Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan (2022) 11(1): 97-105

DEPIK

Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan

Journal homepage: www.jurnal.unsyiah.ac.id/depik

Macrobenthos as an indicator of water quality assessment in Kutaraja Fishing Port, Indonesia

Makwiyah A. Chaliluddin[1,2,*], Shella Yusnita[2], Thaib Rizwan[2], Sayyid Afdhal El Rahimi[3], Ichsan Rusydi[3], Roesa Nellyana[4]

[1]*Fishing Technology Laboratory, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[2]*Department of Fisheries Resource Utilization, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[3]*Department of Marine Sciences, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[4]*Faculty of Law, Universitas Syiah Kuala, Banda Aceh, Indonesia*

ARTICLE INFO

Keywords:
Water quality
Bio-indicator
Benthos
Kutaraja
Banda Aceh

DOI: 10.13170/depik.11.1.25365

ABSTRACT

Water quality is influenced by the high activity in the port area, resulting in decreasing water quality. The biological parameters based on the structure of the aquatic community of organisms that act as bioindicators could be indicated as water quality changes around the port. Bioindicators are a group of living organisms that are susceptible to environmental changes due to human activities and natural damage.One of the aquatic organisms that can be used as an indicator of water quality is Benthos because of its sedentary nature. This study aims to determine the quality of the water environment seen from the benthic community structure, namely density, diversity index, uniformity and dominance index to embody the clean and pollution-free Kutaraja Fishing Port. The research shows the aquatic environment of Kutaraja Fishing Port is included as the less stable category with a moderate diversity value (H' > 1) but has high benthic individual uniformity (E > 0.6) which means that individuals are evenly distributed a low dominance value or C is close to 0.

Introduction

A fishing port is a located between land and waters that is used as a place for government activities or other fishery activities, such as ships to dock, fishing boats to lean on, and an area for loading and unloading catches equipped with security facilities for shipping and other supporting fishery activities(Sharaan *et al.,* 2017; Syakuro *et al.,* 2020). Kutaraja Fishing Port is the largest port in Aceh.Vice President Jusuf Kalla inaugurated the Kutaraja Fishing Port in 2015. Since then, this location has become a mainstay trade center for fish of the Acehnese (Pratama *et al.,* 2019).The Kutaraja Fishing Port is economically located in a very strategic place, including fishery activities (Chaliluddin *et al.,* 2019).

The development of Kutaraja Fishing Port, Banda Aceh is quite significant, marked by many activities in marine services such as fishing ports and activities around the coast such as settlements, industry, businesses, and aquaculture. The high activity in the Kutaraja Fishing Port area impacts the environment, one of which is the decline in water quality at the port (Muninggar *et al.,* 2017). Due to many activities at the port, it is suspected that water quality will decline.Changes in water quality in the port can be seen from the biological parameters based on the structure of the aquatic community of organisms that act as bio-indicators.One of the marine organisms that can be used as an indicator of water quality is benthos because of its sedentary nature (Cunha *et al.,* 2019).

* Corresponding author.
Email address: chaliluddin@unsyiah.ac.id

p-ISSN 2089-7790; e-ISSN 2502-6194
Received 23 March 2022; Received in revised from 21 April 2022; Accepted 26 April 2022
Available online 27 April 2022
This is an open access article under the CC - BY 4.0 license (https://creativecommons.org/licenses/by/4.0/)

Benthos is one of the efforts to monitor the effect of port activities on the environmental status of marine waters (Sany *et al.*, 2015). Ecological management of water quality monitoring becomes crucial to see the level of pollution of a port. Environmental control of water quality is carried out to maintain and overcome the impact of pollution and instability of the aquatic environment (Tarwotjo *et al.,* 2018). According to Nitonye & Uyi (2018), sources of pollution or environmental instability in port waters can derive from the disposal of waste water on ships, ballast water discharge from ships, and oily water discharge from ships, garbage, and others solid waste. Mostly, port pollution caused by human activities and negligence, either directly or indirectly through the inflowing of substances or energy into the water. Those activities include estuaries, waste water generated by cleaning harbor docks, cleaning ships, and liquid leakage or oil spills on ships (Farzingohar *et al.,* 2020). This research is considered necessary to determine the type of benthos found in the harbor waters environment so that the Kutaraja Fishing Port's environmental quality can be seen to embody a clean and pollution-free fishing port.

Materials and Methods

Method of collecting data

This research was carried out using a quantitative descriptive method, specifically by interpreting the data or samples that collected, then samples were identified for the types of each species obtained at the research location (Meisaroh *et al.,* 2018). The data collected in this study came from primary data and secondary data. Primary data includes the type of benthos obtained by directly taking the aquatic substrate, which then filtered and observed for its kind according to the benthos identification book guidelines to see density, diversity, uniformity and benthic dominance index, while secondary data is obtained from literature or related journals, regulations on Maritime Affairs and Fisheries and regulations on water pollution. The location determined by observations carried out using the purposive sampling method, namely choosing the research location according to some logic or strategy, but not at random, samples were taken according to the research objectives that can represent the wider population (Baltes & Ralph, 2020). Benthos sampling was carried out for one month with an interval of 7 days of observation at 5 stations. The observed station was considered to represent the entire observed location. The determination of the station was chosen based on the place that was considered important (Pratami *et al.,* 2018).

