



## Structure of Macrozoobenthos (Gastropods) Community in Mangrove Forest Ecotourism Pandansari Kabupaten Brebes, Central Java

Natasya Natalia Sinaga<sup>1\*</sup>, Heti Herawati<sup>1</sup>, Herman Hamdani<sup>1</sup> and Asep Sahidin<sup>1</sup>

<sup>1</sup>Department of Fisheries, Faculty of Fisheries and Marine Science, Universitas Padjadjaran, Indonesia.

### Authors' contributions

*This work was carried out in collaboration among all authors. Author NNS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors Heti Herawati and Herman Hamdani managed the analyses of the study. Author AS managed the literature searches. All authors read and approved the final manuscript.*

### Article Information

DOI: 10.9734/AJFAR/2019/v4i330057

#### Editor(s):

(1) Dr. Pinar Oguzhan Yildiz, Assistant Professor, Department of Food Engineering, The Faculty of Engineering, Ardahan University, Turkey.

#### Reviewers:

(1) Junir Antonio Lutinski, Universidade Comunitária da Região de Chapecó, Brazil.  
(2) Moses Mwajar Ngeiywa, University of Eldoret, Kenya.

Complete Peer review History: <http://www.sdiarticle3.com/review-history/51309>

Original Research Article

Received 28 June 2019  
Accepted 05 September 2019  
Published 13 September 2019

### ABSTRACT

**Aims:** This research aimed to analyze the abundance and diversity of macrozoobenthos in the Gastropod Class in the Ecotourism Waters of Pandansari Mangrove Forest, Brebes Regency, Central Java.

**Study Design:** The research was conducted by survey.

**Place and Duration of Study:** This research was carried out for 3 months between December 2018 until February 2019 in Ecotourism Forest Areas in Bakau Pandansari, Brebes Regency, Central Java.

**Methodology:** The method used in this research was survey methods using primary data in the form of physical chemistry of aquatic data, gastropod abundance, diversity index, equitability index. Data collection techniques using purposive sampling in determining 3 stations and 3 repetitions. Data analysis in this research used descriptive statistics.

**Results:** Research results found 9 species of Gastropods inhabiting the mangrove ecosystem,

\*Corresponding author: Email: [natasyanataliasng@gmail.com](mailto:natasyanataliasng@gmail.com);

namely *Casidulla aurisfelis*, *Cerithidea* sp, *Cerithidea alata*, *Cerithidea cingulata*, *Cerithidea obtusa*, *Polinices* sp, *Puperita* sp, *Telescopium telescopium* and *Turiculla nellial-suprius*. Gastropod abundance ranged from 67 - 166 ind / m<sup>2</sup>. Gastropod diversity index in the medium category  $2 < H' \leq 3$ . Uniformity values ranged from 0.79 to 0.81 with a high category. The relationship between water quality and gastropods had an R<sup>2</sup> value of 97%, water quality can affect gastropod life and as much as 3% is influenced by other factors.

**Conclusion:** Based on the results of this research that has been done, it can be concluded that in general environmental parameters in the Pandansari mangroves are still favorable in supporting the survival of the gastropods inhabiting them.

**Keywords:** *Gastropods; abundance; diversity index; equitability index.*

## 1. INTRODUCTION

Brebes is one of the districts in Central Java located in the north coast of Java (Pantura). The North Coast region of Brebes has a coastal area that stretches around 54 kilometers with mangrove forests covering an area of approximately 852 hectares from Brebes, Losari Sub-district. Brebes mangrove forests are used for timber, some land is used for shrimp ponds and recently for salt production. So that in 2007 it was estimated that the remaining mangrove forest in Brebes was 275 hectares [1]. Mangrove area has been damaged due to abrasion and excessive logging. Starting from 2000 to 2008, abrasion in Brebes reached 640.45 hectares with a coastline of 27.043 km in the period of 8 years or 29.60 m per year [1]. One of the regions with the highest abrasion level is located in Kaliwlingi Village, Brebes Subdistrict, reaching 385.98 hectares. The activities of mangrove rehabilitation in the coastal area of Brebes Regency were coordinated and carried out by the Department of Agriculture, Forestry and Soil Conservation of the Regency of Brebes which was realized since 2004 [2]. Efforts to rehabilitate mangrove forests from 2008 to 2017 from one stakeholder who has planted as many as 3,500,000 mangrove stems [3]. The most commonly planted species is *Rhizophora* sp because it is relatively resistant to estuary environmental fluctuations.

