Distribution of Macrozoobenthos Species and Communities in Bulaksetra Estuary

Y Krisnafi¹, D Novianto², S Aamsah¹, A C Wibowo¹,*

¹Pangandaran Marine and Fisheries Politechnic, Jl. Raya Babakan Km.2-Pangandaran Jawa Barat Indonesia 46396,
²Pangandaran Integrated Aquarium dan Marine Research Institute Jl. Raya Babakan Km.2-Pangandaran Jawa Barat Indonesia 46396,

Email: adina.martec@gmail.com

Abstract. Distribution of macrozoobenthos species and communities is influenced by several factors, one of the very influential factor is the environment. This research aims to study the diversity and distribution patterns of macrozoobenthos and the environment conditions that influence it. Samples were taken from 31 research stations that spread along the Bulaksetra estuary. Determination of sampling points is done by randomly making zoning point so that the sample points can represent the characteristics of the entire Bulaksetra estuary zone. The data analysis used in this study were the species composition formula, individual abundance, Shannon Wiener diversity index, uniformity index, and Simpson dominance index. The results showed that 12 species of macrozoobenthos consist of 9 genus, 6 families, 4 classes and 2 phylum, with species composition dominated by *Faunus ater* 64.04%, average individual abundance of 239.95/m², moderate diversity, moderate uniformity, and dominance of biota types *faunus ater* is classified as moderate but for other types classified as low.

1. Introduction

Macrozoobenthos is benthic animals that have a size of more than 1 mm [24], in addition according to references [28, 30], macrozoobenthos is one of the aquatic organisms that live in the bottom of the water and have relatively slow movements and cycles relatively long life so that it has the ability to respond to water quality conditions continuously. Macrozoobenthos also have a very important role in food chains, where in the larval phase macrozoobenthos will be a food source for most organisms that live in estuary areas such as fish or other animals that have a larger size [26]. Furthermore, it is said that macrozoobenthos can also increase oxygen levels in sediments or substrates by making holes in the substrate (bioturbation).

Abundance and diversity of macrozoobenthos is strongly influenced by changes in water quality and the basic substrate where it lives [2, 15]. Other than that a reference [20], also said that physical and chemical factors in a tidal waters are very important, this is because these factors can affect the characteristic patterns of a waters, so that it can affect the habitat and the presence of each species of biota in it. Besides physical and chemical factors can also affect the diversity and distribution of macrozoobenthos in a waters [21, 23], where for abiotic factors (physics and chemistry) that can influence include temperature, salinity, pH level, and TDS (total dissolved solid). Changing in environmental factors will influence diversity of organisms [1]. So in addition to observing and researching macrozoobenthos, it is also necessary to observe and research on abiotic factors contained in the habitat.

Pangandaran is one area that has several estuaries. One of the estuaries in Pangandaran is the Bulaksetra estuary. This was also mentioned by references [11], where Pangandaran is an area that has a type of rocky beach with narrow ravines, bays, and brackish estuaries. In addition, on references [7] also explained that the Pangandaran coastline is an area that is influenced by the dynamics of the Indian Ocean, where the area has a morphological condition from flat wavy to mountainous, with a slope between 0-
40%. Unfortunately, the Pangandaran coastal area is included the Bulaksetra estuary was damaged by the tsunami in 2006 [8]. This study aims to analyze the distribution of macrozoobenthos in the Bulaksetra estuary and to see the environmental factors that influence its distribution.

2. Materials and Methods
The implementation of this research was conducted from 1 March 2020 to 14 June 2020. Where data collection and processing took place in the Bulaksetra estuary area which is located in the Babakan Village, Pangandaran Regency, Java West. The following is a map of the sampling points shown as in Figure 1 below:

![Figure 1. Research sites](image)

The data collection method used in this research is the zoning method. This method can represent the characteristics of the condition of the Bulaksetra estuary. Bulaksetra estuary is divided into several sample points that can represent the entire area, where there are 31 sampling points carried out in 3 repetitions (morning, afternoon, evening) which is in the estuary depicted in pink (Figure 1). Sampling points were determined when surveying the research location and then selected so that they could represent the characteristics of the Bulaksetra estuary. The data collected such as water pH, TDS (Total Dissolved Solid), Temperature, Salinity, and soil pH.

