Biodiversity of gastropod in the Sombu Beach, Wakatobi, Indonesia

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Abstract. The Sombu Beach is located in Wangi-wangi Island, Southeast Sulawesi, Indonesia. The beach is still natural and the substrates are dominated by fine sand and coral reef flat which is suitable for the habitats of gastropods. The aim of this research was to understand the diversity of gastropod in the intertidal zone of the Sombu Beach, Wangi-wangi Island. The research was conducted in January 2017 in the Sombu Beach, Wangi-wangi Island, Indonesia. The collection of the samples was conducted using quadrant plot method. Ten transects along the beach were made with four plots on every transect. So that, there were 40 plots data which were analyzed using Shannon-Wiener index of diversity (H’), evenness index (E), and dominancy index (D). The result of this research shows 13 species of classes Gastropods. The most abundant species in this study were Mitra sp. (86 individuals), Columbella sp. (40 individuals) and Conus sp. (35 individuals). The diversity index (H’) was 1.8729, the evenness index was 0.7302, and the dominance index was 0.2071.

1. Introduction
Indonesia is an archipelagic country and known as a mega biodiversity area. Wakatobi is one of the islands in Indonesia, located in the Southeast Sulawesi. The island consists of four clusters island, they are Wangi-wangi, Kaledupa, Tomia and Binongko, with marine waters covering area is 18,377.31 km² [1]. Wakatobi is a National Park area, the occupation is one of the prime locations of marine conservation in Indonesia [2]. These islands are located in the center of Coral Triangle Initiative (CTI), known as the region of coral reef biodiversity [3]. Coral reefs are habitat for many marine species such as molluscs [4].

Gastropod is a soft-bodied animal and runs using the abdominal muscles. In general, the body of mollusc consists of head, body and mantle [5]. Mollusc is a phylum with the highest species diversity after arthropods. Gastropods have extensive habitats such as rivers, lakes, swamps, ponds, beaches and even underground aquifers [6]. The structure of the gastropod community was influenced by many factors such as the way of life, competition, food availability, substrate type, water temperature, and salinity [7]. However, substrate conditions are a major factor affecting the distribution of gastropods [8].

This study was conducted in the intertidal zone of the Sombu Beach within the fine sand and coral reef substrates. Based on the previous research [9] the beach with a substrate of fine sand and coral reefs, gastropods most often found comes from family Cypraeidae. This study aimed to know the
biodiversity of gastropods in intertidal zones of the Sombu Beach which located in the Coral Triangle Initiative and National Park areas. Gastropods are benthos organisms that are used as a bio-indicator of healthy water ecosystems.

2. Materials and Methods
The research was conducted on January 4th, 2017 at the intertidal zone of the Sombu Beach, Wangi-wangi Island, Indonesia (05°16’12.2”S 123°31’08.8”E). The sampling was done by using quadratic plot (1 m x 1 m) which was able to determine gastropod diversity. The instruments used in this research were rolled meter, thermometer, refractometer, GPS, tweezers, aquades, 70 % alcohol, a camera for documentation and identification book.

Gastropods were taken by quadratic plot on the ten transect lines, transects has 20 m in length, vertically with the shoreline. In each transect, four plots were placed. There were 40 plots in total. The pictures of the obtained samples taken, then they were preserved by using aquades (for relaxation), then the visceral mass was separate from the shell. For gastropod that has no shell (e.g. Nudibranch), alcohol 70 % was used for preservation. Gastropod samples identification was conducted by using literature such as The Living Marine Resources of The Western Central Pacific Volume 1 [10].

![Location of the Sombu Beach](image)

**Figure 1.** Location of the Sombu Beach

2.1. Data Analysis
Several characteristics of the community are the diversity of Gastropod species, which were able to be determined by using Shannon-Wiener index [11], of diversity (H’), evenness index (E), and dominance index (D) as follows:

\[
H' = -\sum (ni/N) \ln (ni/N) \\
E = \frac{H'}{H_{\text{max}}} \\
D = \sum_{i=1}^{S} (\frac{Pi}{S})^2
\]

An notational:
- \(S\) = Total number of species;
- \(N\) = Total number of observed individual;
- \(ni\) = The number of I individual;
- \(Pi = n_i . N^{-1}\);
- \(H_{\text{max}} = \log^2 S\)
The criteria for Shannon-Wiener diversity shown:
\[ H' \leq 3.32 \] : diversity is low
\[ 3.32 < H' < 9.97 \] : diversity is moderate
\[ H' \geq 9.97 \] : diversity is high

3. Result
The abundance and diversity of gastropods in the Sombu Beach, Wangi-wangi Island, Wakatobi, Indonesia as follows:

![Graph showing abundance of gastropods](image)

**Figure 2.** The abundance of Gastropods in the Wangi-wangi Island, Wakatobi, Indonesia

Figure 1 shows there were 13 species of gastropods in the Sombu Beach with the largest number of individuals was *Mitra* sp. with total 86 individuals. The index diversity index (\( H' \)) obtained was 1.873 (low diversity), the evenness index (E) was 0.730229 (high), and dominance index was 0.2071 (low).