Mangrove forests are dominated by several species of distinctive trees or shrubs that have the ability to grow in salty waters [4]. Mangrove forest creates a healthy climate atmosphere for aquatic biota, and has contributed to balance the biological cycle in the waters. Mangrove has a very important function as breeding ground, as the venue for biological processes such as spawning ground, nursery grounds for some aquatic organisms such as macrozoobenthos [5]. Macrozoobenthos is a group of invertebrate

animals that live in the benthos, sticking to the substrate at the bottom of the body of the water. Macrozoobenthos are generally relatively sedentary or can move with slow movements [6]. Macrozoobenthos in mangrove forests mostly live on hard substrates than in mud. Generally macrozoobenthos in the Indonesian mangrove region are macrozoobenthos from the Gastropod, Bivalvia, Crustacea, and Polychaeta [7].

Gastropod is a class that has a very wide distribution, because it has a fairly high adaptability [4]. Gastropods are part of the mangrove ecosystem and have a very complex role because their presence in aquatic ecosystems is unique. Unique because in addition to functioning as a food ingredient for other organisms, it can also be used as an indicator of the quality of the waters [8]. In the mangrove ecosystem, the existence of the macrozoobenthos is very closely related to water quality and the type of sediment that exists because in addition to water quality, sediment is a living medium that is in directly contact with macrozoobenthos [8]. Therefore the research entitled "Community Structure Macrozoobenthos (Gastropod) Community in Ecotourism Mangrove Forest Pandansari Brebes, Central Java" needed to be done. This research observed and analyzed species diversity and Gastropod abundance which can be used as bioindicators of the environment and is associated with abiotic factors in mangrove ecosystems for the sustainability of mangrove forest conservation.

## 2. MATERIALS AND METHODS

### 2.1 Time and Place of Research

This research was carried out during December 2018 to March 2019 at Ecotourism Pandansari Mangrove Forest located in Kaliwlingi Village, Brebes Regency, Central Java with coordinates S 6°47'44.5" : E 109°01'53.2".

## 2.2 Materials and Tools

The tools used in this research are Global Positioning System (GPS), quadrant transect, refractometer, DO meter, pH meter. poles, shovel, plastic bags. While the material used is, Gastropods and sediment.

## 2.3 Research Methods

The method used in this research was survey, determination of sampling stations using purposive sampling method. Gastropod sampling was carried out using the quadrant transect method. 1 m x 1 m quadrat size.

Station I is a muddy high density mangrove with a coordinate point S 6°47'8,70" : E 109°2'16,62". Station II is a mangrove forest with a medium density of mud and gravel with a coordinate point of S 6°47'13" : E 109°2'22". Station III is a low density mangrove forest with muddy substrates with a coordinate point of S 6°47'9" : E 109°2'20,23" Fig. 1. Sampling was carried out three times with a monthly sampling interval due to the fast life cycle of macrozoobenthos.

## 2.4 Research Parameters

Data analysis was conducted using the Benthos density equation as shown below:

$$D_i = n_i/A$$

Whereas:

$D_i$  = Macrozoobenthos abundance (ind/m<sup>2</sup>)

$n_i$  = Number of macrozoobenthos that were found

$A$  = Quadrat area (m<sup>2</sup>)

The next stage was to analyze the community structure as shown below:

Diversity (H')

$$H' = -\sum p_i \log_2 p_i$$

$$p_i = n_i/N$$

Whereas:

H' = Indeks Diversity Shannon Wiener

P<sub>i</sub> = Proportion of species i (n<sub>i</sub>) to total number (N)

Equitability (E')

$$E = H'/H_{max}$$

## 2.5 Data Analysis

Statistical data was analyzed for relationships between water quality and gastropods abundance using multiple regression and correlation.

