Structure communities of macrozoobenthos in mangrove tourism area, Wongsorejo sub-district, Banyuwangi regency, East Java

D Fatmawati\textsuperscript{1}, B S Rahardja\textsuperscript{2}, Suciyono\textsuperscript{3}, L Lutfiah\textsuperscript{2} and M F Ulkhaq\textsuperscript{2}

\textsuperscript{1}Faculty of Fisheries and Marine, Campus Banyuwangi, Universitas Airlangga Indonesia
\textsuperscript{2}Department of Fish Health Management and Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Surabaya, Indonesia
\textsuperscript{3}*Corresponding author: suciyono@fpk.unair.ac.id

Abstract. Macrozoobenthos is an organism that lives on the surface or in liquid sediment. Macrozoobenthos is one of the most important organisms for marine and coastal ecosystems. This study aimed to determine the value of the community structure of macrozoobenthos existing in Mangrove Center Bengkak, a subdistrict of Wongsorejo, Banyuwangi regency. Sampling was conducted on three stations with different location characteristics. The community structure was measured by Shannon’s diversity index, Equitability index, and dominance index. The results of this study obtained Shannon’s diversity index of 0.51, equitability index of 0.12, and dominance index of 0.76 at Station 1. At station 2, Shannon’s diversity index of 1.19, equitability index of 0.39, and dominance index of 0.36. While at station 3, it was obtained that Shannon’s diversity index of 1.64, equitability index of 0.85, and dominance index of 0.31.

1. Introduction
Banyuwangi Regency has a mangrove area around 1.962,496 Ha. One of the mangrove areas in Banyuwangi, which is currently being developed into a tourist destination, is Bengkak Beach in District Wongsorejo, which has a mangrove area of 7,150 Ha [1]. Mangrove Center Bengkak is a tourist area. It has also been determined as a mangrove conservation area since 2016, according to Village Regulation No. 07 of 2016 concerning Coastal Protection Area (DPP) of Bengkak Village, Wongsorejo Subdistrict, Banyuwangi District. Mangrove Center Bengkak is located adjacent to residents, farms, and shrimp ponds. Also, this location is used as a tourist destination, which will increase the activities that would produce human waste in the conservation areas.

Increased land used will affect environmental health directly or indirectly [2]. And this also will influence the biodiversity of macrozoobenthos that lived in Mangrove Center Bengkak. Structure and composition change of these organisms can be utilized as a water bioindicator [2]. Aquatic organisms that have been used as bioindicators were microalgae, macrozoobenthos, and fishes. Macrozoobenthos is used as a bioindicator in the waters because of its relatively sedentary life and slow mobility so that it can be directly influenced by
the material entering the seas [3]. Macroinvertebrate is a sensitive organism to changes in the aquatic environment and relatively easy to identify, among other, benthos animals [4]. This group of macroinvertebrates is well known as macrozoobenthos [5]. As an environmental indicator, macrozoobenthos could be viewed in terms of the value of community structure (diversity, equitability, dominance, and relative abundance) [6]. Since established as a conservation area and tourist destination, there was no previous data related to the community structure of macrozoobenthos at Mangrove Center Bengkak. Based on these reasons, it is crucial to research the value of community structures of macrozoobenthos in the Mangrove Bengkak Tourism Area. The result of this study is expected as information for sustainable management of this area.

2. Materials and Methods

2.1. Study area

The study was conducted from February to March 2018 at the Mangrove Beach Bengkak Center, Bengkak Village, Wongsorejo Sub-district, Banyuwangi Regency, East Java, Indonesia (Fig.1). A sample of macrozoobenthos was carried out in three stations by the purposive random sampling method [7]. Station 1 was located around the residential area (E'8° 2'2.7" and 114° 26'0.55 "S), station 2 (E’ 8° 1’55.95" and 114°26' 0.57 S') and 3 (E’ 8° 1’51.96" and 114°26' 0.56 "S) were located around the shrimp ponds culture.

