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Distribution of macrozoobenthos at the Seletreng river in Banyuglugur, Situbondo, Indonesia

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ABSTRACT

The estuary of the Seletreng river is located in the Banyuglugur area of the Situbondo Regency and is directly adjacent to the shrimp pond area. The estuary of this river is widely used by local residents to look for fish, crabs. The existence of shrimp ponds near the mouth of this river has made many changes to the surrounding ecosystem. The purpose of this study is to determine the diversity index of macrozoobenthos and to determine the uniformity of macrozoobenthos. This research was conducted in February-March 2019, located in the waters of the mouth of the Seletreng Banyuglugur river, Situbondo district. Uses 5 stations with 3 repetitions. The diversity index value at the five stations, namely at station 1 is at a value of 0.66 which is categorized as low, at station 2 it is 0.36, at station 3 is 0.53, at station 4 is 0.65, at station 5 is 0, 25 wherefrom all stations the diversity index value is less than 1 and categorized as low diversity. The uniformity index value at the five stations, namely at station 1 is at a value of 0.37, at station 2 is 0.18, at station 3 is 0.24, at station 4 is 0.40, at station 5 is 0.12 wherefrom all stations diversity index value less than 1 and categorized on uniformity depressed.

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1. Introduction

One of the organisms that live on the coast is macrozoobenthos. Macrozoobenthos are organisms that live in clinging to, harboring and both at the bottom of the water and on the surface of the waterbed. Macrozoobenthos living in the seabed mostly live on hard substrates to mud (Arief, 2003). Macrozoobenthos are macro-sized invertebrates that live in and around rocks at the bottom of the water. Macrozoobenthos are also defined as invertebrate animals, living in or on sediment or

other large substrates. macrozoobenthos include snails, crabs, oysters, shellfish and include large insect larvae.

According to Odum (1993), biotic components can be provide an overview of the condition of an environment in determining the condition of a the waters of organisms that can be examined are macrozoobenthoos. Macrozoobenthos can be used as a bioindicator in a waterway due to its relative habitat Remain. Changes in sea water quality, litter availability and substrate type are highly diversity of macrozoobenthos. it is very dependent on tolerance and sensitivity to environmental conditions. Macrozoobenthos are aquatic organisms that live at the bottom of the water and live in a aquatic sediment. Nybbakken (1992) in Simamora (2009) said that macrozoobenthos habitats are grouped into infauna and ephifauna. Infauna is a macrozoobenthos that lives buried in a substrate water by digging holes. Macrozoobenthos is the bioindicator of water quality is seen from the diversity and abundance of macrozoobenthos on the water. Poor or polluted environments affect the distribution or diversity in macrozoobenthos.

Abundant macrozoobenthos can be used as as an indicator of quality in a water, as well as playing a role in the decomposition process mineralization of aquatic organic materials, and occupies several levels of tropical in the food circuit. Macrozoobenthos can live and be found on a variety of types of substrates, sediments and based on sedimentation forms, especially in sediments bar in an intertidal area. This area is primarily dominated by bioclastic substrates (in the form of shards or destruction of corals and marine biota corals, algae and different types that live together with corals). Tendency this allows for the influence of macrozoobenthos distribution (Muhaimin, 2013).

The spread of communities and types of macrozoobenthos is determined by the nature of physics and khemis in a waterway. The physic properties of the waters include color, tidal, speed current, depth, noise or brightness and water temperature. The nature of the water khemis includes organic matter, pH, dissolved gas content, nutrient content, and biological factors such as manufacturers and predators can influence the abundance of macrozoobenthos. By size, Laili and parson (1993) in Simamora (2009) classify zoobentos into two large groups of microzoobentos and macrozoobenthos. Based on the category, bentos can be divided into 3, namely Microfauna is an animal smaller than 0.1 mm and classified into protozoa or bacteria.

