Macrozoobenthos Community Structure in The Estuary of Donan River, Cilacap, Central Java Province, Indonesia

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ABSTRACT

Estuary of Donan River which is adjacent to Segara Anakan Lagoon in Cilacap, Central Java Province (Indonesia) has been used for a number of activities such asfishieries, agriculture, industry, harbor, and tourism activities. The aim of this study is to analyze the ecosystem condition based on mazcrozoobenthos community structure. This study was conducted from Augustus 2015 to January 2016. Samples were collected monthly at five stations from the river close area to the ocean close area. The study was conducted to identify kinds of generaand densityof themacrozoobenthos, and analyze substrates and water quality.Data analysis was performed onabundance, diversity, evenness and dominance indexes.Based on the study, macrozoobenthos at the estuary of Donan River consists of three classes*i.e*Gastropod (12 genera), Bivalvia (9 genera), and Polychaeta (6 genera). Based on the sampling location, Gastropod and Bivalvia are the largest composition found at five stations. Based on the sampling location, the macrozoobenthos density, diversity index,evennes index,and dominance indexcan be inferred that the estuary of Donan River is classified to be moderately ecological polluted.

1. Introduction

Estuary of Donan River is located in Cilacap, Central Java Province, Indonesia, and it is directly adjacent to Segara Anakan Lagoon and connected with the Indian Ocean through Nusakambangan Strait. Estuaryis atransitional zone between land and ocean, and this wateris affectedby tidecontaining salt water, thereby, increasing its salinity. The water flows of the river bring fresh water,thus lowering the salinity level in the estuary (Savenije, 2012). Nevertheless, this will cause a fluctuation in salinity and will affect the unique community of aquatic organisms in the estuary (Rositasari and Rahayu, 1994). Aquatic organism community of the estuary is mixture between theendemic organisms (permanent) inhabitingthe estuary and organisms that can migrate into the estuary waters which have a wide salinity tolerance.

Estuary of Donan River has been utilized for a variety of human activities, such as industry, ports, fisheries, agriculture, and tourism. Some industries that are in the vicinity of the estuary include PT Pertamina RU IV Cilacap (oil refinery activities), and PT Holcim Tbk (holding the activities of cement production process, distribution of cement raw materials, and loading and unloading raw materials and coal mining).The existence of these activities is predicted to affect the water condition, particularly that of estuary of Donan River. In addition to the water quality, this activity seems to affect organisms that live in the water.

One of the organisms that will be impactedby those activities isbenthos. The benthos or benthic organisms area quatic organismcommunities that live at the bottom of waters, either on the substrate or in the substrate (Nupur et al., 2013). Benthos are aquatic organisms with low mobility, and the low mobility of this biota makes them unable to avoid the impact of pollution occurring in the waters of their habitat. The life pattern causes the benthos often to be used as bio-indicators for monitoring pollution to environmental quality. In addition, one of the properties of the benthos is that they are easy to obtain, havediverse kinds, and aresensitive to a range of water pollution. Macrozoobenthos community structure can describe the condition of aquatic habitats (Dar et al., 2010).

Benthos community structure can be illustrated by its diverse species and abundance. Sudaryanto (2001) stated that the macrozoobenthos in estuary of Donan River hadrelatively lowspecies composition and abundance, therefore, it seems they are subjected to pressure. Based on this information, a study isrequired to determine the condition of estuary of Donan River through its macrozoobenthos community structure. This information is one of important tool for the aquatic ecosystem management.Some studiesof the macrozoobenthos have been studied in several locations in Indonesia, i.e. community structure (Setiawan, 2008), community typology (Hidayah, 2003), adaptation strategy of macrozoobenthos (Yusuf dan Handoyo, 2004), gastropod distribution (Islami, 2015), and population structure of *Gelonia* sp (Irwani dan Suryono, 2006). While information of the macrozoobenthos at the estuary of Donan River has not been published.

The objective of this study is to analyze the condition of estuary of Donan River in reference to the macrozoobenthos community structure. The significance of this research is to evaluate the ecological pressures attheestuaryofDonan River based on the informationofthemacrozoobenthos community structure in the area. Subsequently, this studyis expected to be a reference in managing the estuary.

2. Materials and Methods

Time and Location

This study was conducted in estuary of Donan River, Cilacap, Central Java, Indonesia from August 2015 to January 2016 (Figure 1). The study activity involved taking samples, observing, and identifying macrozoobenthos organisms. The benthos sample collections werecarried out at 5 stations spreading from the station close to the river (Station 1) to the other stations close to the sea (Station 5).

