Organic Pollution Status in Mangrove Ecosystem at Tidung Island, Kepulauan Seribu Jakarta Indonesia

Ratna Komala, Mieke Miarsyah, Eka Putri Azrai

Abstract— Tidung Island is one of the major tourist Islands located in the Kepulauan , and has several important areas, one of which is the mangrove ecosystem, which currently has already been degraded from time to time. The aims of this study were to determine the status of organic pollution based on protozoa saprobic index and analyze some of the environmental factors that influence it. Descriptive method with survey design was used in this research. The location of mangrove ecosystem was divided into 3 observation stations and in each station divided into 3 sub-stations which are determined based on the conditions of the mangrove vegetation determined purposively. The data on organic pollution were analyzed descriptively based on saprobic index calculations, while the influence of several environmental parameters on saprobic index analyzed by multivariable statistical based on the Principal Component Analysis (PCA) program. The results show as much as 16 species of protozoa are identified, and the status of pollution in the mangrove ecosystem included in the Beta-Mesosaprobic category or medium polluted waters, while the environmental parameters that have a major influence on organic pollution waters of the mangrove ecosytem at Tidung Island are temperature, pH, turbidity and Biologycal Oxygen Demand (BOD

Key word : Mangrove, Organic Pollution, Tidung Island

I. INTRODUCTION

The mangrove ecosystem is a typical tropical forest type along the coast or river estuary which is affected by tides [4,21]. This ecosystem has very important meaning because it contributes in the form of organic matter to the waters and surrounding organisms, besides that it can reduce the influence of waves, hold mud and protect the coastal from erosion, tidal waves and hurricanes. Based on its ecological role, mangroves act as nurseries and spawning ground in some aquatic animals such as shrimp, fish and clam groups [21]. The Survival and growth of mangrove are determined by 3 main factors, namely: (1) freshwater supply and salinity, (2) nutrient supply and (3) substrate stability [21,22]. Various living organisms in the mangrove area, one of which is benthic fauna especially makcrozoobentos groups and protozoa grups act as a bioindicator of water pollution and as one of the connecting links in the energy flow and cycle of planktonic algae to high-level consumers. Then in terms of economics there are several types of macrozoobenthos which contain high protein values [15,19].

One of the mangrove ecosystems in Indonesia is on Tidung Island, which is the largest tourist island in the Kepulauan Seribu in the northern part of Jakarta. This Island has an ecological and economical role that very important for the people at Jakarta and its surroundings. The denseness of the population and anthropogenic activities such as tourism activities, settlements and the construction of other facilities around this region, as well as the large number of rivers that enter directly or indirectly will have an impact on habitat degradation in coastal areas and cause water pollution. If this condition occurs continuously it is thought that it will affect the lives of marine biota including benthic fauna. One way to measure water quality is by knowing the value of the saprobic index [13]. An assessment of the measurement of water quality using biota is known as the saprobic system. This system studies the effects of pollution from sourced organic wastes on aquatic biota. The saprobic coefficient is an index that is closely related to the level of pollution because the quality of the waters is seen by observing the composition of any organisms found in these waters [8]. Research on protozoa as a quality bioindicator has been carried out by many countries in the world [9] but in Indonesia there are no published scientific reports. Therefore, research on environmental conditions is needed to get a general picture of ecological information as the basis for sustainable management of mangrove ecosystem resources based on the integration of information and objective, realistic and actual knowledge by knowing the level of organic pollution based on the protozoan saprobic index and ecosystem forming benthic fauna community mangrove in Tidung Island Seribu Island waters and analyze several environmental parameters that influence it.

II. METHODOLOGY

Location and time

The research The research was conducted from May to October 2018. Sampling was carried out on the Mangrove ecosystem of Tidung Island, Kepulauan Seribu Jakarta, Indonesia, followed by observation and identification protozoa at the Zoology Laboratory Departement of Biology ,Faculty of mathematics and Natural Science Universitas Negeri Jakarta. The research location consist of 3 zones / stations, which were determined based on the condition of

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mangrove vegetation, namely zone I (sparse vegetation), zone II (medium vegetation) and zone III (dense vegetation). Each zone consists of 3 observation stations, Determination of the location of the station is assisted by a GPS (Global Positioning System). The research method used was descriptive quantitative with survey techniques, while the determination of sampling stations with purposive sampling. the sample was taken using a water sampler and filtered using plankton net

Sampling was done for 3 months with a time interval for taking every 1 month. The samples taken are then sorted and inserted into the botle of the sample given 10% formalin for further observation and identification.

The water substrate was taken by using Eckman dredge. Parameters observed included TSS, NO2, NO3, NH3, PO4 were analyzed in the Laboratory using the AAS method, and TOM (Total Organic Matter) using the Gravimetric method, while the substrate composition was analyzed using the Shephard Triangle method. Water samples were taken in the water column using Water Sampler (Van Dorn), the physical chemical parameters of the waters were measured in situ including temperature, turbidity, brightness, current velocity, pH, salinity by direct measurement and for dissolved oxygen (DO), and Biologycal Oxygen Demand (BOD) using DO Meter and the Winkler titration method. Observations of protozoa were taken from water samples at each station.