![Study area of macrozoobenthos sampling, Wongsorejo sub-district, Banyuwangi Regency East Java, Indonesia.](image)

2.2. Collect data

A sample of macrozoobenthos was taken using a 100 x 100 cm block transect on the three-station. Sampling was performed up to 20 cm depth from the ground surface, using a 3-inch PVC tube with 30 cm long, sifted with 1 x 1 mm sifter, and placed into a labeled jar with an addition of 70% alcohol as preservation. Furthermore, macrozoobenthos identification was analysis on the Instrument Laboratory of Airlangga University in Banyuwangi using stereo microscopes (Nikon E 100) and by referring to an identification book from [8,9,10]. Besides, the water quality in-situ measurement such as Temperature using a thermometer, pH using pH meter, and salinity using hand refractometer. Whereas ex-situ measurements such as dissolved oxygen and turbidity were carried out in the Laboratory of Airlangga University in Banyuwangi using the iodometric titration method and Turbidimeter.

2.3. Data analysis

Descriptive analysis was taken to describe the resulting quality of water measurement on each station sampling. Meanwhile, macrozoobenthos were analyzed by calculating the Important Value Index (IVI) to the determination of community structure using the index of diversity, equitability index, and dominance index following calculation by Shannon-Wiener index performed [6]:

\[
H' = -\sum (n_i/N) \times \ln (n_i/N)
\]
Where:
\( H' \) = index of diversity;
\( n_i \) = number of individuals of each species;
\( N \) = number of individuals of all types.

\[
E = \frac{H'}{\ln S}
\]

Where:
\( E \) = equitability index;
\( H' \) = index of diversity;
\( S \) = number of species.

\[
C = \sum \left( \frac{N_i}{N} \right)^2
\]

Where:
\( C \) = index of dominance;
\( n_i \) = the number of individuals of each species;
\( N \) = number of individuals of all types.

3. Results and discussions
3.1. Macrozoobenthos Composition
Four classes of macrozoobenthos were found consisting of Gastropoda, Malacostraca, Clitellata, and Insecta (Figure 2). At station 1 consisted of 89.54% Gastropod and 10.46% Insects. Station 2 consists of 100% Gastropoda. While station 3 consisted of 56.25% Gastropods, 5.2% Insecta, 10.42% Clitellata and 28.13% Malacostraca. Macrozoobenthos as facultative organisms that can survive in wider changed environmental conditions i.e., capable of living in waters containing high organic matter [3]. According to [11] that the composition of Gastropods is found in soil with a smooth texture. Following the substrate in the site, the study has a smooth substrate.

Gastropods have good adaptability to the environment. Gastropods also have an immune system and a hard shell that make it possible to survive compared to other classes [5]. Larvae *Chironomus* sp. almost found in all types of waters, both flowing and calm waters both in freshwater and also seawater and often found on the surface of the substrate [12]. *Chironomus* sp. can also be an indicator that the waters are polluted, due to its tolerant nature of pollutants [13]. The worms *Oligochaeta* are tolerant of being able to live in environmental conditions that contain high organic materials and have good osmoregulation ability to adapt to extreme environmental conditions [14].

![Figure 2](Figure 2. Distribution of Macrozoobenthos on Bengkak Mangrove Center, Banyuwangi, East Java, Indonesia.)