The data collection process for soil is carried out using a modified soil extractor using a pipe with a diameter of 3 inches, with a length of 30 cm, and a cover on the back, then a 1.5 m air hose so that air can escape when the tool is being used and the last one was given a grip stick 1.5 m long. with the appearance of the tool as shown below:
The tool is used to take sediments as well as macrozoobenthos that are in the water depth to facilitate sampling after the sample is obtained then the soil sample will be tested using a soil meter to see the pH level in it. In the sampling method the tool will be plugged into the sediment and then the air hose will be closed then the tool is pulled so the sediment is carried along and placed in a container. Sampling of macrozoobenthos is done using the 1x1 m transect method to facilitate data collection, this method is carried out in areas that have a depth of water between 0-30 cm and are still visible to the eye, while deep waters use a tool to collect sediment and also by snorkeling while trying to collect data.

**Data Analysis**

After all research data have been collected and can represent the characteristics of the estuary, the data will be analyzed using the following methods:

a. **Composition Type**

Calculation of composition of macrozoobenthos species is done to see the percentage of the presence of a species from the total species obtained. This method is calculated by the equation [14]:

\[
RD_i = \frac{n_i}{\sum_{i=1}^{p} n_ij}
\]

Information:

RD\(i\) : Composition of the type-I (\%),
Ni : The number of individuals of type I
\(\bullet\) : Total number of individuals of all types

b. **Individual Abundance**

The abundance of individuals is calculated to see the abundance of the number of types of individuals obtained in the sampling tool. The abundance of individual macrozoobenthos can be calculated by dividing the number of individuals and the volume or area of the tool used [5].

\[
Di = \frac{n_i}{V}
\]

Information:

Di : Abundance (ind/m\(^3\)),
Ni : Number of Individuals (ind),
V : Extensive sampling tool (m\(^3\))
c. Diversity Index (H')
The species diversity index is an index value used to express community structure and ecosystem stability. Where the better the diversity index of species, it can be concluded that the ecosystem is more stable while if the value of the diversity index is low, it can be concluded that the ecosystem is less stable. The macrozoobenthos diversity index was calculated using the Shannon Wiener diversity index formula (H') [13].

\[ H' = - \sum_{i=1}^{t} p_i \ln p_i \]

Information:
- H': Diversity index,
- Pi: Proportion of type-i (ni /N),
- ni: Number of i-type individuals (individuals),
- N: Total number of individuals (ind).

Diversity index criteria as follows:
- H' < 1 (very low)
- H' 1 ≥ H' ≤ 3 (moderate diversity)
- H'> 3 (high diversity).

d. Uniformity Index (E)
Uniformity index or Equitability (E) is an index used to describe the distribution of individuals between different species, and is obtained from the relationship between diversity (H') with maximum diversity of H max [4, 9].

\[ E = \frac{H'}{H_{maks}} \]

Information:
- E: Uniformity index,
- H': Diversity index
- Hmaks :Ln S (maximum diversity index),
- S : Number of Genera found.

Uniformity index Criteria as follows:
- E < 0.4 (Low uniformity),
- E 0.4 ≥ E ≤ 0.6 (Medium uniformity),
- E > 0.6 = High uniformity.

Where the more even distribution of individuals between species, the balance of the ecosystem in it will increase.

e. Domination Index (C)
Dominance index is used to see the level of dominance of a certain biota against other types of biota. To calculate the dominance index, the Dominance Index formula is used from Simpson [14].

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

Information:
- C : Dominance Index,
- ni : Number of individuals of each type,
- N : The number of individuals of all types

Dominance index Criteria as follows:
- C 0< C < 0.3 (Low dominance index)
- C 0.3 ≥ C ≤ 0.6 (Medium dominance index)
- C 0.6 > C ≤ 1 (High dominance index).

3. Results and Discussion
3.1. Macrozoobenthos
From the observations obtained data macrozoobenthos distribution at the Bulaksetra estuary with 31 data collection points and 3 repetitions obtained information that there are 2 phyla, 4 classes, 6 families, 9 genera, and 12 different species. Distribution of macrozoobenthos obtained from observations obtained data where the highest value is at station 29 with a total of 2668 tails and number 7 stations as many as 2593 tails. Whereas the lowest value is at station numbers 3, 4, 24, and 25 with no macrozoobenthos found in it. For macrozoobenthos observations data at each station can be seen as shown below:
The presence value of macrozoobenthos is not only seen according to the sample point of observation can also be seen based on repetition, where in the morning 6361 biota is obtained or 28% of the total biota, afternoon 7107 or 32%, and evening 9008 or 40% of the total biota is 22476. From the data, the results of the study obtained several analyzes with the following calculation results:

3.1.1. Composition of Macrozoobenthos Types
The highest value composition of macrozoobenthos species in the Bulaksetra estuary was obtained by *Faunus ater* species with a composition of up to 64% of all recorded biota, this is in line with the discovery of *Faunus ater* biota dominating almost every station. Meanwhile, the lowest score was obtained by the types of *Nerita (ritena) balteata* and *Neritina pulligera*, which only scored 0.01%. The presence value of a type of biota is very much influenced by the environmental factors they live in, where the more suitable they are with their environment, the higher the presence value, while if the environment is not suitable, the presence value will be smaller. The following is a table of composition of types of macrozoobenthos:

| No | Species                      | Composition Type% |
|----|------------------------------|-------------------|
| 1  | *Faunus ater*                | 64.04             |
| 2  | *Terebralia palustris*       | 15.34             |
| 3  | *Nerita (ritena) balteata*   | 0.01              |
| 4  | *Coenobita sp*               | 0.03              |
| 5  | *Telescopium Telescopium*    | 0.05              |
| 6  | *Pictoneritina oualaniensis* | 0.02              |
| 7  | *Clithon corona*             | 0.07              |
| 8  | *Neritina turrita*           | 1.45              |
| 9  | *Neritina pulligera*         | 0.01              |
| 10 | *Nerita albicilla*           | 0.02              |
| 11 | *Cirripedia*                 | 1.01              |
| 12 | *Saccostrea glomerata*       | 17.89             |

3.1.2. The abundance of individual macrozoobenthos
The value of individual abundance can be seen from the average species presence divided by the transect plot area. For the individual with the highest attendance in 1m² is *Faunus ater* with the attendance rate reaching 153.67/m². Meanwhile, the biota with the lowest presence were *Nerita (ritena) balteata* and...
Neritina pulligera with a presence level of 0.04/m². Meanwhile, the total abundance of individuals per plot is 239.95/m². From these data, it can be seen that the individual abundance value is in line with the species composition value in the Bulaksetra estuary where the highest value is in the Faunus ater biota and the lowest value is in the Nerita biota (ritena) Balteata and Neritina pulligera. Below is an individual abundance table:

Table 2. Abundance of Individual macrozoobenthos

| No | Species                          | Individual abundance/m² |
|----|----------------------------------|-------------------------|
| 1  | Faunus ater                      | 153.67                  |
| 2  | Terebralia palustris             | 36.81                   |
| 3  | Nerita (ritena) balteata         | 0.04                    |
| 4  | Coenobita sp                     | 0.08                    |
| 5  | Telescioum Telescopium           | 0.12                    |
| 6  | Pictoneritina oualaniensis       | 0.06                    |
| 7  | Clithon corona                   | 0.18                    |
| 8  | Neritina turrita                 | 3.48                    |
| 9  | Neritina pulligera               | 0.04                    |
| 10 | Nerita albicilla                 | 0.06                    |
| 11 | Cirripedia                       | 2.43                    |
| 12 | Saccostrea glomerata             | 42.93                   |

3.1.3. Macrozoobenthos diversity index
The diversity index value obtained is 1.00 where the value is obtained from adding up all PiInPi values with a total of -1.00 and times with a negative value (-) so it can be concluded that the diversity index of the biota in the Bulaksetra estuary has a moderate value where the values are > 1. The moderate diversity index value indicates that the abundance of individuals in each macrozoobenthos species can be classified as fairly even and there is no too big difference, even though the value is indeed at 1.00 where this value is very close to the low category. The following is a table of diversity index values as shown in Figure 3:

Table 3. Index of macrozoobenthos diversity

| No | Species                          | Pi   | InPi  | Pilnpi |
|----|----------------------------------|------|-------|--------|
| 1  | Faunus ater                      | 0.64 | -0.44 | -0.28  |
| 2  | Terebralia palustris             | 0.15 | -1.87 | -0.28  |
| 3  | Nerita (ritena) balteata         | 1.79(10)^4 | -8.62 | -1.54(10)^3 |
| 4  | Coenobita sp                     | 3.58(10)^4 | -7.93 | -2.84(10)^3 |
| 5  | Telescioum Telescopium           | 5.37(10)^4 | -7.52 | -4.04(10)^3 |
| 6  | Pictoneritina oualaniensis       | 2.68(10)^4 | -8.22 | -2.21(10)^3 |
| 7  | Clithon corona                   | 7.61(10)^4 | -7.17 | -5.46(10)^3 |
| 8  | Neritina turrita                 | 0.01 | -4.23 | -0.06  |
| 9  | Neritina pulligera               | 1.79(10)^4 | -8.62 | -1.54(10)^3 |
| 10 | Nerita albicilla                 | 2.68(10)^4 | -8.22 | -2.21(10)^3 |
| 11 | Cirripedia                       | 0.01 | -4.59 | -0.04  |
| 12 | Saccostrea glomerata             | 0.17 | -1.72 | -0.30  |
3.1.4 Macrozoobenthos Uniformity Index