Data analysis

The parameters analyzed include the calculation of density (K), the diversity index (H'), uniformity index (E), and dominance index (C) as follows (Odum, 1971):

a. Density (K)

$$D = \frac{Ni}{A}$$

Wherein : D = Benthos density (ind/m^2); Ni = Number of Individuals per unit of tool; A = tool mouth opening (m^2); b. Shannon Whienner Diversity Indeks (H'), as follows:

$$H' = -\sum_{i=1}^{S} \text{Pi} \ln \text{Pi}$$

Information:
H' = Diversity Index
Pi = $\frac{ni}{N}$, Proportion of number of individuals of i-th species (ni) to the total individuals (N)
N = Total number of individuals of all species
The criteria for the diversity index are as follows: H` < 1= Low or unstable diversity; 1< H` < 3 = Moderate or less stablediversity; H` > 3 = High or stable diversity.

b. Shannon-Evenness Uniformity Index (E) is as follows:

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

Wherein: E = Uniformity Index; H' = Diversity Index; H maks = ln S Uniformity index value (E) ranges from 0 -1. If the value of E is greater than 0.6 then the uniformity value is high

c. Simpson's Dominance Index (C) as follows:

$$D = \sum_{i=1}^{S} (\text{Pi})^2 = \sum_{i=1}^{S} \left(\frac{ni}{N}\right)^2$$

Information: D = Dominance Index; ni = Number of individuals of the species – i; N = Total number of individuals; s = Number of taxa/species. The value of the dominant index (C) ranges between 0 and 1, if the value of C is close to 0 it means that almost no individual dominates, while if C is close to 1, it means that individuals are dominating the population.

Table 1. Water quality.

Station	Observation 1				Observation 2				Observation 3				Observation 4			
	H'	E	C	K	H'	E	C	K	H'	E	C	K	H'	E	C	K
1	1.10	1.0	0.3	88	1.10	1.0	0.3	35.29	1.04	0.9	0.3	47.06	1.10	1.0	0.3	35.29
2	1.39	1.0	0.3	47.06	1.39	1.0	0.3	47.06	1.33	1.0	0.2	58.82	1.00	0.9	0.3	47.06
3	1.10	1.0	0.3	35.29	1.10	1.0	0.3	35.29	1.61	1.0	0.2	58.82	1.39	1.0	0.3	47.06
4	1.15	0.8	0.1	105.88	1.42	0.8	0.1	129.41	1.15	0.8	0.1	105.88	1.22	0.9	0.1	117.65
5	1.83	0.9	0.1	164.71	1.93	0.9	0.1	152.94	2.14	1.0	0.1	136.79	1.71	0.9	0.1	152.94

Table 2. Density of benthic individuals during the study.

Station	Observation 1		Observation 2		Observation 3		Observation 4	
	Individual	Density	Individual	Density	Individual	Density	Individual	Density
1	3	35.29	3	35.29	4	47.06	3	35.29
2	4	47.06	4	47.06	5	58.82	4	47.06
3	3	35.29	3	35.29	5	58.82	4	47.06
4	9	105.88	11	129.41	9	105.88	10	117.65
5	14	164.71	13	152.94	12	136.79	12	152.94

Density

The water quality at Kutaraja Fishing Port regarding benthos density from stations 1 to 5, the highest density is at station 5 and the lowest is at station 1, which is presented in Table 2, station 1, the 3rd observation has a higher density of 47.06 ind/m^2 with 4 individuals and is dominated by 2 individuals of *Nereis diversicolor*. At station 2, the 3rd observation has a higher density of 58.82 ind/m^2 with 5 individuals and dominated by 2 individuals of *Nassarius sp.* At station 3, the 3rd observation has a higher density of 58.82 ind/m^2 with 5 individuals with the same number of species (evenly). At station 4, the 2nd observation has a higher density of 129.41 ind/m^2 with 11 individuals and is dominated by 6 individuals of *Anodontia edentula*.While at station 5, observation 1 had a higher density of 164.71 ind/m^2 with 14 individuals and was dominated by 3 individuals of Anodontia edentula and 5 of *Nassarius pullus*.

Table 2 provides that in the first observation, station 5 has the highest density of 164.71 ind/m2 with 14 individuals and is dominated by 3 individuals of Anodontia edentula, 5 individuals *Nassarius pullus*. In the second observation, station 5 has the highest density of 152.94 ind/m^2 with 13 individuals and dominated by 4 individuals of *Nassarius pullus*. In the third observation, station 5 has the highest density of 136.79 ind/m^2 with 12 individuals and dominated by 2 *Polinices didyma* individuals, 2 Nassarius pullus and 2 Polinices sp. Meanwhile, in the fourth observation, station 5 also has the highest density of 152.94 ind/m^2 with 12 individuals and dominated by 4 individuals of *Nassarius pullus* and 4 individuals of *Anodontia edentula.*

Diversity index

The Kutaraja Fishing Port's pollution level has an average diversity index of > 1 which is included in the moderate category or less stable environment. Figures 1, 2, 3, and 4 show that the highest diversity index at station 1 is found in observation 1,2,4 and the lowest is at observation 3. This happens because in the 3rd observation, there was more than one *Nereis diversicolor* organism or exceeding the number of other species. At station 2, the highest diversity index is found in observation 1,2, and the lowest is in observation 4. This also happened because at observation 4 there was an organism *Nassarius sp.,* which is more than one or exceeds the number of other species. At station 3 the highest diversity index is in observation 3 and the lowest is in observations 1 and 2. This happened because there were fewer species at observations 1 and 2 than other observations. At station 4 the highest diversity index found in observation 2, and the lowest was in observations 1 and 3. This happened because the organism *Anadontia edentulata* most commonly found in observations 1 and 3. The lowest found in the 4th observation.This occurred because in the 4th observation, there were more than one *N. pulluss* and *Anadontia edentulata* organisms or more than the number of other species.