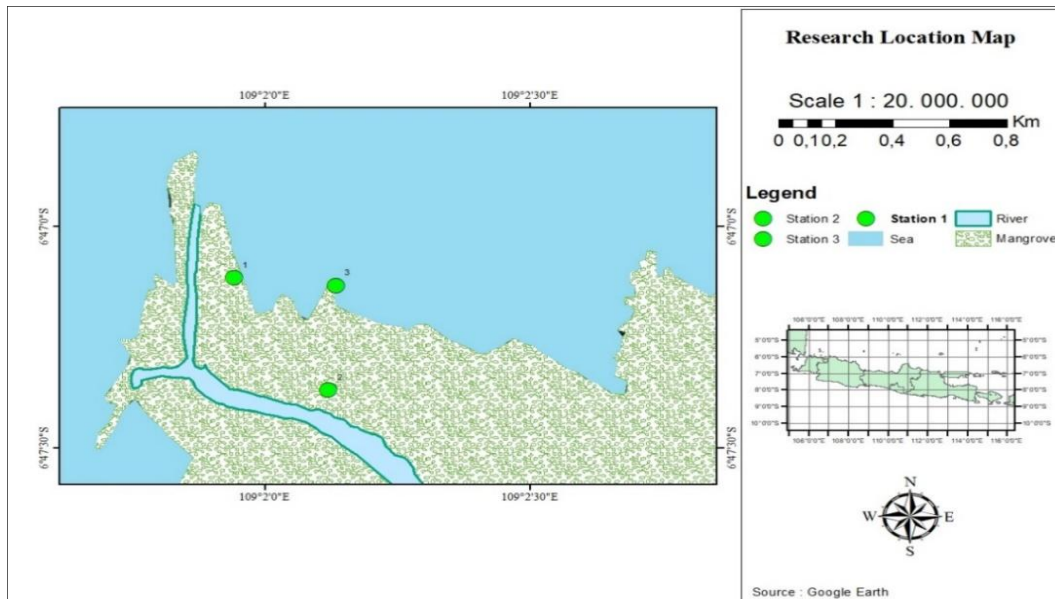


Fig. 1. The map of study stations located at Ecotourism Pandansari mangrove forest Brebes central java

### 3. RESULTS AND DISCUSSION

Water quality is one of the main environmental factors in the fish farming system. Water quality is a physical and chemical factor in the form of temperature, depth of sludge, pH, salinity, and dissolved oxygen (DO) that can affect the maintenance media environment and indirectly affect the metabolic processes of test fish. Poor water quality can cause fish to become susceptible to disease [9,3].

#### 3.1 Temperature

This research found 9 species of Gastropods which were divided into 6 Genera. We found that total abundance of Gastropods in station to be 166 ind/m<sup>2</sup>, station 2 144 ind/m<sup>2</sup>, and station 3 67 ind/m<sup>2</sup> as shown in (Table 1).

The higher abundance of Gastropods was obtained in study station 1(166 ind/m<sup>2</sup>) which was dominated by *Cerithidea* sp. These results are in agreement with Supratman [10] who reported that mangrove forest is the most preferred habitat for *Cerithidea* sp. Moreover, this species are thought to have a wide habitat range and are able to live in various types of habitats both in the mangrove ecosystem, muddy to sandy beaches, and the species are able to live in unstable conditions such as in mining areas. Overall Station 1 had a high abundance of mangroves, so that the production of mangrove organic matter at Station 1 is more than in other stations. According to Nybakken [4] mangrove leaf decay will become an important organic material for organisms. In addition, the type of substrate in station1 is mud and this type is the most suitable for gastropods life. The abundance of Gastropods at station 3 is lower than in all the other stations because the location of the station is closer to the sea, the location of the substrate being deeper makes the sampling technique difficult, besides that the substrate at the station

is dominated by mud and waterlogged soil so that distribution of gastropods are expanded.

#### 3.2 Structure Community

Diversity is identical to the stability of an ecosystem, if the diversity of an ecosystem is high then the condition of that ecosystem tends to be stable. Ecosystem environments that have diversity disorders tend to be moderate, and ecosystem environments that are polluted their diversity tend to be low. Diversity index of Gastropods in the mangrove ecosystem of Pandansari Brebes can be seen in Fig. 2. Gastropod diversity index from observations in each station included in the medium category  $2 < H' \leq 3$ . This condition shows that the distribution of the number of individuals of each species is moderate. This productivity is quite high, the condition of the ecosystem is balanced, and the ecological pressure is moderate. The highest diversity index was found at station 2, with a diversity index value of 2.555. The high diversity value of station 2 is because the stability of the community and the distribution of the number of gastropods at station 2 was relatively evenly distributed. The lowest gastropods diversity index was at station 3 with a value of 2.506. The low diversity index value is due to the small number of gastropod species found here compared to the other stations. High and low levels of diversity are also influenced by sediment conditions and the quality of waters in the mangrove environment.