The macrozoobenthos uniformity index value gets a value of 0.40 with the following calculation:

\[
\text{be discovered: } S = 12 \\
\text{Hmaks : } \ln S = 2.48 \\
H' = 1.00
\]

The value of E (uniformity index) is the value of the division of H' and Hmaks so that the results obtained 0.40, where from these results it can be concluded that the uniformity index value is moderate because of its value > 0.4. The moderate value on the uniformity index obtained in the Bulaksetra estuary waters shows that the density of macrozoobenthos which tends to be the same and does not occur too high dominance of certain species. This is consistent with the statement of references [29], which states that the large value of uniformity shows a large uniformity of species, which means that the density of each species can be said to be the same and tends not to be dominated by certain types, on the contrary the smaller the uniformity value indicates a small species uniformity, which means the density of each type can be said not the same and tends to be dominated by certain types.

3.1.5 Indeks dominasi makrozoobentos

The dominance index value of macrozoobenthos in the Bulaksetra estuary ranges from low to moderate, where for the dominance index moderate being occupied by *Faunus ater* biota which has a dominance index of 0.41, and for other biota namely *Terebralia palustris, Nerita (ritena) balteata, Coenobita sp, Telescopium Telescopium, Pictoneritina oualaniensis, Clithon corona, Neritina turrita, Neritina pulligera, Nerita albicilla, Cirripedia, Saccostrea glomerata* received a low dominance index value, which is below 0.3.

The value of the dominance index can be concluded that there is a not too prominent dominance of a type of biota in the Bulaksetra estuary ecosystem. The existence of this dominance indicates that not all macrozoobenthos have the same adaptability and survival capacity in the Bulaksetra estuary ecosystem besides this also indicates that macrozoobenthos in the observation location does not use existing resources equally [19]. The following is a table of dominance index values:

| No | Species                          | Dominance index |
|----|---------------------------------|-----------------|
| 1  | *Faunus ater*                    | 0.41            |
| 2  | *Terebralia palustris*           | 0.02            |
| 3  | *Nerita (ritena) balteata*       | 3.21(10)^8      |
| 4  | *Coenobita sp*                   | 1.29(10)^7      |
| 5  | *Telescopium Telescopium*        | 2.89(10)^6      |
| 6  | *Pictoneritina oualaniensis*     | 7.23(10)^8      |
| 7  | *Clithon corona*                 | 5.80(10)^7      |
| 8  | *Neritina turrita*               | 2.11(10)^4      |
| 9  | *Neritina pulligera*             | 3.21(10)^8      |
| 10 | *Nerita albicilla*               | 7.23(10)^8      |
| 11 | *Cirripedia*                     | 1.03(10)^4      |
| 12 | *Saccostrea glomerata*           | 0.03            |

3.2 Abiotic factors

The results of measurements of environmental parameters in the field obtained information that the environmental conditions of the bulaksetra estuary as in the data below:
3.2.1. **Weather**
Weather factors were also encountered during data collection where there were four weather groupings obtained with the following results: sunny weather covering 17%, drizzle 37%, after rain 6%, and overcast 40%. This proves that cloudy weather has a high percentage of biota and is followed by drizzle where in that weather category the water conditions tend to be less hot and more suitable for the biota to come out.

3.2.2. **Salinity**
The salinity values obtained at each research point ranged from 8-35 ppt where the highest salinity was at the first station, which in fact at the first station the conditions were a confluence of the Sangai estuary with the high seas, thus allowing the area to have high salinity values. Meanwhile, the lowest salinity is at station 20 with a salinity value of 11 ppt, station 20 itself is in the Bulaksetra estuary area where there is a lot of fresh water flow from the residents' irrigation ditches. Meanwhile, the average salinity value of the Bulaksetra estuary is 19.44 ppt. Meanwhile, areas where there is no salinity value are areas that are not flooded because they are tidal areas. The following is the data on the distribution of salinity of the Bulaksetra estuary:

![Salinity values at each observation station](image)  
**Figure 4.** Salinity values at each observation station

3.2.3. **Temperature**
Temperature The temperature value of the Bulaksetra estuary has a range between 30-35°C, while if seen according to the average data collection time the temperature value is 32.09°C in the morning, 33.09°C in the afternoon, and 32.45°C in the afternoon. Meanwhile, the average value of the total temperature in the Bulaksetra estuary is 32.5°C. The condition of the temperature factor itself can be influenced by the time of data collection, the condition of the research point, and the tides that occur in the area. The following is the temperature data of the Bulaksetra estuary:
3.2.4. Water pH
The pH value at each research point ranges from 7.3-8.6 where the highest value is at the second point which is located at the end of the estuary with the condition of the area being isolated from outside waters due to the river deepening project. The lowest value itself is in the Bulaksetra forest area. Meanwhile, the average pH value at all observation stations reached a value of 8.06. Meanwhile, areas where there is no pH value are areas that are not flooded because they are tidal areas. The following is the distribution of the pH value of the Bulaksetra estuary:

![Figure 6. pH value of water at each observation station](image)

3.2.5. TDS
The average TDS value per sampling point ranges from 187-910 ppm with the highest value being at station 1 this is because the first station is the mouth of the estuary and in that area the water conditions are very intensive, there is sediment stirring caused by the confluence of the estuary and sea and high wave conditions, while the lowest value is at station 20, which is located in a mangrove forest which tends to be calm. For the TDS value of the Bulaksetra estuary itself is classified as good for the life of the biota in it. Meanwhile, areas where there is no TDS value are areas that are not flooded because they are tidal areas. The following is the TDS value data for the Bulaksetra estuary:

![Figure 5. Temperature values at each observation station](image)
3.2.6. Depth
The research was carried out at river depths ranging from 0-213 cm, where the 0 criteria were filled with areas that did have high humidity to allow the presence of biota in them, while for a depth of more than 100 cm it was taken from the middle of the Bulaksetra river estuary. With three repetitions used in order to see macrozoobenthos conditions both at high tide and low tide. The following is the depth data at each data collection point:

![Graph showing TDS value of water at each observation station](image1)

**Figure 7.** TDS value of water at each observation station

3.2.7. Soil pH
Bulaksetra estuary has an average soil pH value at each research point ranging from 6-8 with the highest pH concentration value of 8 at point 15 in the afternoon, where that point is in the Bulaksetra mangrove forest area. And the lowest value is 6 at point 6 at noon, where the place is in the mangrove area next to the Pangandaran marine and fisheries polytechnic pond. Meanwhile, the total average value is 7.18. The following is the data on the pH distribution of the Bulaksetra estuary:

![Graph showing the value of water depth at each observation station](image2)

**Figure 8.** The value of water depth at each observation station
3.3. Discussion

Recently, references [16], revealed that the macrozoobenthos in the Bulaksetra estuary is dominated by the gastropod class, which is in accordance with the data obtained by us with the gastropod class dominating with 9 species out of a total of 12 species. Furthermore references [12], also found data that there were 6 species of macrozoobenthos in the Bulaksetra estuary but from our research data has been obtained that there are at least 12 species of macrozoobenthos, this difference is thought to be due to the different coverage of the research locations, where references [12] only examined the Bulaksetra forest part, while our study covered almost all of the characteristics of the Bulaksetra estuary, besides that the differences were also thought to occur because the condition of the waters of the Bulaksetra estuary has experienced a decrease in salinity due to the closure of the channel towards the sea caused by sedimentation that occurred around 2017-2019, and it was not until the end of 2019 that the Bulaksetra estuary was rehabilitated by deepening the estuary and opening channels to the sea, this allows the entry of new macrozoobenthos species from outside the Bulaksetra area due to land suitability. From these data it can also be seen that the diversity of macrozoobenthos species of the bulaksetra estuary is different from the waters around it, one of which is the waters in the estuary of the Cikamal River where at the mouth of the Cikamal river there are 3 phyla, 4 classes, 6 orders and 18 families with several different types, see references [11], this difference may occur due to the different conditions and characteristics of the estuary where as already stated that the bulaksetra estuary has problems in the channel to the sea, which affects the salinity, pH, and TDS levels of the estuary.