Figures 1, 2, 3, and 4 explain that station 5 has the highest diversity index from the first observation and the lowest are at station 1 and 3. In the second observation, station 5 has the highest diversity index and the lowest are at station 1 and 3. In the third observation, station 5 has the highest diversity index and the lowest is at station 1. While in the fourth observation, station 5 has the highest diversity index and the lowest is at station 2. This happens because station 5 has a total number of *Nassarius pullus, anodontia edentula, Macrophiothrix belli, polinices didyma, polinices sp* individuals which are the most compared to other stations.

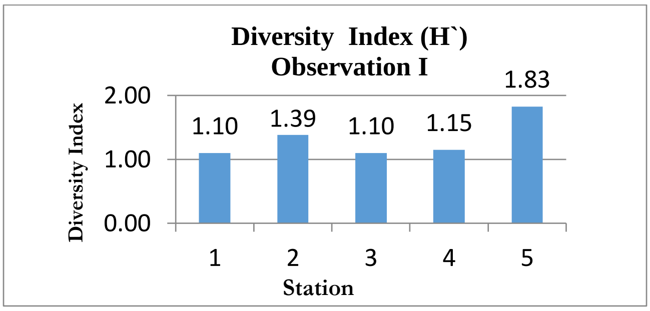

Figure 1. Diversity chart I

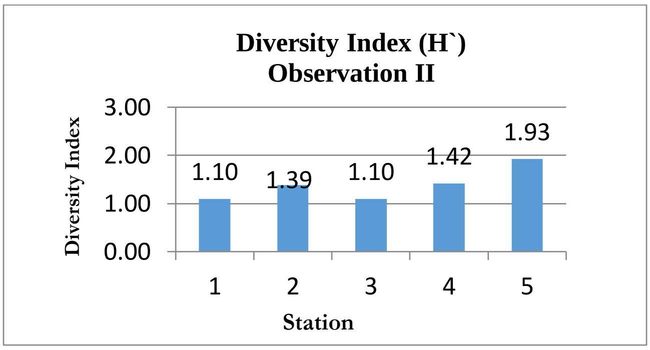

Figure 2. Diversity chart II

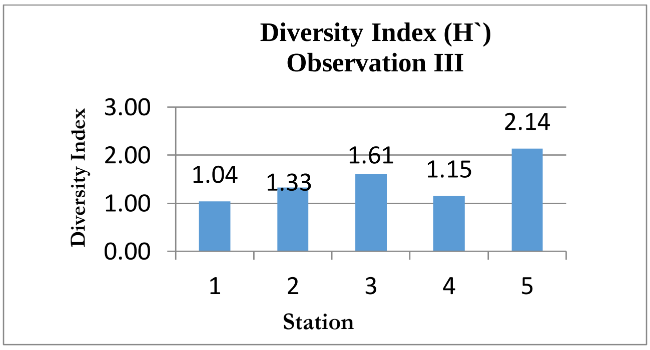

Figure 3. Diversity chart III

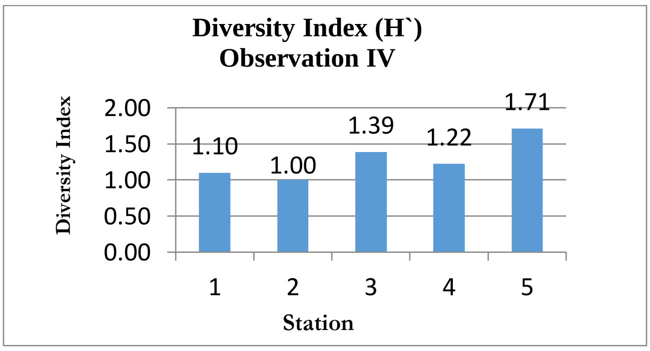

Figure 4. Diversity chart IV

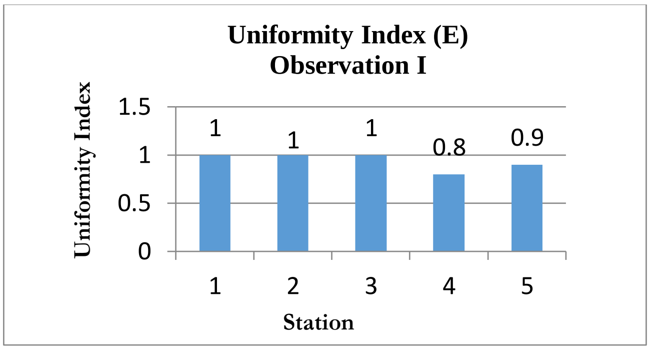

Figure 5. Uniformity Chart I

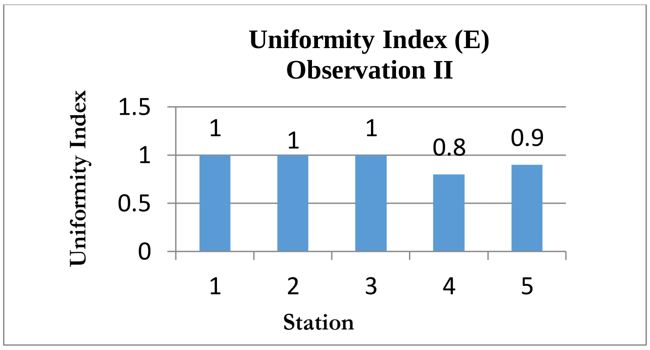

Figure 6. Uniformity Chart II

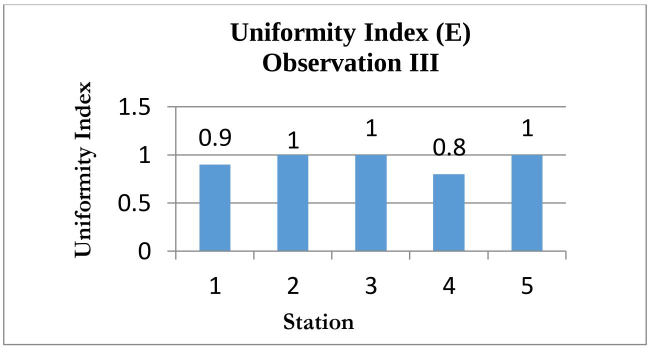

Figure 7. Uniformity Chart III

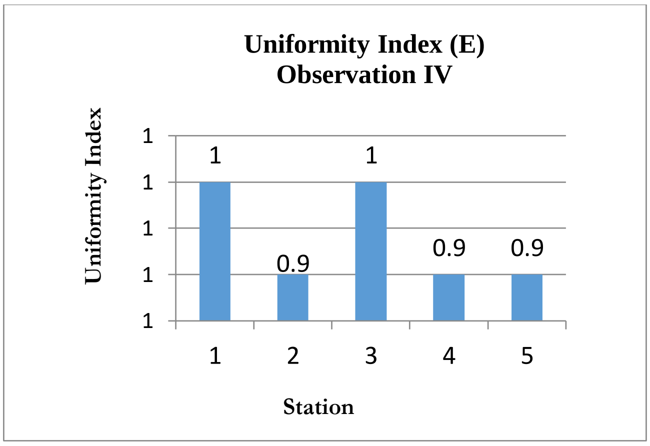

Figure 8. Uniformity Chart IV

Uniformity index

The benthos uniformity index in Kutaraja Fishing Port has an average value greater than 0.6, which means the waters have a high uniformity. The uniformity graph is presented in the Figures 5, 6, 7, and 8.

