific, one of the world's most bio diverse ecosystems (Springsteen and Leobrera, 1986) [16].

Despite of their ecological and economical importance, there are few specific quantitative data on the diversity, density and biomass that suffering from the threat of extinction (Poutiers, 1998) [14]. The purpose of this study was to establish a baseline data on the species composition and abundance of seashells in the intertidal zone of Brgy. Tubalan, Malita, Davao Occidental, Philippines. Monitoring of this species is very essential for management and conservation of marine invertebrate populations. Thus, this study can be useful for decision making as well as future scientific studies.

The specific objectives of this study were as follows: (1) Determine the species composition and abundance of seashells; (2) Calculate the species density and diversity indices of seashells; (3) Characterize the substrate-types among sampling stations; and, (4) Determine the socio-economic profile of the gleaners in the study area.

Materials and Methods

The study was conducted in the intertidal zones of Brgy. Tubalan, Malita, Davao Occidental, Philippines, particularly in the Sitios of Lagaolawan and Agdao where different marine ecosystems are present. A transect line quadrat method was used in determining the species composition and abundance of seashells in the study area. The transect line was measured 50 meters and it was positioned parallel to the shoreline. There were 2 stations established in the study area, each station was laid with 3 transects and a 5 meters apart from each other. In each transect, a 5 quadrats were laid with a dimension of 1x1 meter and an interval of 10 meters from the other quadrats.

Sampling of different genus of seashells in each sampling site was conducted during daytime only at the lowest low tide. The time duration was 8:00am until 5:00pm to ensure visibility and manageability in sampling procedure. A One Shot Sampling was employed throughout the study period of the two sampling stations.

Fisherfolks (local settlers) performing gleaning activities were tapped to glean the study area. Gleaning for seashells was done using bolo and hand picking in every quadrat. Collected samples was placed in the different bag nets for sorting purposes and was brought to SPAMAST General Science Laboratory for further analysis especially on its species identification according to its nearest taxonomic information. Samples were determined up to genus level and a reference book (Philip's Guide to seashell of the world by Oliver, 2012) [9] was used as point of comparison with the collected samples.

The species abundance and population density of seashells were determined using the formula of Odum (1971) [8]. Species diversity of seashells in the study area was calculated using the formula of Shannon-Weiiner (1949) [15] as cited by English *et al*., 1994 [6]. Determination of substrate types were pattern in the protocols given by Whiting *et al.*, 2014 [19].

A Purposive Sampling Technique was employed during the conduct of interview among respondents. It was administered through personal interview and active gleaners were given priority.

Data Analysis

The data obtained from the study were analyzed using Mean, Percentage, and Paired t-test for unequal variance was used to determine the significant difference in species composition, abundance, density, diversity of seashells in every station using the formula (Daniel, 1995 as cited by Pacyao & Macadog, 2018) [12].

Results and Discussions

Species Composition

The results found out that there were 8 species of seashells found in the study area namely: *Anodontia edentula, Anadara antiquata, Cerastoderma edule, Lutraria australis, Nerita undata, Paphia amabilis, Strombus urceus* and *Terebralia sulcata*. Seashells are good indicators of localized conditions such as gastropods and bivalves that are generally benthic organism, and are regularly used as bio-indicators of aquatic healthy ecosystem (Aiken and Waddy, 1993) [1].

Abundance of Seashells

The results for relative abundance of seashells revealed that *Cerastoderma edule* exhibited highest number of relative abundance with 35.42 % while the *Anodontia edentula* is the lowest with 5.21 % (Table 1). In-faunal bivalves are frequently cryptic and difficult to detect, thus, assessing potential impacts on their populations requires suitable, scalable methods for estimating abundance and distribution. However, occurring in mangrove forest, river bed, and intertidal flats thereby considered as a potential biological indicator for climate change adaptation and mitigation studies (Dolorosa, 2014) [4]. Therefore, the abundance of seashells such as *Cerastoderma edule* is very evident due to the presence of a fine sandy substrates type, and thus, a no significant difference (0.795) at 0.05 significant level among stations in terms of relative abundance was observed, and is comparable with each other.