Analysis of organic pollution data was carried out descriptively through calculation of the Protozoa saprobity index [8] . To find out the classification of pollution levels refers to the criteria based on [10]. The data was analyzed based on the calculation of Shannon-Wiener diversity index and density [5] , while to examine variations in the characteristics of the aquatic environment that affected the saprobic index between observations station, used multivariable statistical analysis, based on Principal Component Analysis approach [18].

III. RESULT AND DISCUSSION

RESULTS

a. Abundance and composition of Protozoa

Protozoa identified as many as 16 species included in 11 genus. The most abundant species found from the three research stations was *Euglena anabaena* as much as 13 individuals and the least found species was *Stylonichia mytilus* only 1 individual. The highest protozoan abundance is found at station 3 with a value of 1.44 / m^2 then followed by station 1 with a value of 1.11 / m^2 and the lowest abundance value is at station 2 with a value of 0.972 / m^2 (Table 1)

The largest composition of pprotozoa is represented by the genus *Anabaena*, while the small composition is represented by 2 genus of *Amphisella* and *Stylonichia* (Fig. 2)

Table 1. Protozoa abundance during observation

Num	Protozoa	Stasion			Total
		1	2	3	
1	*Amphisiella sp*	0	0,036	0,036	0.072
2	*Cyclidium*	0,072	0,108	0,114	0,294
3	*glaucoma*	0,036	0,072	0,072	0,180
4	*Didinium*	0,108	0,114	0,114	0,336
5	*nasutum*	0,072	0,072	0,18	0,324
6	*Euglena*	0	0,072	0,072	0,144
7	*anabaena*	0	0,072	0,036	0,108
8	*Euglena*	0,036	0,072	0,108	0,216
9	*spyrogira*	0	0,072	0,036	0,108
	Euglena				
10	*muntabilis*	0,036	0	0,036	0,072
11	*Euglena sp*	0,114	0,108	0,114	0,336
	Euplotes sp				
12	*Gymnidium*	0,108	0,108	0,108	0,324
13	*aaeruginosum*	0	0,036	0,036	0,072
14	*Nasula ornata*	0	0,036	0	0,036
15	*Paramaecium*	0	0,072	0,072	0,252
16	*caudatum*	0,108	0,072	0,072	0,180
	Paramaecium sp				
	Phacus sp				
	Stylonichia mytillus				
	Vorticella sp 1				
	Vorticella sp 2				

Composition of protozoan Protozoa composition shows a different percentage between genus.

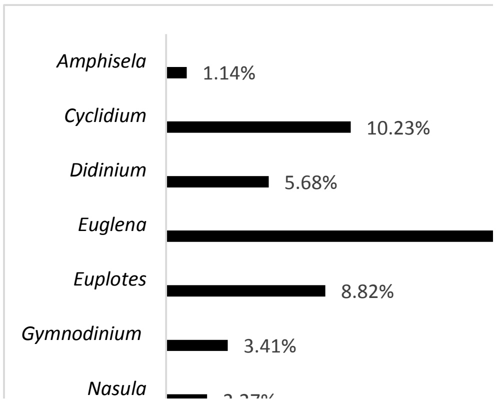

Fig 2. Composition based on genus of Protozoan

b. Saprobity Index

The Saprobity Index (SI) at 3 sampling stations shows that the highest SI value is located at station 2, which is equal to 2.481 then followed by station 1 at 2.338 and the lowest SI value at station 3, which is 2.350. Based on the saprobic index range, it was shown that at the three observation stations including moderate pollution criteria (Beta-Mesosaprobic)

d. Environmental Parameters

The results of observations and measurements both in the field and the results of analysis in the laboratory showed that the values of the physical chemical parameters of the waters varied both temporally and spatially between observation stations, but most were still in normal conditions for the life of marine organism .

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The results of Principal Component Analysis (PCA) showed the most influential parameters for the saprobic protozoa index values were temperature, pH, turbidity and Biologycal oxygen Demand (BOD) (Fig 3)