The distribution of macrozoobenthos in the Bulaksetra estuary varies greatly at each observation station, where the highest value is 2668 at station 29 and the lowest value is 0 species at stations 3, 4, 24, and 25, the high value of macroozobenthos is suspected because the area is suitable for macrozoobenthos to live in it, while the absence of biota indicates that the area is not suitable. This is consistent with this study because in places that have low macroozobenthos values tend to be dominated by areas that have a depth of >200 cm or areas that have parameter values out of bounds. In contrast to the macrozoobenthos, the distribution and structure of the zooplankton community is influenced by water depth [17].

The Bulaksetra estuary area has a composition of macrozoobenthos species which is dominated by faunus ater species with a percentage of 64.04%. Whereas for individual abundance the highest value was also obtained by the faunus ater with attendance reaching 153.67/m², with the total abundance of all individuals for each pilot reaching 239.95/m². Furthermore, the macrozoobenthos diversity index in the Bulaksetra estuary got a value of 1.00, from which the diversity of Bulaksetra macrozoobenthos was in the medium category because it was in the value range >1 and <3. Furthermore, the macrozoobenthos uniformity index obtained a value of 0.40, so that the macrozoobenthos uniformity index that the value
was moderate, because it was in the range >0.4 and <0.6. Finally, the macrozoobenthos dominance index obtained values that are in the low to moderate range with moderate values obtained by the *faunus ater* with a value of 0.41, where these values are in the range >0.3 and <0.6, while other biota are in low values because the value is <0.3.

The results of this study also obtained 4 groupings on weather parameters, namely sunny, drizzling, after rain, and cloudy where the dominant macrozoobenthos were found in cloudy conditions with a percentage of 40%. Furthermore, for the salinity value in the waters of the Bulaksetra estuary, it ranges from 8-35ppt with prominent fluctuations, this is possible because of the tides, the location distance from the mouth of the estuary, the weather, and the fresh water supply. Whereas the average salinity is at a value of 19.44ppt where the salinity conditions of the Bulaksetra estuary tend to be appropriate and only a few places close to the mouth of the estuary have salinity above 30ppt, this is in accordance as explained by references [6], which states that the salinity of brackish water should have a value of 0.5-30 ppt.

The temperature at the Bulaksetra estuary can range between 30-35ºC with an average morning temperature of 32.09ºC, daytime 33.09ºC, and in the afternoon 32.45ºC with prominent fluctuations that may occur due to differences in depth, time, weather, and location. So it can be concluded that the temperature at the Bulaksetra estuary tends to be stable even though it has an average value of >30ºC, this is because the Bulaksetra estuary area is a tidal area which is explained by references [3], that the tidal temperature value can reach 36-40ºC so that can make the biota in it die if it can't adjust. This is also because water temperature also affects currents and tidal movements [27].

The pH in the Bulaksetra estuary is obtained in the range of 7.3-8.6 with moderate fluctuations that may occur due to tides, weather, and location. As for the average value, it is obtained a value of 8.06, it can be concluded that the pH value of the Bulaksetra estuary tends to be normal even though there is one area that has a value of more than 8.5 but other areas tend to have stable pH levels. This is consistent with references [25] statement where the pH value of sea water ranges from 7-8.5 with levels varying from river to sea.

The TDS value of Bulaksetra estuary ranges from 187-910 ppm with moderate fluctuation, this is possible due to tides, weather, and location. But for the TDS results themselves are classified as good, as explained by references [12], where the waters of the Bulaksetra estuary tend to have sunny conditions. Furthermore, for the depth area studied ranged from 0-213cm this was done in order to see the effect of depth on the existing biota. From the results of the influence of the depth itself, it can be concluded that the conditions of depth >200 cm have less biota as well as areas that have a depth of shallow. Then soil pH where the obtained values ranged from 6-8 with prominent fluctuations which may occur due to tides and weather, while the average pH value obtained is 7.19 so it can be concluded that the soil pH conditions are stable with a range of not more than 6-8.5 [25].