Identification of the macrozoobenthos was conducted from September 2015 to March 2016 atLaboratory of Macro Biology, Division of Ecobiology and Aquatic Resource Conservation, and at Laboratory ofMicro Biology I, Division of Aquatic Environment and Productivity, Department of Aquatic Resource Management, Faculty of Fisheries and Marine Science, Bogor Agricultural University.
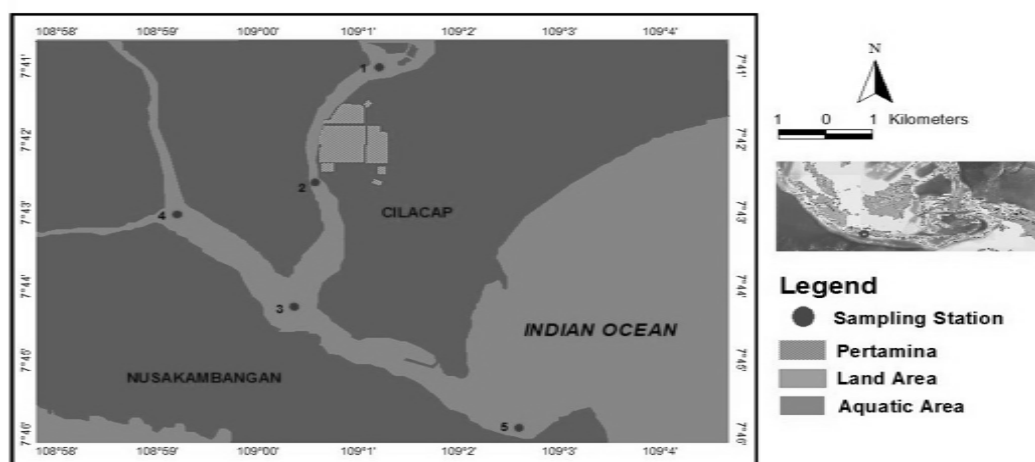

Figure 1. Study location at estuary of Donan River, Cilacap, Central Java, Indonesia

Table 1. Analytical method of the waters physical-chemical parameters (APHA 2012)

Parameter	Unit	Method/Measuring Equipment	Note
Temperature	^{o}C	Thermometer	*In-situ*
Tranparency	m	Visual/*Secchi disk*	*In-situ*
Depth	m	Scaled Rope	*In-situ*
pH	-	pH stick	*In-situ*
Salinity	‰	Refract meter	*In-situ*
DO	mg/l	DO meter	*In-situ*

Materials and equipment

The equipment utilized in this study included Ekman grab sized of 13 cm x 26 cm, a sieve with a mesh size of 1 mm, sample plastic bags, a magnifying glass, a microscope and an identification book. The materials used in this study consistedof sediment substrate samples, macrozoobenthos, water samples and formaline of 10 %.

Data collection

Data collection in this study was divided into two parts *i.e.*the direct measurement and observation in the field and analysis performed in the laboratory. Directly measurements were conducted to obtain data of macrozoobenthos and environmental conditions by analyzing water parameters which include transparency, depth, temperature, pH, salinity, and DO. Meanwhile, the observation in the laboratory was performed to identify the collected macrozoobenthos and analyze the obtained types of sediment substrates.

Macrozoobenthos and substrate sample collections were conducted by using Ekman grab

Data analysis

Macrozoobenthos density

The density of the identified macrozoobentoskinds of genera was then calculated in individual units per meter square. The calculation of the macrozoobenthos density was conducted by using the following formula:

$$K = \frac{10000a}{b}$$

Notes:
K   : Macrozoobenthosdensity per meter square (individual)

(13 cm x 26 cm) at five chosen stations. At each station, sediment sample was taken as many as three replications, and the sediments were then inserted into the plastic bags without preservation and stored in a cool box. The samples of the sediments were then filtered to obtain a sample of macrozoobenthos by using a sieve (with a mesh of ± 1 mm). The macrozoobenthos sample was inserted into a sample bottle and added by 10% of formaline. The macrozoobenthos identification was performed by observing the morphological characters directly using the microscope. Macrozoobenthos identification is based on Gosner (1971).

Sample analysis

Physical-chemical parameters

The physical-chemical analytical method used in estuary of Donan River is referred to APHA 2012 (Table 1). The physical parameters analyzed included temperature, transparency, and depth while chemical parameters included DO, pH, and salinity.

a : Total macrozoobenthos obtained
b : The opening size of Ekman grab (cm^2)
10000 : Conversion from $cm^2$to m^2

Diversity index

Diversity index is the number of organism typesidentified in an area. The index was obtained by using Shannon-Wiener index formula as follows (Krebs 1999) :

$$H' = -\sum_{i=1}^{s} P_i \log_2 P_i$$

Notes:
H'   : Shannon-WienerDiversity Index

P_i : -i type proportion ($P_i = n_i/N$)
n_i : Number of individuals of –i type
N : Total number of individuals
s : Number of taksa

Criteria of Diversity Index (Kusmana *et al.* 2015):
H'<1 : Low diversity, high ecological pressure
1<H'<3 : Moderate diversity, moderate ecological pressure
H'>3 : High diversity, low ecological pressure

Evenness index

Evenness index is a composition of individuals of each species existing in a community (Krebs 1989 *in* Odum 1971). This index was calculated by using the following formula:

$$E = \frac{H'}{H_{max}}$$

Notes:
E : Evenness Index
H' : Diversity Index
H_{max} : Log_2 s
S : Number of taxa

Evenness index value (E) ranges from 0 to 1. A smaller E value showed that the evenness of a population is also small, and it is estimated that there is a genus that dominates the population. On contrary, a higher E value indicatesthatevenness of the population is high; therefore, there is no dominating genus (Krebs 1999).