These results are in agreement with Suwodo [11] who reported that diversity index will decrease with decreasing water conditions or quality. Species diversity is declared high if the community is composed by many species and with the same or nearly the same species abundance, conversely if the community is composed of a few species and if only a few species are dominant then the diversity of species is low [12].

**Table 1. Abundance of gastropods in study stations (ind/m<sup>2</sup>)**

Species	Station 1	Station 2	Station 3
<i>Casidulla aurisfelis</i> (Gmelin, 1791)	63	55	26
<i>Cerithidea</i> sp (Gmelin, 1791)	34	32	12
<i>Cerithidea alata</i> (Gmelin, 1791)	3	7	4
<i>Cerithidea cingulate</i> (Gmelin, 1791)	9	8	6
<i>Cerithidea obtuse</i> (Gmelin, 1791)	18	15	0
<i>Polinices</i> sp (Linnaeus, 1758)	22	15	10
<i>Puperita</i> sp	9	6	5
<i>Telescopium</i> (Linnaeus, 1758)	6	5	2
<i>Turiculla nellial-suprius</i> (Linnaeus, 1767)	2	1	2
<b>Total</b>	<b>166</b>	<b>144</b>	<b>67</b>

The equitability index is used to determine the evenness of the type of organisms in a community, the equitability index can also be used as an indicator of the presence of symptoms of species dominance in a community [13]. Uniformity values from the three stations ranged from 0.79 to 0.81 with a high category. Based on the criteria of uniformity index values it can be said that all species found at each station were almost evenly distributed. At each station the species were found to be almost the same, allegedly the equitable availability of food sources for Gastropods and in the area enabled Gastropods to defend themselves and reproduce well. Base of substrate is also an influencing factor because of the type of substrate that has mud texture and the content of organic material which is spread evenly in the mangrove ecosystem [5].

### 3.3 Relation of Water Quality with Gastropods Abundance

Result of regression test between abundance and water quality in Pandansari Mangrove Ecotourism in Brebes Regency, Central Java obtained  $y = 14.04 + 2.31 \text{ pH} - 0.22 \text{ DO} + 0.44 \text{ Salinity} + 0.09 \text{ temperature} - 14.6^\circ\text{C}$ , c-organic + 0.80 clay with an R2 value of 0.97, which means as much as 97% of water quality can affect gastropod life and as much as 3% is influenced by other factors which is derived from human activities or anthropology.

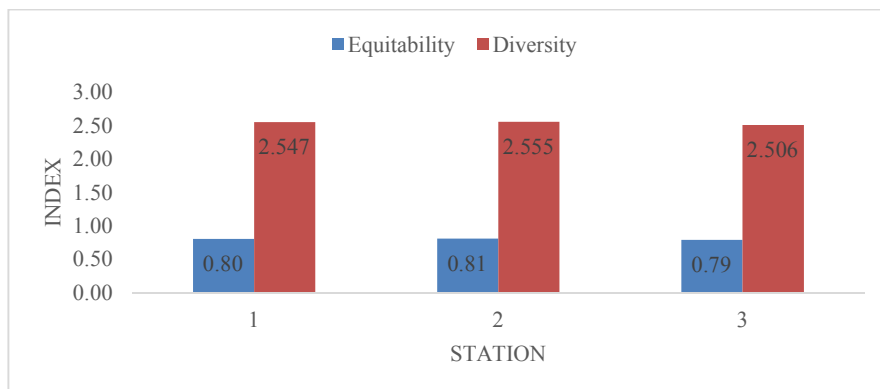
The correlation coefficient is divided into several groups such as 0.00 - 0.199 very low relation, 0.20 - 0.399 low relation, 0.40 - 0.599 moderate, 0.60 - 0.799 strong relation, and 0.80 - 1.000 very strong relation [14]. Gastropods correlation test results on water quality namely pH 0.32 has

a low relation, DO 0.20 has a very low relation, salinity 0.06 has a very low relation, temperature 0.36 has a low relation, c-organic 0.97 has very strong relation and 0.40 clay has a moderate relation as seen in Table 2. The c-organic correlation test has a very strong relation to influence the life of the gastropods, this is in accordance with the existing criteria.