Based on the data that has been obtained about the conditions of macrozoobenthos at the Bulaksetra estuary, it can be concluded that the conditions of the estuary waters are classified as moderately polluted, where these conditions can be seen based on data on macrozoobenthos diversity which is still classified as being at values >1 and <3 as in previous research conducted by references [10] stated that the value of macrozoobenthos diversity can be grouped into three criteria, namely $H' <1$: heavily polluted water quality, $H' 1-3$: moderately polluted water quality, and $H' >3$: clean water quality. This is consistent with the statement of references [18], that macrozoobenthos biota can be used as an approach in estimating water conditions and quality. This is also reinforced by the statements of references [25], which state that macrozoobenthos are biota that are classified as sedentary life, so they have the ability to respond to water quality conditions continuously. References [26] also revealed that the presence of macrozoobenthos can increase oxygen levels in the sediment or substrate because these biota make holes and also in the larva phase macrozoobenthos will be a source of food for other biota. From the data that has been obtained, it can be concluded that the condition of the waters of the Bulaksetra estuary is classified as moderately polluted but the environmental conditions are still suitable for the life of the biota in it.
4. Conclusion
From the results of observations and analyzes that have been carried out on macrozoobenthos conditions and environmental factors that influence it can be concluded that the macrozoobenthos in the estuary of the bulaksetra consists of 12 species, 9 genera, 6 families, 4 classes, and 2 phyla. The species composition is dominated by *faunus ater* 64%, the average individual abundance is 239.95/m², moderate diversity, moderate uniformity, and the dominance of *faunus ater* species are classified as moderate but other types are low. Aside from that the condition of the waters of the bulaksetra estuary is classified as moderate, where this condition can be seen based on data on the diversity of macrozoobenthos biota which is classified as moderate. and also from direct observations, there is also the same conclusion that the condition of the environmental parameters in the estuary is still classified as supportive for the macrozoobenthos life therein, even though there are several areas that have parameters above the normal threshold such as the salinity condition in the mouth of the estuary which is more than 30ppt and isolated area conditions that have a water ph more than 8.5 for other areas environmental parameter conditions are classified as normal.

References
[1]. Ambariyanto, A., 2017. Conserving endangered marine organisms: Causes, trends and challenges. In *IOP Conference Series: Earth and Environmental Science*. 55(1): 012002.
[2]. Ario, R. and Handoyo, G. 2002. Kajian Struktur Komunitas Macrozoobenthos Sebagai Bioindikator di Perairan Muara Sungai Ketiwon, Tegal. *Ilmu Kelautan: Indonesian Journal of Marine Sciences*, 7(1): 17-22. [https://doi.org/10.14710/ik.ijms.7.1.17-22](https://doi.org/10.14710/ik.ijms.7.1.17-22)
[3]. Aziz, A. 1994. Influencing Salinity on the Distribution of Ekhinoderm Fauna. *Oseana*. 19(2): 23-32.
[4]. Bengen Dg. (2000). Introduction and Management of Mangrove Ecosystems. Center for Coastal and Ocean Resources Study. IPB. Bogor.
[5]. Brower Je, Zar Jh, Ende, Cn Von. 1990. Field And Laboratory Methods For General Ecology.3nd Edition. Dubuque, Iowa: Wim C. Brown Co.Pub.
[6]. Hasrianti, and Nurasia. 2016. Analysis of Color, Temperature, pH and Salinity of Well Bore Water in Palopo City. Proceedings of the National Seminar. 2 (1): 747-896.
[7]. Hartati, T. S., and A. Rahman. 2016. Health of Coral Reefs and Structure of Fish Communities in Pangandaran Beach Waters, Reply. *Bawal*. 8(1): 37-48.
[8]. Kusuma, C., and D. R. P. Ningrum. 2016. Typology and Vegetation Condition of Bulaksetra Mangrove Area in Pangandaran Regency, West Java Province. *Bawal*. 7 (2): 137-145.
[9]. Muqsit, A., D. Purnama, and Z. Ta'alisin. 2016. Coral Reef Community Structure in Pulau Dua, Enggano District, North Bengkulu Regency. *Enggano Journal*. 1 (1): 75-87.
[10]. Nangin, S. R., Marmix, L. L., Dan Deidy, Y. K. 2015. Makrozoobentos Sebagai Indikator Biologis Dalam Menentukan Kualitas Air Sungai Suhuyon Sulawesi Utara. *Jurnal Mipa Unsrt Online*. 4 (2): 165-168.
[11]. Noortiningsih, I. S. Jalip, and S. Handayani. 2008. Macrozoobenthos, Meiofauna and Foraminifera Diversity in the West White Sand Beach and estuary of the Cikamal Pangandaran River, West Java. *Vis Vitalis*. 1 (1): 34-42
[12]. Nurfajarin, A. R., and Rosada K. K. 2018. Macrozoobenthos Biodiversity in Bulaksetra and Batukaras Mangrove Areas, Pangandaran, West Java. *Prosemnas Masy Biodiv Indon*. 4 (2): 248-253.
[13]. Odum, E.P. 1993. Fundamentals of Ecology. Gadjah Mada University Press. Yogyakarta. 546 Pg.
[14]. Odum Eo. 1971. Fundamentals of Ecology. 2nd Edition. W. B. Saunders, Philadelphia. 564 Pg.
[15]. Pelealu, G. V. E., K. Roni, and R. R. Butarbutar. 2018. Macrozoobenthos Abundance and Diversity in the Tunan Waterfall River, Talawaan, North Minahasa, North Sulawesi. *Journal of Scientific Science*. 18 (2): 98-102.
[16]. Pranata, R., F. Ardiansyah, and F. W. Sari. 2017. Mapping Intertidal Benthic Habitat Preliminary Information on Spatial Planning of Coastal Management in Bulak Setra and Batu Karas, Pangandaran Regency. National Geomatics Seminar.