3.2. The value of community structure of macrozoobenthos
Community structure consisting of Shannon’s diversity, equitability index, and dominance index that is often used in evaluating the condition of waters in terms of biology [6]. The community structure indices presented (Table 1). The calculation result of station 1 diversity index is a very low and depressed community category for uniformity index and high category for dominance index. The result of the diversity index at station 2 also was low categories, depressed community category for uniformity index, and the low category for dominance index. The diversity index at station 3 included in the low categories. The uniform index belongs to the stable community category, and the dominance index was in a low category.
Table 1. Shannon’s diversity index, equitability index and dominance index at each station.

| Station | Diversity (H’) | Equitability (E) | Dominance (C ) |
|---------|----------------|------------------|---------------|
| 1       | 0.51           | 0.13             | 0.76          |
| 2       | 1.19           | 0.39             | 0.36          |
| 3       | 1.64           | 0.86             | 0.32          |

3.3. Environmental parameters

The environmental parameters measured in the Mangrove Center Bengkak were temperature, pH, substrate type, and dissolved oxygen, salinity, turbidity, and ammonia content (Table 2). There is no much variation between water quality conditions of the chemical and physical aquatic parameters of all stations. The temperature still on the range to the living of macrozoobenthos is 25-36 °C [2]. The temperature obtained at Mangrove Center Bengkak still supports macrozoobenthos life. The recommendation pH level ranges from 7 to 8.5 [15]. pH achieved at station 1 is 7.8, Station 2 is 7.9, and Station 3 is 7.8. The pH is still relatively safe for the life of macrozoobenthos. Salinity concentration from 0-34 ppt supports the coastal ecosystem [15]. The salinity obtained at station 1 was 14 mg.L⁻¹, station 2 was 20 g.L⁻¹, and station 3 was 16 g.L⁻¹.

The oxygen solubility (DO) obtained at station 1 was 2.3 mg.L⁻¹, station 2 was 2.37 mg.L⁻¹ and station 3 was 2.77 mg.L⁻¹. The dissolved oxygen level required by macrozoobenthos ranges from 1-3 mg.L⁻¹ [16]. Oxygen dissolved in mangrove ecosystems is still able to support macrozoobenthos life. The suitable turbidity for mangrove biota was <5 NTU [15]. Turbidity obtained at station 1 was 0.05 NTU, station 2 was 0.05 NTU and station 3 0.07 NTU.

Table 2. Result of measurement the Environmental parameters at Mangrove Center Bengkak.

| Parameter   | Station 1 | Station 2 | Station 3 |
|-------------|-----------|-----------|-----------|
| Temperature | 29 ± 1.26 | 30 ± 1.04 | 29 ± 0.29 |
| pH          | 7.8 ± 0.12| 7.9 ± 0.40| 7.8 ± 0.12|
| Salinity (g.L⁻¹) | 14 ± 2.65 | 20 ± 0.31 | 16 ± 3.00 |
| DO (mg.L⁻¹) | 2.37 ± 0.06| 2.37 ± 0.06| 2.77 ± 0.06|
| turbidity (NTU) | 0.05±0    | 0.05±0    | 0.07±0    |
| Ammonia (mg.L⁻¹) | 3 ± 0     | 3 ± 0     | 3 ± 0     |
| Substrates   | sandy clay| sandy clay| sandy clay|

The turbidity value is still safe for macrozoobenthos life. The type of substrate found in Mangrove Center Schwollen is sandy clay. But the number of presentations each element type of each station is different. Station 1 consisted of 0.83% corals, 51.31% coarse sand, 35.26% fine sand, 11.54% dust and 1.07% clay. While station 2 consists of 1.06% coral, 53.08% coarse sand, 25.49% fine sand, 19.92% dust and 0.44% clay. While station 3 consists of 0.58% coral, 29.51% coarse sand, 36% fine sand, 33.07% dust and 0.84% clay. The substrate of each station corresponds to the type of macrozoobenthos present in each station.

4. Conclusion

Macrozoobenthos community is regulated by many factors within the community, including the chemical-physical water parameter and also the substrate. At station 1 obtained the index of diversity 0.51, uniformity index 0.12, and index of dominance 0.76. At station 2, the index of diversity 1.19, uniformity index 0.39, and index of dominance 0.36. While at station 3 obtained the index of diversity 1.64, uniformity index 0.85, and index of dominance 0.31.

5. References

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