Table 1: Abundance of Seashells in the study sites

Species	Station 1 (No of individuals)	Relative Abundance (%)	Station 2 (No of individuals)	Relative Abundance (%)
Anodontia edentula	-	-	5	5.21
Anadara antiquate	10	15.38	6	6.25
Cerastoderma edule	21	32.31	34	35.42
Lutraria australis	3	4.62	7	7.29
Nerita undata	15	23.08	8	8.33
Paphia amabilis	-	-	12	12.50
Strombus urceus	9	13.85	12	12.50
Terebrali asulcata	7	10.77	12	12.50
Total		100		100

Population Density of Seashells

The species of *Cerastoderma edule* has the highest value of 55 individual species/m^2, while the lowest value is *Anodontia edentula* with 5 individual species/m^2 (Table 2). The two species (*Cerastoderma edule* and *Nerita undata*) has been observed to have a highest population density in mangrove area because they have higher adaptation ability in changing environmental factors such as drought due to low tide and salinity. But most bivalves are obviously unable to tolerate for longer periods of exposure to air and fluctuating physico-chemical parameters such as salinities (Poutiers, 1998) [14]. Further, the study is located in Brgy. Tubalan, Malita, Davao Occidental where the mangrove forest is adjacent to the coastal water wherein most of seashells preferred mangrove ecosystem as host for their survival, thus, the presence of the species mentioned are very evident (Pacyao and Barail, 2020) [10]. Hence, a no significant difference was observed among sampling stations.

Table 2: Population Density of the Seashells.

Species	Station 1 (No. of individuals per species/m^2)	Station 2 (No. of individuals per species/m^2)	Total
Anodontia edentula	-	5	5
Anadara antiquate	10	6	16
Cerastoderma edule	21	34	55
Lutraria australis	3	7	10
Nerita undata	15	8	23
Paphia amabilis	-	12	12
Strombus urceus	9	12	21
Terebralia sulcata	7	5	12

Plate 1: The *Cerastoderma edule* commonly-found in Brgy. Tubalan, Malita, Davao Occidental, Philippines

Plate 2: The *Anodontia edentula* found in Brgy. Tubalan, Malita, Davao Occidental, Philippines

Species Diversity Indices

In terms of species diversity, the result revealed that the highest number was observed in Station 2 with a value of 3.737, while the lowest number was in Station 1 (2.376). Species diversity is the number of species in a particular area of a measure derived from combining the number of species with their relative abundance in an area. The abundance of seashells was mostly distributed among marine and freshwater environment particularly in the marine intertidal zone (Poutiers, 1998) [14]. Thus, *Cerastoderma edule* in this study, exhibited highest number of distribution and abundance in the study area.

Table 3: Species diversity of the seashells

Station	Diversity
1	2.376
2	3.737

Determination of the Substrate Types

The Station 2 revealed that fine sand was the highest per cent retained value of 76.269, while medium sand for Station 1 with 41.973 (Table 4). Seashells are occurring in different habitats such as mangroves, coral reefs, rocky coast, sandy beaches, and sea grass beds and also at great depth in the sea. The large riverine inputs to the area, together with the mangrove-derived organic matter, periodically suspended by the tidal fluctuations, are seen as responsible for increasing organic matter content of the substrates and abundance of the species (Campos *et al.*, 2006; Pacyao and Macadog, 2018) [3, 12].

Table 4: The substrate types of the study area

Station	Highest (%) Retained	Substrates Type
1	41.973	Medium sand
2	76.269	Fine sand

Socio-economic Profile of the gleaners

A total of 23 respondents were interviewed among stations. According to the respondents, gleaning activity was performed in a group (comprising the age of 24 to 65 years old) with 60.87 %, although others preferred solo. The cost of collected seashells per container (approximately 0.5 L in capacity) is within the range of 15-20 pesos. On the average, a daily income of One Hundred Fifty Pesos (Php 150.00) for every gleaner at 6-10 containers will usually be sold. In terms of market potential, gleaners usually sell within their neighbours, and even some reached the local public market. The gleaning activity (aside from direct fishing) is an additional livelihood of the gleaners for more than 30 years

(on the average), spending 6 hours for daily gleaning. A study of Pacyao and Llameg (2018) [3] stressed that fisheries activities like gleaning in the intertidal areas may exhibit sustainable and good income due to its demand in local market, and even abroad.

Conclusions

There were eight species of seashells commonly found and identified in Brgy. Tubalan, Malita, Davao Occidental, Philippines. The species of *Cerastoderma edule* had the highest relative abundance and population density in the study area, while *Anodontia edentula* was the lowest. The soil type of Station 1 and 2 is Fine to Medium Sand.

A total of 23 respondents were interviewed and revealed that their collected seashells during gleaning will be sold in local public markets. A One Hundred Fifty Pesos (Php 150.00) was their average income for 6-10 containers daily. The 2 sampling stations exhibited the same species composition and abundance of seashells. And a no significant difference on the number of species in terms of abundance and population density is accepted while in terms of the number of species between the two stations was rejected based on the t-Test result.

Further study shall be conducted beyond tubalan cove in order to identify all other species of seashells in the locality. The physic-chemical parameters should be an additional determining factor that might affect species composition and abundance of seashells.

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