Mesofauna is an animal measuring 0.1 to 1.0 mm and is classified into in several classes namely large protozoa, small stinging crustaceans, worms and larvae of invertebrates. Macrophauna are animals larger than 1.0 mm and classed as mollusks, echinodermata, crustaceans, and some phylums annelida. Macrozoobenthos according to Odum (1993) can be incorporated into animal species macroinvertebrates. The main group stages are generally insects, mollusks, chaetopoda, crustaceans, and nematodes. Macrozoobenthos are often found in the waters are a group of crustaceans, mollusks, and insecta

2. Material and methods

The research was conducted in September to Desember 2019, located in the estuary of seletreng banyuglugur river (figure 1), Situbondo. Using 5 Transects with 3 replays. Samples obtained are identified in the Fisheries Laboratory Muhammadiyah Malang using the identification book " The Encyclopedia of SHELLS".

Figure 1. Sampling location

2.1. Sampling

Macrozoobenthos sampling is conducted randomly in the estuary of the river Seletreng Banyuglugur using 5 stations and repeated 3 times. The process of retrieving macrozoobenthos is to use PVCs by lowering them to the bottom of the water, then lifting the paralons after 15-30 minutes. The samples obtained are further separated between mud sediments and macrozoobenthos samples. Macrozoobenthos sampling is performed at high tide. Sample macrozoobenthos that have been obtained are washed with water and then put in plastic clip and given a 10 % formaldehyde solution as a preservative and labeled as a sign. Macrozoobenthos identification is then carried out in the Fisheries Laboratory UMM.

2.2. Water quality measurement

Water quality measured in this study includes temperature, pH, DO, Salinity, TOM (total organic meter), Ammonia, Nitrite, Nitrate, and Substrate types. Water quality measurement is done directly when in the field and there are several parameters conducted in the Laboratory

2.3. Data Analysis

The data obtained is processed by calculating density, index diversity, uniformity index, and Dominance. Macrozoobenthos density defined as the number of individual macrozoobenthos per unit of area (m2). Identified macrozoobenthos will be calculated density by type found with formulas (Brower and zar, 1977)

$$K = {}^{a}_{b}$$

K = macrozoobenthos density
a = number of macrozoobenthos found
b = Sampling area area

Diversity is one mathematical overview of the state of an organism's community to make it easier to analyze individual types and biomass. Diversity data management is used in the diversity index using the Evvenes Index formula (Odum 1993) as follows:

$$H' = -\sum ni/N \; X \; \ln ni/N$$

H' = Diversity Index of type

ni = Number of individuals of each type
N = Number of whole individuals.

H'<1: Low diversity, the spread of the number of individuals per species is low, and the biota community is low (unstable) 1<H'<3: Medium diversity, the spread of the number of individuals per species is moderate, and the medium biota community. H'>3: High diversity, the spread of the number of individuals of each species is high, and the community of high biota (stable) after obtaining the diversity index, then the uniformity index can be searched with the following formula:

$$E = \frac{H'}{LnS}$$

E = uniformity index
H = diversity index of types.
S = number of types of organism
Criteria:
0.00 > E > 0.50: Distressed community
0.50 > E > 0.70: Labil community
0.75 > E > 1.00: stable community
The dominance index is used for determining the absence of macrozoobenthos organisms that dominate a water. The Dominance Index can be ized in the following formula:

$$D = \sum (ni/N)^2$$

D = Domination Index.
ni = Number of individual types
N = the total number of individuals of all
criteria genus:
0.00 > D ≤ 0.50: Low Category
0.50 > D ≤ 0.75: Medium Category
0.75 > D ≤ 1.00: High Category

3. Results and Discussion

Salinity ranges from 25 to 30 g L^{-1}, the highest salinity is at station 4. temperatures at all five stations range from 28 to 34 ^oC. The water condition of the estuary of the river where the sampling can be seen in table 1.

Table 1. Water quality observations

Parameters	station 1	station 2	station 3	station 4	station 5
Temperature (^oC)	28	27	33	34	32
Salinity (ppt)	25	27	30	30	25
Amoniac (mg L^{-1})	0.50	0.25	0.50	0.50	0.25
Nitrite (mg L^{-1})	0.25	80	0.25	0	0
Nitrate (mg L^{-1})	40	80	5.0	10	5.0
Dissolved Oxygen (mg L^{-1})	1.4	1.6	2.9	3.1	2.8
pH	6.7	7.7	8.0	7.7	7.9
TOM (total organic matter)	10.73	12.99	13.48	11.02	10.73
Substrate type	muddy	sandy mud	sandy	muddy	Sandy mud

Macrozoobenthos observations were conducted at five stations with the highest number of macrozoobenthos at station 3, 107 with 8 different species, while at station 1 85 with 6 different species, at station 2 as many as 101 with 7 different species, at station 4 as many as 46 with 5 different species, while at station 5 as many as 87 with 8 different species , presented in table 2.