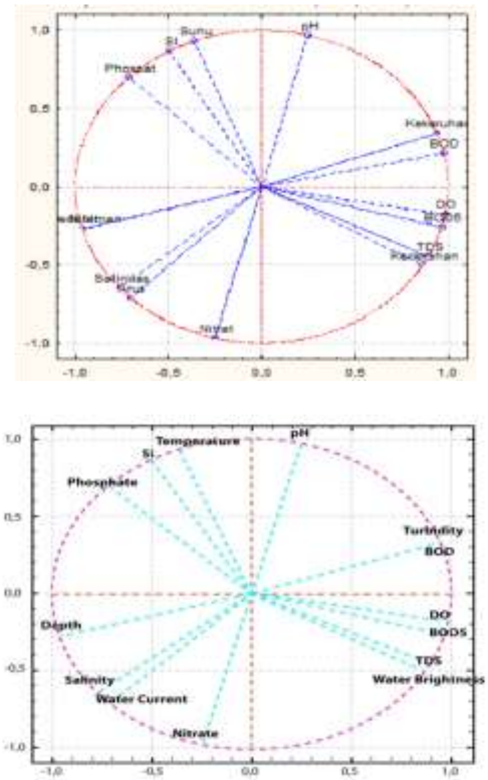

Fig 3. Environmental parameters that affect the saprobic index

IV. DISCUSSION

The most abundant protozoa are represented at station 3 because the water conditions at this station are quite good for the life of the Protozoa. This is indicated by favorable environmental conditions, for example pH ranges from 7-8. The pH (optimum acidity) for the metabolic process of Protozoa is between pH 6-8 [3] . At station 3 Euglena anabaena species, well developed, this is because the condition of the base substrate in the form of clay is very suitable for the life of that species. Euglena is a genus of Protozoa that likes basic clay and sand habitats [14].

Euglena anabaena is a species that is quite tolerant of polluted waters and likes basic clay and sand habitats. At least the species of *Stylonichia mytilus* was found, allegedly due to the condition of the waters that are not in accordance with the life of *Stylonichia mytilus*. Based on the classification of organic pollution levels in the three research locations, the three were classified into the zone of Beta-Mesosaprobic waters or moderately polluted waters [10]

The saprobic level will show the degree of pollution that occurs in the waters and will be manifested by the number of microorganisms of the pollution indicator. Saprobity index values respectively from stations 1, 2 and 3 are 2,387; 2,481; and 2,350. The pollution of the environment in these waters is allegedly due to industrial activities in the area around the waters. At station 1 Protozoa species were found which naturally inhabit the Beta-Mesosaprobic waters zone due to sensitivity to certain organic matter content such as nitrate (NO_2-N) and nitrite (NO_3-N), namely *Didinium nasutum* (Farmer, 1980). Didinium is a predator of Paramecium. The discovery of two Paramecium species at station 1, namely *Paramecium caudatum* and *Paramecium* sp. it is assumed that the two species are prey and contribute to the existence of *Didinium nasutum*.

Protozoa at station 2 were found some indicators species in the Beta-Mesosaprobic waters zone, including *Cyclidium glaucoma*, *Vorticella* sp. and *Paramecium* sp. *Cyclidium glaucoma* belongs to the Beta-Mesosaprobic zone because it has properties similar to *Didinium nasutum* which is sensitive to certain organic matter content. High tolerance for various environmental conditions causes this species to be widespread in the waters, including acidic waters, for example due to mining industry waste [16,22]. The most common species of *Gafrarium pectinatum* are found in all three research locations. The number of these species is suspected because this species can adapt well to the environment of dusty and sandy clays and has the most members among members of other aquatic organisms. Mollusks also include animals that are very successful at adjusting to life in several places and weather [1,3] . The genus of *Allocopnia* likes a place with a base substrate in the form of sand and rocky [13] , while at station 1 is not a rocky substrate. This species lives in a slightly muddy and slightly rocky conditions, this is not in accordance with the substrate in the three typologies on the research location there are two types, namely dusty clay and sand.

Bioindicators are species or groups of species that can accurately describe both abiotic and biotic environmental conditions or describe the impact of environmental changes from a habitat, community or ecosystem or indicate the diversity of taxon groups or overall diversity within an area [10].

Based on PCA analysis of environmental parameters that greatly affect the saprobic index of protozoa index are temperature, pH, turbidity and Biological oxygen Demand (BOD). The high turbidity values, it will affect the survival of macrozoobenthos animals. For benthic fauna that obtain food by filtering the water (filter feeder). BOD and DO affect the availability of organic matter in the waters. BOD is the need for oxygen to convert organic matter into nutrients in waters [2].

Temperature is an important factor in water quality which greatly affects aquatic organisms. This parameter is affected by high temperature fluctuations, the presence of suspended matter and the least float The optimum temperature for growth is 24-30^{o} C and is one of the important factors for the life of the organism in it, because the temperature affects metabolic activity and breeding [11]. Temperature is affected by high temperature fluctuations, the presence of suspended matter and the lack of floating plants [7]. Temperature affects the organism's life cycle and is a limiting factor for the spread of a species in terms of maintaining survival, reproduction, development, and competitivenes

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Most aquatic organism are sensitive to changes in pH and generally like pH around 7 - 8.5. Changes in pH in marine waters are usually very small due to the turbulence of the water period which always stabilizes the condition of the waters [6,22]. High turbidity results in the growth of organisms that adjust to clear water to be inhibited and can also cause the death because it interferes with the process of respiration [12]

V. CONCLUSION

The mangrove ecosytem in Tidung Island Kepulauan Seribu is in the condition of experiencing organic pollution with moderate category, and caracterized by some protozoan species as pollution indicator. Effort to monitor several environmental parameters are needed to maintain ecosystem balancing in that region.

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