Dominance Index

Dominance index is an index that is used to determine to which extent a group of organisms dominates other groups in an ecosystem. This index was obtained by the following formula (Odum, 1971):

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

Notes:
C : Dominance Index
n_i : Individual number per one species
N : Individual total number of identified species

The C value ranges between 0 and 1. C value closer to 0 indicates that there is almost no dominance of individuals. In contrast, C value closer to 1 indicates that there is a certain kind of dominance (Odum, 1971).

Substrate Types

Substrates are classified into several factions, and the classification of the substratesis based on the size of the substrate particles and sediment textures. In general, the substrate is classified into three categories i.e. sand, silt, and clay. The sand, silt, and clay substrates have a particle sizeof0.05 - 2 mm, 0.002 - 0.05 mm, and <0.002, respectively (USDA 2012). Types of the substrates can be determined based on the triangle of the substrate texture presented in Figure 2.

Correlation analysis between the macrozoobenthos and environmental parameters

Principal Component Analysis (PCA) is a multivariable destrictive statistical method to present the maximum information from a matrix of information to a graphical form. This analysis can provide an overview that is easily interpreted on data structure by only drawing upon important information. The results of the principal component analysis show a correlation between the parameters at each station.
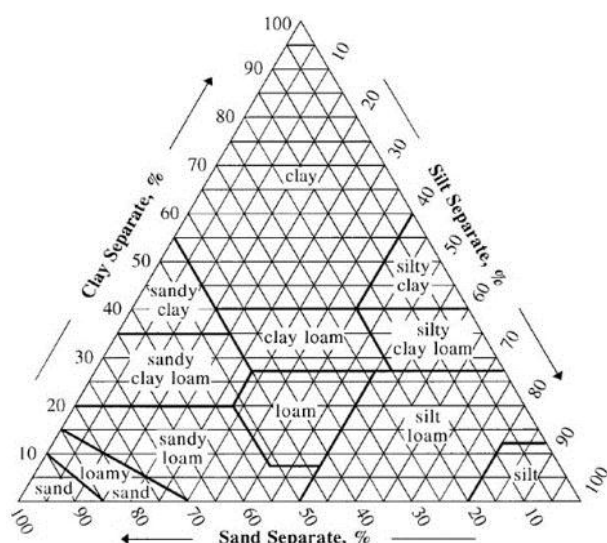
Figure 2. Percentage of substrate types based on the triangle of the substrate texture (USDA 2012).

3. Results and Discussion

Results

Type composition of macrozoobenthos

Composition of macrozoobenthos species found based on sampling station in estuary of Donan Riveris presented in Figure 3 and Appendix 1. Macrozoobenthos found and identified consist of three classes *i.e.* Gastropods (12 genera), Bivalvia (9 genera), and Polychaeta (6 genera). The macrozoobenthos mostly live inside the substrate. In reference to Figure 3, it can be seen that the genera of Gastropods and Bivalvia spread evenly across each sampling station. Polychaeta was found only at Stations 1, 2, 4 and 5. Moreover, genera of Gastropods and Bivalvia were most commonly found in each sampling station.   Based on the study, fives genera were found in a large number i.e.*Tellina* sp, *Pyramidella* sp, *Polineces* sp, *Buccium* sp, and *Nassarius* sp. The *Tellina* sp. is a genus that has the largest composition at Stations 1, 2, 3, and 5. Meanwhile, *Pyramidella* sp. has the largest composition at Station 4 (Table 2).

Table 2. Density of macrozoobentos based on the sampling stations

Organisms	Sampling Stations				
	1	2	3	4	5
	Density (Ind/m^2)				
Bivalvia					
Anadara sp.	13	0	0	10	10
Astarte sp.	10	0	0	0	0
Barbatia sp.	10	10	0	10	10
Noetia sp.	0	0	0	10	10
Siliqua sp.	10	0	0	10	0
Solen sp.	13	0	0	0	0
Spisula sp.	10	10	10	0	10
Tagelus sp.	0	0	0	0	20
Tellina sp.	36	52	18	27	18
Gastropoda					
Buccinum sp.	10	20	10	23	18
Calliostoma sp.	10	0	0	0	0
Calyptraea sp.	0	0	10	18	0
Columbella sp.	25	0	10	20	0
Epitonium sp.	15	0	0	20	0
Eupleura sp.	20	0	10	0	15
Littorina sp.	0	0	0	10	0
Melampus sp.	13	0	10	20	0
*Mitra*sp.	0	0	0	0	20
Nassarius sp.	20	27	40	26	10
Polinices sp.	20	30	30	15	10
Pyramidella sp.	22	10	20	13	46
Polychaeta					
Swainsonia sp.	0	0	0	20	0
Cheilonereis sp.	0	20	10	20	0
Nereis sp.	10	23	10	20	10
Onuphis sp.	0	0	17	10	0
Tachyrhynchus sp.	0	0	10	0	0
Terebra sp.	0	0	0	10	10