**Table 1.** Shimpson’s diversity index, evenness index and dominance index of gastropods.

| Index              | Index Number | Category |
|--------------------|--------------|----------|
| Diversity Index (\( H' \)) | 1.8729       | Low      |
| Evenness Index (E)   | 0.7302       | High     |
| Dominance (C)        | 0.2071       | Low      |

4. Discussion
The characteristic of gastropods which found in the intertidal zone of the Sombu Beach were small which less than 5 cm and had a distinctive color. Most of the gastropod samples found had a rather non-distinctive color pattern with variations between black and white or yellow. Engina had a yellow-black pattern and Cymbium had a distinctive shiny shell shape with a wide inner lip side. Patteloida had a distinctive shell shape like a symmetric cone but still in the Gastropods class [12]. Intertidal
zone of Krakal beach was dominated by carnivorous gastropods. In the same substrates, gastropods were mostly found from the family Cypraeidae as an omnivore organism [9, 10].

Based on sampling conducted in the Sombu Beach, obtained 13 genera of gastropod. Figure 1 shows that the highest abundance of Gastropods is from genus Mitra consists of 86 individual, following by Columbella with 40 individual and Conus with 35 individual. Table 1 shows the evenness index, diversity index, and dominance of Gastropods in Sombu Beach. Index of evenness measures the relative abundance of the different species making up the richness of an area. Based on the result of evenness calculation, high evenness index value was 0.7302. Otherwise, the diversity of gastropods in the Sombu Beach shows a low level of diversity with a diversity index was only 1.8729. This caused by the substrate conditions that consist of rocks, sand and cliffs only without the variation of vegetation. The substrate conditions in gastropod habitat are important for attaching and grazing. The sandy substrate in the Sombu Beach makes Gastropods difficult to attach. Whereas on the coral cliffs area were supporting gastropods to attach, so the abundance of gastropod were high. Vegetation such as algae and seagrass as main food stock for gastropods supports the gastropods variety because certain types of gastropods are herbivores, for example, *Strombus* sp. The number of gastropods was also found small in the intertidal area due to the lack of seagrass number and variety. *Vexillum*, *Cymbium*, *Polinices*, *Conus*, and *Mitra* Genera were found abundance on this beach because those were carnivorous gastropod and did not depend on the presence of slight vegetation [10,13,14,15].

The dominance index measured the diversity which calculating the present number of species, and the relative abundance of each species [16]. The dominance means the most striking and abundant species. Dominance also means the relative importance of species associated with the degree of influence on ecosystem components, such as competition for food sources. Dominance is used for community characterization, habitat types and ecological sites of a species and helps in identifying climate and disease responses. Dominance can determine the species function in the group [17].

The results obtained were 0.2071 which less than 0.5 which means there are no species that dominate other species. Gastropods are benthic organisms whose existence depends on substrate conditions and environmental conditions such as waves. The substrate conditions on the Sombu coast were sandy with several coral spots. Gastropods depend on substrate conditions which could be functioned as a shelter or hindrance from the waves. Also, the substrate provides food sources such as seagrass and organism remnants. The benthic organism has a strong relation to the substrate conditions. Herbivore type gastropods would be difficult to be found in the sandy beach which covered only by few seagrasses but would be easy to find both carnivorous and scavenger types [17].

From 40 plots, the most abundance gastropods found were in the 1 to 10 plot with a coral substrate. Substrates may affect the presence of gastropods and coral substrate is an ideal substrate for most Gastropods because Gastropods need to be attached to life. *Mitra* sp. known as carnivores and active predators [10]. Besides *Conus* sp. also known as a predator whose prey is other Molluscs, Polychaeta or small fish [18]. Also, Conus has conotoxin that serves to paralyze the prey [19]. Therefore these two genera can be found abundantly in the coral substrate although algae are not available because other living organisms can be prey to them.

5. Conclusion
From this research, we concluded that the diversity of gastropods was moderate due to the value of diversity index (1.8729), the evenness index (0.7302) and the dominance index (0.2071). There were only three genera that found in the Sombu Beach because the variety of the substrate is low, that will impact the food resources and habitats for gastropods.

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