It provides information that the highest uniformity index for station 1 is found in observations 1,2,4 and the lowest is at observation 3. This happens because in the 3rd observation, there is more than one *Nereis diversicolor* or exceeds the number of other species. At station 2 the highest uniformity index found in observation 1,2,3, and the lowest was at observation 4. This also happened because in observation 4 there was *Nassarius sp*, which had more than one species or exceeded the number of other species. At station 3 it has the same uniformity index (evenly) starting from observations 1 to 4. At station 4 the highest uniformity index is in observation 4 and the lowest is in observation 1,2,3. This happened because in observation 1, 2 and 3 there were more *Anadontia edentulata* than the other species. While at station 5 the highest uniformity index found in observation 3 and the lowest was in observations 1,2 and 4. This happened because at observations 1, 2 and 4 there were *Nassarius pullus* and *Anadontia edentulata* which were more numerous than the number of other species.

Figures 5, 6, 7, and 8 explained that from the first observation, there were stations that had the highest uniformity index, those are station 1,2,3 and the lowest is station 4, as well as the second observation, which has the highest uniformity index at station 1,2,3 and the lowest, is at station 4. While in the third observation has the highest uniformity index, namely station 2,3,5 and the lowest is at station 4. This happens because at station 4 there are more *Anadontia edentulata* than a number of other species. In contrast to the fourth observation, station 1 and 3 have the highest uniformity index and the lowest is at station 2,4 and 5. This happens because at station 2 there was *Nassarius sp*, at station 4 there was *Anodontia edentula* and station 5 there was *Anodontia edentula* and *Nassarius pullus* which are more numerous than the other species.