Table 3. Density of macrozoobentos based on the sampling times

| Organisms	Sampling Times					
	August	September	October	November	December	January
	Density (Ind/m^2)					
Bivalvia						
Anadara sp.	10	10	10	20	0	0
Astarte sp.	0	0	0	0	10	0
Barbatia sp.	10	10	10	10	10	0
Noetia sp.	10	0	0	0	0	0
Siliqua sp.	0	0	10	0	0	10
Solen sp.	10	0	0	0	10	20
Spisula sp.	10	10	10	0	0	0
Tagelus sp.	0	20	0	0	0	0
Tellina sp.	23	26	42	26	25	20
Gastropoda						
Buccinum sp.	15	15	10	30	30	13
Calliostoma sp.	10	0	0	0	0	0
Calyptraea sp.	0	10	10	20	30	10
Columbella sp.	20	10	10	30	0	0
Epitonium sp.	20	0	10	0	20	0
Eupleura sp.	0	17	10	0	0	0
Littorina sp.	0	0	0	0	10	0
Melampus sp.	0	10	0	10	20	15
Mitra sp.	0	0	0	20	0	0
Nassarius sp.	25	43	25	35	10	10
Polinices sp.	15	20	0	22	26	0
Pyramidella sp.	10	10	15	20	43	30
Polychaeta						
Swainsonia sp.	0	0	0	0	20	0
Cheilonereis sp.	0	0	15	20	0	0
Nereis sp.	30	20	10	10	20	15
Onuphis sp.	10	0	10	0	10	30
Tachyrhynchus sp.	0	0	0	0	0	0
Terebra sp.	0	0	0	10	10	0
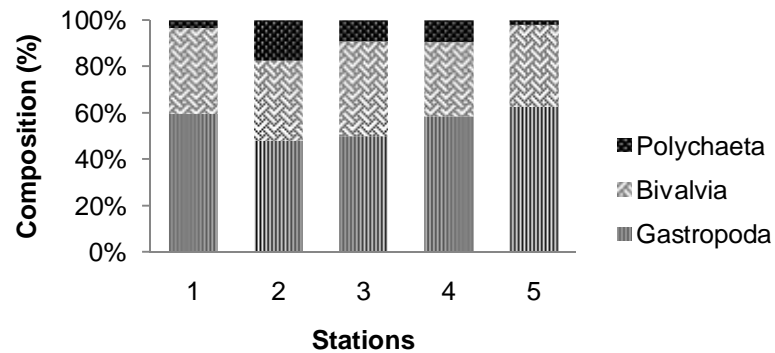
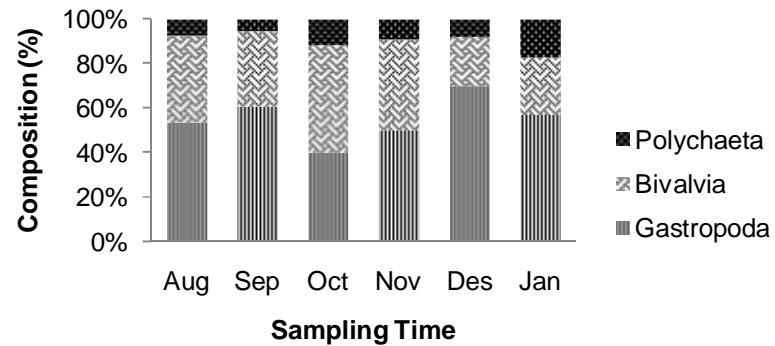Figure 3. Composition of macrozoobenthos species based on the sampling station

Figure 4. Composition of macrozoobenthos species based on the sampling time

The composition of macrozoobenthosin reference to the sampling time is presented in Figure 4 and Table 3. Based on the Figure 4, it can be seen that the spreads of the macrozoobenthos genera in a number of observation period are various. Percentage of Gastropoda was higher during sampling conducted in December, while Polychaeta was higher during January. Based on this study, *Tellina* sp was also found in a large number (August, October-January).

Density

Macrozoobenthos found in the estuary of Donan Riverconsist of 28 genera. Class Gastropoda and Bivalviaare most commonly found with 16 and 9 genera,respectively, and Polychaeta is found only 3 genera. The total density of the macrozoobenthos at each stationof estuary of Donan River is presented in Figure 5, while total density of the macrozoobenthos based on sampling time is presented in Figure 6.