Table 2. Macrozoobenthos measurement results

Spesies	station 1	station 2	station 3	station 4	station 5
Turitella telebra	13	0	0	0	0
Turbo bruneus	8	10	47	9	9
Telescopium telescopium	20	15	5	0	0
Melanoides spp	7	12	0	0	0
Cirithidea cingulata	37	0	0	0	0
P. scutata	9	0	0	0	0
Anadara granosa	0	9	12	17	0
Telebralia palustris	0	18	0	0	0
Cirithidea cingulata	0	30	0	0	0
Brotia testudinaria	0	17	0	0	0
Lithorina littorea	0	0	7	0	0
Lithopa nigra	0	0	9	0	0
Globose	0	0	12	0	0
Ostrea edulis	0	0	10	0	0
Periglypta purpurea	0	0	9	11	8
Pilsbryococha exilis	0	0	0	12	0
Nerito undarta	0	0	0	8	0
Turbo pethalatus	0	0	0	0	6
Strombus canarium	0	0	0	0	13
Strombus urceus	0	0	0	0	9
Canus ebraeus	0	0	0	0	13
Turitella telebra	0	0	0	0	16
Mytilus viridis	0	0	0	0	21
Total	85	101	107	46	87

Table 3. Results of density measurement, diversity (H'), uniformity (E), domination (C)

Station	Density	Diversity	Domination	Uniformity
1	8.5	0.666	2.212	0.372
2	10.1	0.367	2.198	0.189
3	10.7	0.534	2.168	0.243
4	4.6	0.782	2.478	0.486
5	8.7	0.259	2.184	0.125

Table 3 shows the density index value on station 1 with a value of 8.5 m^2. Density values are calculated from the results of the number of samples obtained and divided by the area of sampling area. Density affects the life of macrozoobenthos where the more dense macrozoobenthos it indicates that in the watered ecosystem is good. Density at station 1 belongs to the low category, low density due to certain factors namely lack of nutrients and food that can not support the life of macrozoobenthos biota. Density is also related to the type of substar where the substart is the source of the nutrient. According to Marwan (2012) states that bentos animals are closely related to the availability of organic matter contained in substrates, since organic matter is a nutrient source for biota which is generally a basic substrate. Diversity index at station 1 with a value of 0.66 where the value of the diversity index is categorized as low. Low diversity is also related to water quality

where in the sampling area is obtained high nitrate yield with a value of 40mg/l, as well as substrates composed by mud. The low value of the diversity index causes instability and balance in the ecosystem. This is in accordance with Odum's (1993) statement stating that species density tends to be low in ecosystems that experience both physical and chemical pressures. The value of the uniformity index at station 1 is 0.37 which is close to the number 0, meaning uniformity is depressed.

The low value of uniformity has an impact on the unevenness of biota, causing distress to the ecosystem. low uniformity due to poor water quality where ammonia value is 0.50 mg/L, nitrate 40mg/L, and nitrite 0.25mg/L. so only types of biota with high adaptation can live in areas with poor water quality. According to Odum (1993) if the uniformity index relaxes one, then the organism in the community shows good uniformity. Conversely, if the uniformity of macrozoobenthos is close to the number 0 then the organism the community is not uniform. The value of the domination index at station 1 with a value of 2.21 or close to the number 2 which is categorized into high domination. The high value of dominance is due to the influence of water quality such as temperature, pH, salinity. The high value of dominance causes the absence of certain biota biota depressed. Furthermore Odum (1993) states that the basic substrate or texture of the soil is a very important component for the life of the organism. Substrates at the bottom of the water will determine the abundance and composition of the type of benthos animals.