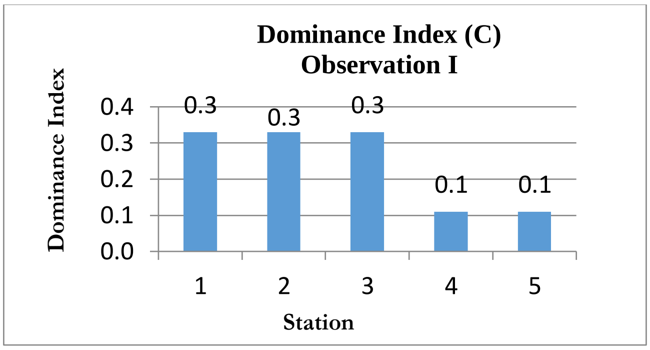

Figure 9. Dominance Index I

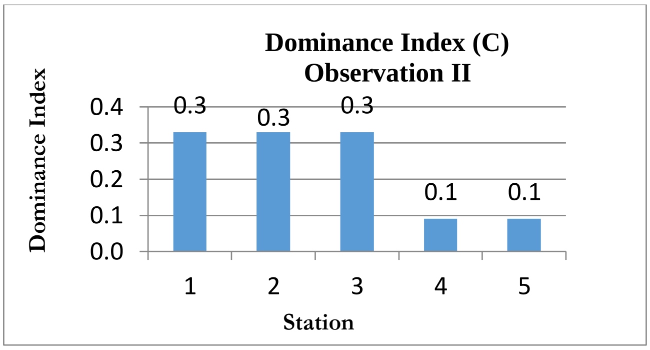

Figure 10. Dominance Index II

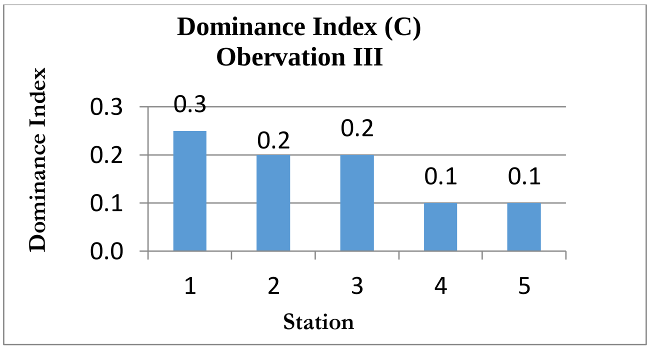

Figure 11. Dominance Index III

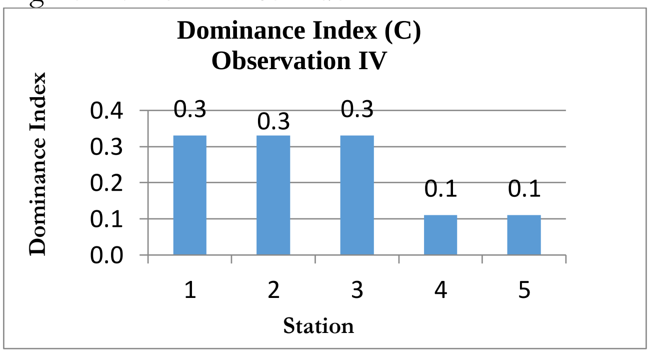

Figure 12. Dominance Index IV

Tabel 3. Measurement of water characteristics

Water Characteristics	Quality Standards	Observation				
		Station 1	Station 2	Station 3	Station 4	Station 5
Temperature	28-32	29.25	29.37	28.12	29.35	28.83
Salinity	30-35	32.60	32.60	33.10	33.10	33.20
pH	6.5-8.5	7.20	7.20	7.30	7.10	7.30
Dissolved Oxygen (DO)	>5	3.78	3.65	4.27	5.15	5.11

Dominance

The dominance of benthos in the waters of the Kutaraja Fishing Port has a value close to 0 or not more than 0.3, which means that the dominance is low or the waters do not have benthic individuals that dominate. The dominance graph is presented in the following Figures 9, 10, 11, and 12.

The dominance index at station 1 from each observation has the same results. At station 2, the highest dominance index in observations 1, 2, 4 and the lowest was at observation 3. This also happened because at observation 3 there was *Nassarius sp*, which had more than one species or exceeded the number of other species. At station 3, the highest dominance index is in observation 1, 2, 4 and the lowest was in observation 3. This is happens because at the 3rd observation, there are more kinds of species, and the overall number of individuals is evenly distributed, or none dominates each other.While the dominance index at station 4 has the same results or there are no differences, as well as at station 5, which has the same dominance index or there are no differences in each observation.

Figures 9, 10, 11, and 12 explain that from the first observation, stations 1,2 and 3 have the highest dominance index and the lowest is at stations 4 and 5 and the second observation. While in the third observation, which has the highest dominance index, namely station 1 and the lowest, is at stations 4 and 5. In contrast to the fourth observation, stations 1,2 and 3 have the highest dominance index and the lowest is at stations 4 and 5. This happened because at station 4 there were *Anodontia edentula* and station 5 there are *Nassarius pullus*, *Anodontia edentula*, *Polinices didyma* and *Polinices sp* which have more individuals than other species.

Water characteristics against Macrobenthos

The measurement of water characteristics includes temperature, salinity, pH, and dissolved oxygen (DO), which is presented in Table 3.

Discussion

Macrobenthos

Based on the ecological index, the differences in the value of the environmental index occur due to benthos species that have a higher number of individuals found at each station, including *Nereis diversicolor*, *Anadontia edentulata*, *Nassarius pullus*, *Polinices didyma*, *Polinices sp* and *Macrophiothrix belli*. *Nereis diversicolor* is an invertebrate organism classified as class Polychaeta and the family Nereidae. *Nereis* divers color is one of the commodities with a high economic value and is an important commodity in the cultivation field. This species was found at station 1 because it likes muddy substrates. Rajuansah *et al.* (2021 stated that *Nereis* divers colour usually lives in tidal areas, on muddy, sandy, and sandy mud substrates. At station 2, the most common benthic species is *Nassarius sp* because this species likes sandy or muddy sand substrates. *Nassarius sp* is a small to sea slug that belongs to marine gastropod molluscs in the family Nassariidae. This is in accordance with Putro *et al.* (2020) which states that the mollusk family Nassariidae generally lives in sandy and muddy substrates.