Based on Figure 5, it can be seen that the largest total abundance is found at Station 2 of25 Ind./m^2, whilethe smallest total density is found at Station 4of17 Ind./m^2. The total density of macrozoobenthos at every period ofstudy is presented in Figure 6. Based on the Figure 6, it can be seen that the largest total density of macrozoobenthos is in December (reaching 23 Ind./m^2) while the smallest density is in August (15 Ind./m^2).
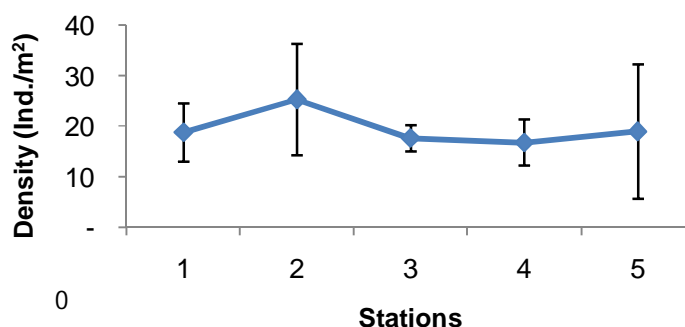
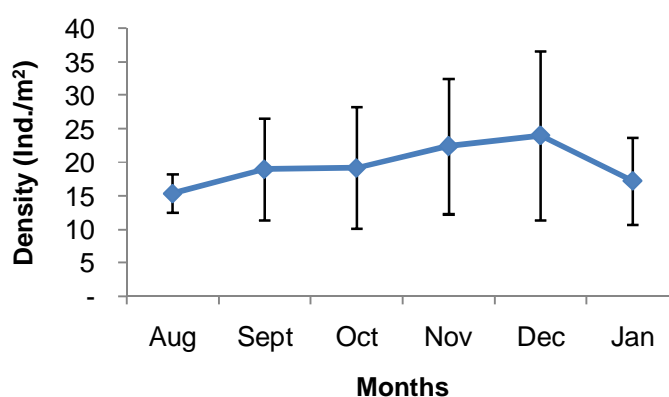Figure 5. Total density of Macrozoobenthos (Ind./m^2)based on the sampling station

Figure 6. Total density of macrozoobenthos(Ind./m^2) based on the sampling time

Diversity, evenness and dominance indices

Based on location, the diversity, evenness, and dominance index graphs are showed in Figure7 –9. It can be seen that the value of the diversity index (H') at every sampling location is>1 with the highest average value found at Station 4 and the smallest average value found at Station 2. Generally, the average value of diversity index ranges from 1.6 to 2.3. Evenness index values of the macrozoobenthos ranges from 0.9 to 0.1. The highest average value is at Station 4, while the smallest average values are atStation 1. Dominance index value generally ranges from 0.2 to 0.40. The highest average value is at Station 2, while the smallest average value was obtained from Station 4.
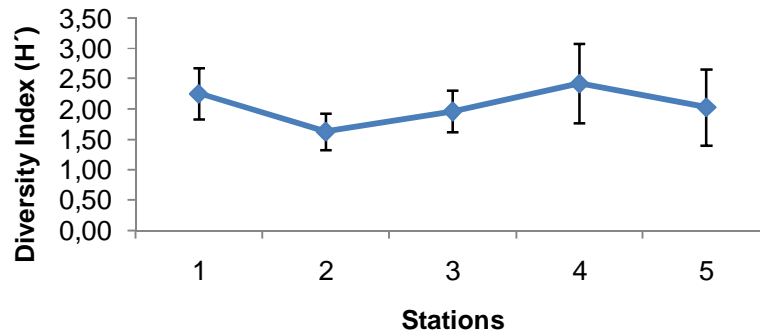
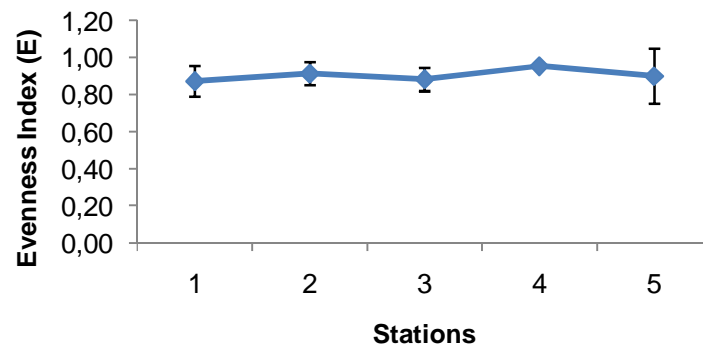Figure 7. Diversity index graph based on the sampling station

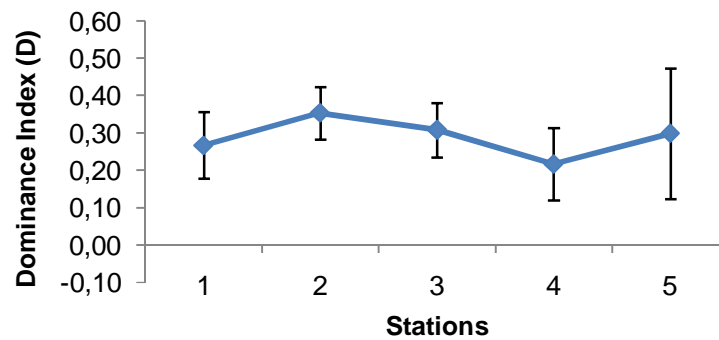Figure 8. Evenness index graph based on the sampling stations