The density value at station 2 is 10.1 where density indicates the amount or not of macrozoobenthos found in the sampling area. The diversity index at station 2 is 0.36, the low value of diversity is thought to be due to the waste of pond waste in the estuary area of the river that causes the water quality to change. Low diversity causes inequality in ecosystems. Where the water quality in the estuary of the ammoniac river is 0.25 mg L^{-1} nitrate 80mg L^{-1} as well as nitrite 80 mg L^{-1} as well as substrates composed by mud. An estuary water polluted by human behavior will result in a low value of diversity of aquatic organisms. Other factors that are thought to affect the low value of diversity include basic substrates, DO and BOD content (Tantalu et al. 2017). The uniformity index value at station 2 is 0.18 where the uniformity value is less than the number 1 which can be categorized as low or depressed. Uniformity is depressed due to the absence or high value of dominance (Bahri, 2014). where the dominance value at station 2 is 2.19 which is where there is a certain biota that dominates in the ecosystem of the estuary of the river. As well as the high dominance is also related to the quality factor of water which is flowed from the waste ponds that are dumped directly in the estuary of the river. A species can be the largest competitor in a habitat space or right then that species will generally dominate that habitat.

Based on the results of the density study at station 3 which is 10.7 high density related to water quality i.e. at station 3 known types of substrates in the form of sand and dissolved oxygen value (DO) of 2.9 Density affects diversity in aquatic ecosystems. The value of the station diversity index 3 is 0.53 which is categorized as low. The low value of diversity is due to a decrease in water quality at station 3 where nitrate values of 50 mg L^{-1}, nitrite of 0.25 mg L^{-1} and ammoniac of 0.25 mg L^{-1}. uniformity index reaches the maximum value if the spread of the individual number of each species is evenly distributed. The smaller the value of uniformity (close to zero) indicates that the spread of the number of individuals of each type is not the same as the tendency that the community will be dominated by a particular species. The uniformity index value at station 3 is 0.24. As well as the dominance index value at station 3 of 2.16. A community is said to have a high diversity of species if the community is composed by many species with an abundance of species of the same or almost the same, or in other words the diversity index is strongly influenced by the number of

species and the total number of individuals each species in a community (Hakiki et al. 2017). According to Pakpahan et al., (2013), the dominance index is used to indicate the absence of macrozoobenthos organisms that dominate a waterway.

Based on the results of the density study at station 4 which is only 4.6 where the low density is caused at the time of sampling at high tide and away from the estuary area of the river, as well as at station 4 substrates in the form of mud also affects and the high ammoniac at station 4 affects adaptation to biota. The value of the diversity index at station 4 is 0.78 or less than 1 where it is categorized as low. The cause of low diversity is where biota is found slightly and there is a high amoniac water quality factor of 0.50 mg L^{-1} so macrozoobenthos are found only slightly. The value of the station uniformity index 4 is 0.4 which is categorized as depressed. The low uniformity is related to the number of macrozoobenthos species found and the low uniformity resulting in imbalances in aquatic ecosystems (Hakiki et al. 2017). The dominance index at station 4 is 2.47 which is categorized as high domination so that there are certain types of species that are depressed in aquatic ecosystems. The classification of water pollution levels based on the dissification index <1 can be classified in heavily polluted waters. In deeper waters macrozoobenthos get greater physiological and hydrostatic pressure, therefore not many macrozoobenthos are found.

Based on the results of the study density value at station 5 which is 8.7 per m^2 where low density due to the high nitrate content at station 5 i.e. 5.0 mg L^{-1}, index at station 5 i.e. 0.25 low category and uniformity index of 0.12 categorized distressed and dominance index of 2.18 categorized high, where the diversity index, uniformity, is related to the index of dominance where if the index of diversity and uniformity is low then the index of high dominance caused by the absence of certain species dominates the aquatic ecosystem. According to Nontji (1993) states that the index of uniformity, discontinentness and dominance is related or related where if uniformity is low then the value of domination is high or vice versa

4. Conclusion

The value of the diversity index at the five stations at station 1 is at a lowly 0.66, at station 2 at 0.36, at station 3 at 0.53, at station 4 at 0.65 , at station 5 of 0.25 where the highest diversity index value is at station 4 but of all stations the diversity index value is less than 1 and categorized at low diversity. The uniformity index value at the five stations at station 1 is 0.37, at station 2 at 0.18, at station 3 at 0.24, at station 4 at 0.40 , at station 5 at 0.12. Where the highest uniformity index is at station 4 and lowest at station 5. where of all stations the value of the diversity index is less than 1 and categorized on distressed uniformity.

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