Station 4 which is located close to the river mouth and there are mangroves around it, the benthos species that is more commonly found is *Anodontia edentula*. This species is a member of the *Lucinidae* family that spreads in mangrove areas and can be consumed, and has economic value as a protein source (Tan *et al.,* 2015). *Anadontia edentulata* can also be found on muddy substrates such as at station 5. This is in accordance with Putro *et al.* (2020) which states that *Anodontia* are often referred to as mud shells because they inhabit muddy areas and spend most of their lives submerged in mud (mudflats). In addition, *Nassarius pullus* or gastropod class sea slugs in the *Nassariidae* family are also abundant at station 5 which has a muddy substrate. This is following Hermanus *et al.* (2020) which stated that *Nassarius pulluss* was found as the dominant species on muddy sand substrates and very abundant in mud flats.

Station of 5 benthic types *Polinices sp* and *Polinices didyma* are also commonly found. *Polinices* is a sea slug belonging to the gastropod family in the family Naticidae, commonly known as moon snail. The presence of *Polinices* at station 5 is because this species likes muddy substrates. This is following Lwin (2020) which states that the dominant *Polinices* species are found on muddy bottom substrates. In addition, *Macrophiothrix belli* or snaking stars are also found at station 5 which is an area that has a muddy substrate. This is in accordance with Nurdiansah and Supono (2017), which states that snaking stars are found on the bottom substrate of waters in tidal areas which are dominated by a mixture of mud and black sand with seagrass vegetation cover.

Several studies related to the density of benthos as in the study of Rahimi *et al.* (2016) who reported that the benthos organisms *Petrolisthes sp.*, Zoanthus sp., *Barbatia sp.* and *Pickles spp*, found only on rocky, sandy substrates. While *Uca sp.* and *Halophia sp.* were found only in sandy substrates. In contrast, Holzhauer et al. (2020) stated that the bristle worms *Spiohanes bombyx* and *Nephtys cirrosa* were mostly found in coarse-

Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan
Volume 11, Number 1, Page 97-105

sedimentary mud. *Capitella capitata* is mostly found on muddy substrates and contains organic matter. *Magelona johnstoni*, *Nephtys hombergii*, *Spio martinensis*, *Limecola balthica*, *Ensis*, *H. arenarius*, *B. elegans* and *B. pelagica* are found most often on sandy beaches. *S. squamata* can be found on beaches and offshore sands which are very dynamically hiding in sediments with low silt content. At the same time, Bivalves S. *subtrucata*, *L. balthica*, and *A. alba* prefer medium sand to muddy sand.

Characteristics of the waters also influenced by macrobenthos. External and internal factors influence the elements of water both in terms of physical and chemical. External factors originating from the high seas include temperature, salinity, pH and dissolved oxygen (DO). While internal factors are generally influenced by inputs sourced from aquaculture and community activities. Water quality also shows the size of water relative to the needs of aquatic biota and humans (Wibowo and Rachman, 2020). In Table 3, it can be explained that the characteristics of the waters of each station are still in accordance with the quality standards set by the Minister of the Environment Number 51 of 2004. Quality standard is a measure of the limit or level of living things, substances, energy or components that exist or must exist and or pollutant elements whose existence is tolerated in sea water.

Temperature is one of the important factors to support aquatic organisms' metabolic and reproductive activities. Based on temperature measurements at station 1 to station 5 it is still classified as a quality standard status, namely 28-29ºC. This is in accordance with Gultom *et al.* (2018) The temperature range is still quite good for the life of *macrozoobenthos*. According to Setyowati (2015) the higher the temperature can cause the death of aquatic organisms due to an increase in oxygen consumption, a decrease in dissolved oxygen and an increase in the speed of chemical reactions. Salinity affects the spread of *macrozoobenthos* organisms both vertically and horizontally. Indirectly, salinity can also lead to changes in the composition of organisms in an ecosystem (Angelia *et al.*, 2019). Based on the measurement of salinity at station 1 to station 5, it is still classified as a quality standard, which is around 32-33, which means this condition is quite good for *macrozoobenthos* life (Nugroho *et al.*, 2020). This is confirmed by Pradnyani *et al.* (2018) that optimal salinity conditions for gastropod life are in the range of 25-45 ‰. pH is the degree of acidity that describes the absolute balance of acid and base determined by the concentration of hydrogen ions in the water. The pH range of station 1 to station 5 is still classified in the quality standard status, namely 71-73. This is also following Siburian *et al.* (2017) state that the ideal acidity for the survival and growth of aquatic organisms ranges from 6.5 to 8.5.While Dissolved Oxygen (DO) is the total amount of oxygen present (dissolved). Dissolved oxygen (DO) has an essential role in microbial metabolism in aquatic environments and determines the level of oxygen available to living organisms and predicts DO concentrations for marine ecosystems. Dissolved oxygen (DO) obtained from station 1 to 5 has different values. At station 2 it has the lowest dissolved oxygen value, which is 3.65 mg/l, and at station 4,5 it has the highest dissolved oxygen value, which is >5 mg/l. This is because at station 2 there is a lot of activity that occurs in accordance with Patty *et al.* (2021) which states that the high turbidity influences the low levels of dissolved oxygen (DO) in the waters and the increasing organic waste material causes the least amount of residual dissolved oxygen (DO) in the waters.