Figur 9.Dominance index graph based on the sampling station

Diversity, evenness, and dominance index graphs based on the sampling time are presented in Figure 10, 11 and 12.Figure 10 showed that higher value of the diversity index exists in September, while the lowest one exists in January.
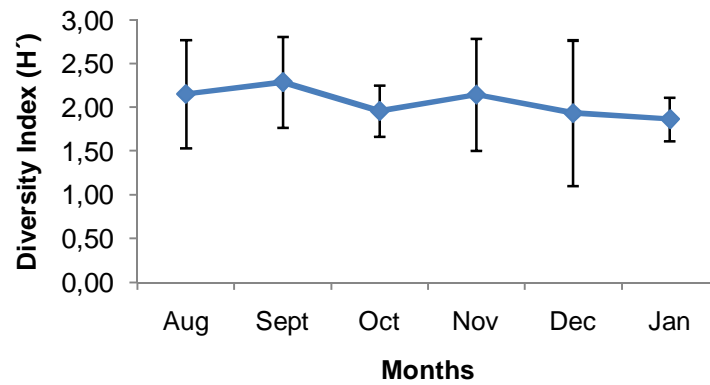
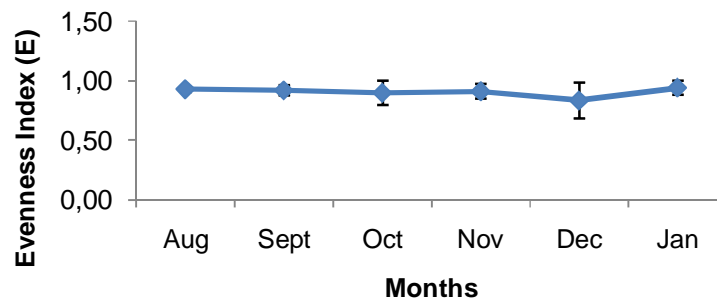Figure 10. Diversity index graph based on the samplingtime

Figure 11. Evenness index graph based on the samplingtime

According to Figure 11, it showed that higher value of evenness index is in Augustus, while a lower one is in January. Based on Figure 12, a higher value of dominance index is in January, while a lower one is in December.
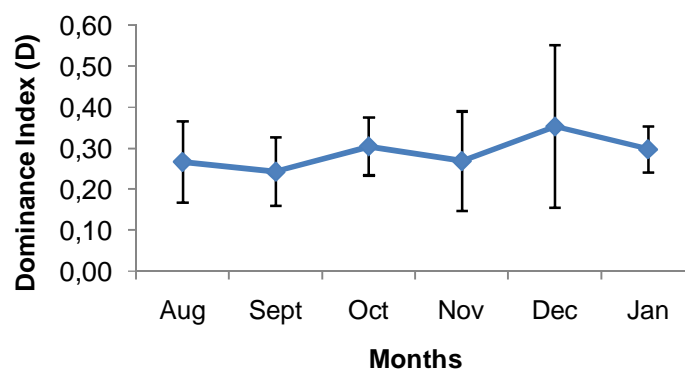

Figure 12. Dominance index graph based on the sampling time

Substrate types

The data of the substrate types of estuary of Donan River at each station are presented in Table 4. Sandy substrates were found at Station 3 and 4, clays were found at Station 2, sandy clay loams were found at Station 1, and sandy loam were found at Station 5.

Water quality parameters

The observed water quality parameters includedparameters of temperature, tranparency, depth, dissolved oxygen (DO), pH, and salinity. The average values ofthetemperature, brightness, depth, pH, and salinityof estuary of Donan River ranged from 28.32 to 29.37°C, 0.66 to 1.67 m, 2.32 to 7.66 m, 6.5 to 7.33 and 28.33 to 32.83 ‰, respectively (Tabel 5).

Table 4. Substrate Textures at each station

Station	Texsture (%)			Substrate Classification
	Sand	Silt	Clay	
1	52.34	18.6	29.06	Sandy clay loams
2	2.06	38.12	59.82	Clay
3	94.19	3.48	2.33	Sand
4	88.7	4.72	6.58	Sand
5	86.85	5.35	7.8	Sandy loam

Table 5.Parameters of water quality in estuary of Donan River

Parameter	Unit	Station				
		1	2	3	4	5
Physics						
Temperature	°C	29.37±1.90	29.37±1.24	28.60±1.82	29.07±2.17	28.32±2.33
Transparency	m	0.66±0.16	0.63±0.18	0.7±0.22	0.97±0.41	1.67±0.89
Depth	m	7.00±1.70	2.32±1.03	2.50±0.90	4.42±0.70	7.66±2.45
Chemics						
pH		6.83±0.41	6.50±0.55	7.33±0.51	7.00±0.63	7.17±0.41
Salinity	‰	29.67±3.67	31.00±3.85	28.33±5.79	31.17±0.71	32.83±2.86
DO	mg/l	7.03±1.63	7.38±1.69	8.50±1.17	8.52±1.20	8.60±2.09