**Table 2. Correlation test of water quality with gastropods abundance in Pandansari mangrove ecotourism in Brebes regency, Central Java 2019**

	Gastropods
pH	-0,3215973
DO	0,20078189
Salinity	-0,0641675
Temperature	-0,368975
c-organic	-0,9752935
Clay	-0,4009145

From these results, it was found that gastropod abundance was influenced by the conditions of the surrounding waters. Based on the correlation values, it was found that the abundance correlated most with organic carbon. The higher the c-organic content, the gastropod abundance will tend to increase, this is in accordance with the statement of Denisenko [9] that high macrozoobenthos abundance is influenced by the high c-organic value at each station. The high c-organic in a waters generally will result in an increase in populations [15]. In general, the results of environmental parameters in the Pandansari mangrove waters are still feasible in supporting the survival of the gastropods in them. Intensive community activities in the surrounding area will have an impact on the survival of gastropods in these waters.



**Fig. 2. Graphic of diversity index and equitability index for gastropods in ecotourism mangrove forest Pandansari Brebes, Central Java 2019**

#### 4. CONCLUSION

Based on the results of this research that has been done, it can be concluded that in general environmental parameters in the Pandansari mangroves are still favorable in supporting the survival of the gastropods inhabiting them. In addition, more human activity factors can also affect gastropod life.

#### ACKNOWLEDGEMENTS

Thank you for the people who provided assistance in the preparation of the manuscript and completion of this research.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Mackay P. Brebes mangrove restoration and reforestation for climate change adaptation project. Central Java Green Belt Mangrove Corridor Program, Brebes Regency, Indonesia; 2012.
2. Suryono, Supriharyono B, Hendarto O, Radjasa K. Mapping of mangrove ecosystem degradation and coastal abrasion based on geographic information system in Brebes Regency, Central Java. *Oceatek*. 2015;9(01).
3. Burhanudin M. Kaliwlingi proves coastal green belt is not an impossible; 2017. Available:<http://kehati.or.id/kaliwlingi-buktikan-sabuk-hijau-pesisir-bukan-hal-mustahil/> (Diakses pada tanggal 10 November 2018)
4. Geist J, Hawkins SJ. Habitat recovery and restoration in aquatic ecosystems: Current progress and future challenges. *Aquat Conserv Mar Freshw Ecosys*. 2016;26: 942–962.
5. Das S. Evaluation of mangrove ecosystem services: Methodological and data challenges. In: Gupta A., Dalei N. (Eds) *Energy, Environment and Globalization*. Springer, Singapore; 2019.
6. Odum EP. *Ecological basics*. Third Edition. Gadjah Mada University Press. Yogyakarta; 1993.
7. Arief AMP. *Mangrove forest functions and benefits*. Canisius Publisher. Yogyakarta; 2003.
8. Simanungkalit V, dan Afrizal T. Distribution of macrozoobenthos In The Mangrove Forest of Marine Protected Areas (MPA) Pariaman of West Sumatra; 2013.
9. Denisenko SG, Denisenko NV, Lehtonen KK, Andersin AB, Laine AO. Macrozoobenthos of the Pechora Sea (SE Barents Sea): Community structure and spatial distribution in relation to environmental conditions. *Marine Ecology Progress Series*. 2003;258:109–123.
10. Supratman O, Arthur MF, dan Jemi F. Abundance and gastropod diversity in the intertidal zone on Eastern Bangka Island. *Enggano Journal*. 2018;3(1):10-21.
11. Suwondo E, Sumanti F. Gastropod community structure in mangrove ecosystems on Sipora Island, Mentawai Islands District, West Sumatra. *Biogenesis*. 2005;2(1):25-29.
12. Janestia RN, Ali S, dan Syahrul P. Makrozoobentos community structure in the mangrove ecosystem Keudee Lung Waters, Pidie Jaya Regency. *Scientific Journal of Marine and Fisheries Unsyiah*. 2017;2(3):406-414.
13. Romdhani AM, Sukarno, Eko S. The biodiversity of gastropods identified in the mangrove forest of Baban Village, Gapura Districts Sumenep Regency as the resource of learning biology. *Journal Pendidikan Biologi Indonesia*. 2016;2(2): 161-167.
14. Sugiyono. *Qualitative quantitative research methods and R&D*. Bandung: Alfabeta; 2007.
15. Asriani WO, Emiyarti E, Ishak. Study of environmental quality around nickel loading ports (Ni) and their relationship to the macrozoobenthos community structure in the waters of Motui Village, Konawe Utara Regency. *Jurnal Mina Laut Indonesia*. 2013;3(12):22–35.

© 2019 Sinaga et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:  
<http://www.sdiarticle3.com/review-history/51309>