Water environmental quality

The water environment quality at Samudera Fishing Port Kutaraja from station 1 to station 5 has almost the same value. It does not have a significant difference with a moderate diversity value (H' > 1). It means that the aquatic environment of Samudera Fishing Port Kutaraja is in the less stable category but has a high uniformity of benthic individuals (E > 0.6). So, the individuals are evenly distributed and a low dominance value (C is close to 0 or not more than 0.3) that there are no dominant individuals. It caused by the *benthic* found can survive and have the characteristics of High tolerance, an organism found in declining waters. This condition occurs due to Samudera Fishing Port Kutaraja such as waste water from washing catches that flows into water ponds, disposal of fish remains, loading and unloading ships, and fishing activities at the port, community waste and other activities in the waters. These habitual activities that is carried out continuously can trigger a decrease in water quality at the port. Shipping activities waste from port activities can come from ship waste (loading and unloading goods), drainage channels that empty into the sea, rainwater flows, Leaks and spills of unloading cargo. Those kinds of things which also consist of oil from ballast residue and residual washing water settlements that enter directly on the coast or the outskirts of the port cause a decrease in water quality in the port area (Siburian *et al.*, 2017).

The high abundance of organisms means that the aquatic environment is still stable because the activities around these buildings supply both organic and inorganic materials, namely the main food of organisms, to the surrounding waters. While the low abundance of organisms means that pollution has occurred or is unstable due to direct physical disturbances from various anthropogenic activities to the habitat (Chatzinikolaou *et al.,* 2018; Yusal *et al.,* 2019). Meisaroh *et al.* (2018) stated that moderate diversity is the distribution of moderate numbers of individuals and is classified as moderate pollution level because the surrounding ecological conditions are quite good because the value of water quality parameters does not decrease in quality. While the level of diversity is low, namely the number of individuals of each species is low, the stability of the community is low and the condition of the waters is classified as a heavy pollution level because it is a mangrove area around which there is a lot of community waste disposal, besides that it has a DO that is less than the optimum value and turbidity that exceeds the optimum limit. In addition, according to Putro *et al.* (2020) Macrobenthos diversity is considered low at all sampling stations because the area has mild disturbances caused by human and industrial activities.

Environmental management of water quality can be carried out as an effort to maintain and overcome the impact of pollution or water instability. Efforts that can be made including public awareness about environmental sanitation, procurement of wastewater treatment industry (IPAL) at ports, environmental law enforcement and cleaning the sea of garbage. This is in accordance with (Löhr *et al.,* 2017; Schmaltz *et al.,* 2020) which states that a comprehensive approach is needed that combines technology, policy-making, and advocacy to prevent further pollution and subsequent damage to aquatic ecosystems and human health. The strategy adopted in developing countries is to focus on better waste management and major system changes such as moving towards a circular economy and changing people's behavior.

Conclusion

The water quality at Kutaraja Fishing Port is included in the moderate diversity category, which means that the water environment of Kutaraja Fishing Port is less stable.

Acknowledgements

The author would like to thank Mr. Oni Kandi as the Head of Kutaraja Fishing Port for the permission to conduct this research, thanks to Tika Novia Putri, Rizal Mahendra and Rika Lismayana who have assisted in the research.

References

Angelia, D.W., S.A. Adi. 2019. Keanekaragaman dan kelimpahan makrozoobentos di Pantai Batu Belubang Bangka Tengah The diversity and abundance of Macrozoobenthos in Batu Belubang Beach, Central Bangka, 13(1): 68-78.

Baltes, S., P. Ralph. 2020. Sampling in software engineering research: a critical review and guidelines. ArXiv Preprint ArXiv, 2002(07764): 1-37.

Chaliluddin, M.A., D. Rianjuanda, R.M. Aprilla, L. Afriani, R. Fachruddin. 2019. The business study of shark fishing with bottom longline in Kutaraja Fishing Port of Banda Aceh, Indonesia. IOP Conference Series: Earth and Environmental Science, 348(1): 012090.

Chatzinikolaou, E., M. Mandalakis, P. Damianidis, T. Dailianis, S. Gambineri, C. Rossano, F. Scapini, A. Carucci, C. Arvanitidis. 2018. Spatio-temporal benthic biodiversity patterns and pollution pressure in three Mediterranean touristic ports. Science of the Total Environment, 624(1): 648-660.

Cunha, L.L., M.I.B. Alves, E.R. Ono, V.S. Uieda. 2019. Methods of sampling benthic invertebrates in lotic habitats: A spatial and temporal evaluation. Acta Limnologica Brasiliensia, 31(1): 1-8.

Farzingohar, M., Z. Khakpour, S.M. Ahmadizadeh, A. Soory. 2020. Fishing port pollution due to the vessel activities along Bandar Abbas Coast, Iran. International Journal of Coastal and Offshore Engineering, 3(4): 47-53.

Gultom, C.R., M.R. Muskananfola. 2018. Hubungan kelimpahan makrozoobenthos dengan bahan organik dan tekstur sedimen dikawasan mangrove di Desa Bedono Kecamatan Sayung Kabupaten Demak. Journal of maquares, 7(2): 172-179.

Holzhauer, H., B.W. Borsje, V.J.A. Dalfsen, K.M. Wijnberg, S.J.M. H. Hulscher, P.M.J. Herman. 2020. Benthic species distribution linked to morphological features of a barred coast. Journal of Marine Science and Engineering, 8(1): 2-23.