Analysis of the correlation

Macrozoobenthos utilized in this study consisted of three classes: Gastropod, Bivalvia, and Polychaeta in reference to the environmental parameters *i.*e. transparency, depth, pH, salinity, and DO, and type of substrates included dust, clay, and sand. The principal component analysis is presented in Figure 13 and 14.
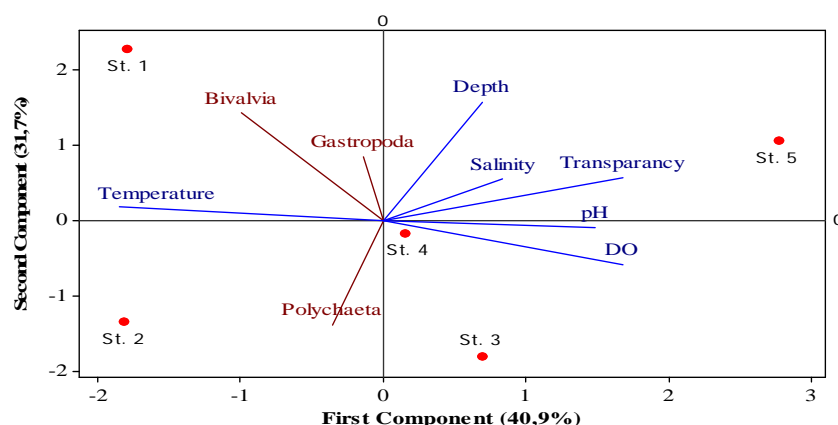
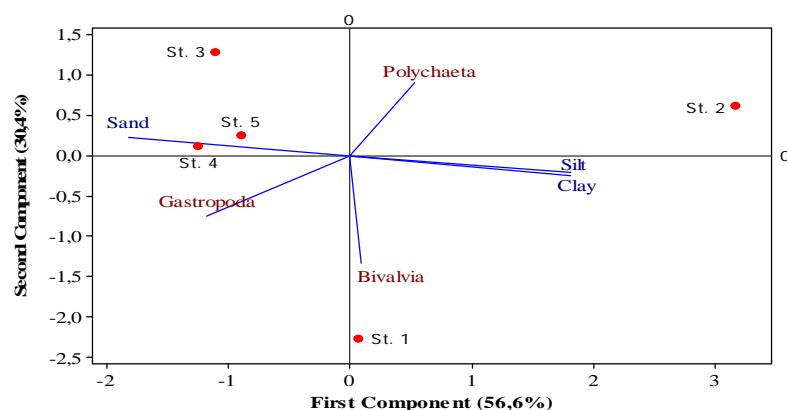Figure 13.The trend of environmental parameters with an density of macrozoobenthos (Ind./ m^2)

Figure 14. Trends types of substrates with density of macrozoobenthos (Ind. / m^2)

The principal component analysis of environmental parameters by adopting macrozoobenthos organisms (Figure 13) showed that the Classes Gastropodsand Bivalvia have a positive correlation with the parameters of transparancy, depth, pH, salinity and DO. The principal component analysis for the substrate types and macrozoobenthos organisms(Figure 14) showed that the classes of Gastropod sand Bivalvia have positive correlations with the substrate type of sand. Class of Polychaeta has a positive correlation with the substrate types of clay and dust.

Discussion

Macrozoobenthos is an aquatic organism that lives at the bottom of the waters. Rosa et al. (2014) stated that an macrozoobenthos organism

is easily available, has diverse types and sensitive to the different types of pollutants. Macrozoobenthos is also a good indicator to predict an aquatic habitat condition (Kumar and Vyas, 2014). Based on this study conducted in estuary of Donan River, Gastropod and Bivalvia which belong to the dominating class of macrozoobenthos contain 16 and 9 Genera. *Tellina* sp. is a macrozoobenthos of Class Bivalvia that had the highest composition at Stations 1, 2, 3, and 4, while *Pyramidella* sp. belongs to the macrozoobenthos of Class Gastropod with the highest compositionat Station 5.

This result is consistent with the study conducted by Hidayah (2003), which stated that the type of macrozoobenthos of Classes Gastropod and Bivalvia were most commonly found in estuary of Donan River. Sudaryanto

(2001) also stated that a group of mollusks dominates the macrozoobenthos community in Donan River. The research conducted by Wibosono (2005) at the mouth of Cimandiri River also obtained the results that class Gastropod dominated the area with the highest species composition. This showed that Gastropod has an adaptability and enough broad range of tolerance to environmental conditions. This is in accordance with the statements of Kalyoncu et al. (2008); Esenowo and Ugwumba (2010); Sahin (2012) stating that Gastropod has a fairly high adaptability and considerably high tolerance to the watercondition and different seasons. Study conducted by Hongayo et al. (2013) stated that Gastropoda was found in a large number in Songculan Lagoon (Philippines). Furthermore, Gogina et al. (2010) stated that Polychaeta was found in a large number in the western Baltic Sea Baltik (Germany). While, Sharma et al. (2013) stated that Gastropoda was found in a few number comparing of those to the other macrozoobenthos in Sungai Kunda (India).