[17]. Pranoto, B.A., Ambariyanto, A. and Zainuri, M., 2005. Struktur Komunitas Zooplankton di Muara Sungai Serang, Jogjakarta. *Ilmu Kelautan: Indonesian Journal of Marine Sciences*, **10**(2): 90-97.

[18]. Rachman, H., Agus, P., Dan Yusli, M. 2017. Makrozoobenthos Sebagai Bioindikator Kualitas Air Sungai Di Sub Das Ciliwung Hulu. *Media Konservasi* **21**(3): 261-269.

[19]. Ridwan, M., R. Fathoni, I. Fatihah, and D. A. Pangestu. 2016. Macnozoobenthos Community Structure in the Four Estuaries of Pulau Dua Nature Reserve, Serang, Banten. *Al-Kauniyah Journal of Biology*. **9**(1): 57-56.

[20]. Rumahlatu, D., A. Gofur, and H. Sutomo. 2008. Relationship between Physical-Chemical Environments Factors with Echinoderms Diversity in the Tair Zone of Kairatu Beach. *Mipa* **37**(1): 77-85.

[21]. Sari, I. N. 2017. Diversity and Distribution of Macnozoobenthos in the Central Progo River. Essay. Biology Study Program, Faculty of Science and Technology, Sunan Kalijaga State Islamic University, Yogyakarta.

[22]. Septian, W. D., P. N. I. Kalangi, and A. Luasunaung. 2014. The Dynamics of Salinity of Fishing Areas Around the Estuary of the Malalayang River, Manado Bay, During the Spring Tide. *Journal of Fishing Science and Technology*. **1**(6): 215-220.

[23]. Simamora, D. R. 2009. Study of Macnozoobenthos Diversity in Padang River Flow, Tebing Tinggi City. Essay. Faculty of Mathematics and Natural Sciences, University of North Sumatra. Field.

[24]. Sulphayrin, L. O. L. Ola, and H. Arami. 2018. Composition and Types of Macnozoobenthos (Infauna) Based on Substrate Thickness in Seagrass Ecosystems in the Southeast Sulawesi Nambo Waters. *Journal of Water Resource Management*. **3**(4): 343-352.

[25]. Susana, T. 2009. Level of Acidity (pH) and Dissolved Oxygen as an Indicator of the Quality of the Waters Around the Cisadane River Estuary. *Journal of Environmental Technology*. **5**(2): 33-39.

[26]. Ulfah, Y., Widjaningsih, and M. Zainuri. 2012. Macnozoobenthos Community Structure in the Morosari Region Waters of Bedono Village, Sayung Demak District. *Journal of Marine Research*. **1**(2): 188-196.

[27]. Wisha, U.J., Husrin, S. and Prasetyo, G.S., 2016. Hydrodynamics of Bontang Seawaters: Its Effects on the Distribution of Water Quality Parameters. *Ilmu Kelautan: Indonesian Journal of Marine Sciences*. **21**(3). 123-134.

[28]. Yusuf, M. and Handoyo, G. 2004. Dampak Pencemaran Terhadap Kualitas Perairan dan Strategi Adaptasi Organisme Makrobenthos di Perairan Pulau Tirangcawang Semarang. *Ilmu Kelautan: Indonesian Journal of Marine Sciences*, **9**(1): 41-49.

[29]. Zulfiandi, M. Zainuri, and R. Hartati. 2012. Macnozoobenthos Community Structure in Pandansari Waters, Sayung District, Demak Regency. *Journal of Marine Research*. **1**(1): 62-66.

[30]. Zulkifli, H., and D. Setiawan. 2011. Macnozoobenthos Community Structure in the Musi River Waters of the Pulokerto Region as a Biomonitoring Instrument. *Jurnal Natur Indonesia*. **14**(1): 95-99.