According to the study, the average values of diversity index based on sampling time ranged from 1.9 to 2.4 (1 <H '<3). Almost all stations have a diversity index value of > 2, and only Stations 2 has a value of <2. Therefore, it can be seen if compared with the other stationsthat they have a tendency to experience an ecological pressure, causing the macrozoobenthos community to be unstable. This is due to the fact that Station 2 is located close to the area producing waste disposals. Based on the study conducted from August to January (2015/2016), it can be seen that in January,the diversity index has the lowest value compared to that from the study in the other months. It may be caused by the beginning of the rainy season which occurs in January. The average value of the diversity index obtainedin this studyhas a lower range if compared with that of the previous studyconducted by Sudaryanto (2001) in this estuarywasfrom 1.24 to 3.88. Furthermore, the average value of the evenness index in general has a range of value from 0.9 to 1.0 (close to 1); therefore, this value indicates high evenness while the average value of dominance index has a range from 0.2 to 0.4 (close to 0) in general. The values of the dominance index obtained show that there is no particular genus domination. Thus, estuary of Donan River ecosystem is moderately diverse with a moderate ecological pressure and there is no dominance by one genus. Therefore, it can be

said that the condition of this estuary is still reasonably good.

The most common substrate type at the sampling location issand, except at Station 2 which is dominated by clay substrate (Table 4). Sari et al. (2017) explained that different types of sandy, muddy or gravelly substrates cause differences in the density and types of organisms in this estuary. Rieradevall et al. (1999) suggested that relatively less macrozoobenthos was found at a finer substrate. It can be seen that Station 2 which hasfiner substrates than the other stations contains the lowest total of abundance of macrozoobenthos. According to Putri et al. (2016), there is a correlation between number of organism (macrozoobenthos) and percentage of loam.

Based on the water physical-chemical parameters, it appears that there are no significant differences in each station, especially related to DO and pH parameters. DO value at each station ranges from 7.03 to 8.60 mg/L, and this value is good for the life of macrozoobenthos, where this organism can generally live in DO of more than 3.0 mg/L (Sudaryanti and Marsoedi 1995). The pH value at every station ranges from 6.50 to 7.33, and it is reasonably good for the life of macrozoobenthos. This is in accordance with the statement of Odum (1971) that aquatic organisms generally live well in the pH ranging from 6 to 9. Moreover, Il'yashcuk (1999) stated that the macrozoobenthos species of mollusks was highly sensitive to a decrease in pH.

The principal component analysis between the environmental parameters and macrozoobenthos organisms showed that Class Gastropod and Bivalvia have a positive correlation with the parameters of transparency, depth, salinity, pH and DO so that the life of them is influenced by the parameters of transparency, depth, salinity, pH and DO, while the principal component analysis between types of substrates and macrozoobenthos organisms showed that Classes Gastropodand Bivalvia have a positive correlation with the type of substrate of sand. While Class Polychaeta is positively correlated with the substantiate types of clay and dust. This showed that the existence of the Classes Gastropods and Bivalvia is influenced by the environmental parameters except for the temperature, and this condition is more common in substrates with a higher percentage of sand. Mean while,Class Polychaeta was not greatly influenced by changes in the environmental parameters and was found in many types of

substrates such as silt and clay. This class is tolerant and an opportunistic type, which will improve its process of reproduction in the depressed environmental condition (Pawhestri et al. 2015).The close correlation between Class Polychaeta and silt and clay substrates showed that macrozoobenthos of this class can be found in many types of substrates that have a higher percentage of silt and clay. The study conducted by (2006) in Jakarta Bay also obtained a similar result that Class Polychaeta has a very close correlation with the percentage of clay and dust.

Macrozoobenthos community structure in estuary of Donan River has a diversity index ranging from 1.9 to 2.3, evenness index ranging from 0.9 to 1.0, and dominance index ranging from 0.2 to 0.4. These values indicate that the condition of the estuary waters is still moderate. Differences in some of these parameters indicate the influence of the activities around the river estuary Donan that can affect water quality.

4. Conclusion

This study has identified, as many as 28 genera of macrozoobenthos from three classes i.e. Gastropod (12 genera), Bivalvia (9 genera), and Polychaeta (6 genera).Five genera are found in a large number i.e.*Tellina* sp, *Pyramidella* sp, *Polineces* sp, *Buccium* sp, and *Nassarius* sp. The index value of diversity at each observation station varyfrom 1.6 to 2.3, while the evenness index value is various from 0.9 to 1.0, and the dominance index is from 0.2 to 0.4. These values indicate that the condition of the estuary waters ofthe Donan River has a moderateecological pressure, with a reasonably stable community structure of macrozoobethos, a fairly uniform distribution and no indication of dominance. The condition of estuary of Donan River in reference to the physical-chemical parameters of waters is still relatively suitable for the life of aquatic organisms, especially for macrozoobenthos.

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