Löhr, A., H. Savelli, R. Beunen, M. Kalz, A. Ragas, V.F. Belleghem. 2017. Solutions for global marine litter pollution. Current Opinion in Environmental Sustainability, 28(1): 90-99.

Lwin, M.L. 2020. Macrobenthos community structure of Kan Maw Island and adjacent areas of Myeik Archipelago, Myanmar. Journal of Aquaculture & Marine Biology, 9(4), 129-137.

Meisaroh, Y., I.W. Restu, D.A.A. Pebriani. 2018. Community structure as an indicator of water quality on the coast of Serangan Bali Province. Journal of Marine and Aquatic Sciences, 5(1): 36-43.

Muninggar, R., E. Lubis, B. H. Iskandar, J. Haluan. 2017. Water quality status in the largest Indonesian fishing port. 9(3): 173-182.

Nitonye, S., O. Uyi. 2018. Analysis of marine pollution of ports and jetties in Rivers State, Nigeria. Open Journal of Marine Science, 08(01): 114-135.

Nugroho, A., M.R. Muskananfola. 2020. Jurnal Pasir Laut Jurnal Pasir Laut. Jurnal Pasir Laut, 4(1): 16-21.

Nurdiansah, D., Supono. 2017. Diversity of brittle stars (Ophiuroidea) in Talise waters, North Sulawesi. Journal of Tropical Marine Science and Technology, 9(2), 709-716.

Patty, S.I., F.Y., Yalindua, P.S., Ibrahim. 2021. Analisis kualitas Perairan Bolaang Mongondow, Sulawesi Utara Berdasarkan Parameter Fisika-Kimia Air Laut. Jurnal Kelautan Tropis, 24(1): 113-122.

Odum, E.P. 1971. Ecological Fundamentals. Translated by: T. Samingan and B. Srigandono. Ecological basis. Gadjah Mada University Press.

Pradnyani, G.A.M., I.W. Arthana. 2018. Kelimpahan dan Similaritas Gastropoda di Perairan Pantai, 1(1): 32-39.

Pratama, R., M. Muhammad, I. Rusyd. 2019. Study of the distribution of heavy metal (Pb) on the Lampulo Banda Aceh Samudera (PPS) Fishing Water. Marine Fisheries Student Scientific Journal Unsyiah, 4(4): 185-191.

Pratami, V. A. Y., P. Setyono, S. Sunarto. 2018. Diversity, zoning and overlay distribution of benthos in the Keyang River, Ponorogo, East Java. Depik, 7(2): 127-138.

Putro, S.P., S. Adhy, H. Safrijal, F. Muhammad. 2020. Assessment of environmental status of coastal mangrove area using macrobenthic assemblages: A study case at Tapak Mangrove area, Semarang, Central Java. Journal of Physics: Conference Series, 1524(1): 012139.

Putro, S.P., J. Sharani, A.S. Widowati, Suryono. 2020. Biomonitoring of the application of monoculture and integrated multi-trophic aquaculture (Imta) using macrobenthic structures at Tembelas Island, Kepulauan Riau Province, Indonesia. Journal of Marine Science and Engineering, 8(11): 1-13.

Rahimi, M., J.F. Seyfabadi, Z. Owfi, Ansari. 2016. Standard classification of intertidal habitats in North Qeshm Island (Persian Gulf). Indian Journal of Geo-Marine Sciences, 45(9): 1172-1180.

Rajuansah, R., M. Junaidi, H.B.D. Setyono. 2021. The solid influence of spread on the growth and survival rate of Sea Worm's (Nereis sp.). Journal of Tropical Biology, 21(1): 248-254.

Hermanus, N., J. Pagaya, M. Kaihena. 2020. Pengaruh beberapa pasta gigi terhadap pertumbuhan Streptococcus Mutans. Rumphius Pattimura Biological Journal, 2(1): 16-23.

Sany, S.B.T., R. Hashim, A. Salleh, M. Rezayi, O. Safari. 2015. Ecological quality assessment based on macrobenthic assemblages indices along West Port, Malaysia coast. Environmental Earth Sciences, 74(2): 1331-1341.

Schmaltz, E., E.C. Melvin, Z. Diana, E.F.G. unady, D. Rittschof, J.A. Somarelli, J. Virdin, M.M.D. Daly 2020. Plastic pollution solutions: emerging technologies to prevent and collect marine plastic pollution. Environment International, 144(1): 106067.

Setyowati, R.D.N. 2015. Status kualitas air das Cisanggarung, Jawa Barat. Jurnal Teknik Lingkungan, 1(1): 37-45.

Sharaan, M., A. Negm, M. Iskander, M. El-Tarabily. 2017. Analysis of Egyptian Red Sea Fishing Ports. International Journal of Engineering and Technology, 9(2): 117-123.

Siburian, R., L. Simatupang, M. Bukit. 2017. Analysis of the quality of sea waters on activities in the Port of Waingapu-Alor, East Sumba. Journal of Community Service, 23(1): 225-232.

Syakuro, M. A., A.A. Handaka, Junianto, A. Rizal. 2020. Analysis of the role cikidang fish landing port (PPI) towards fishermen's socio-economy in Pangandaran District, Indonesia. Asian Journal of Fisheries and Aquatic Research, 7(4): 1-7.

Tan, K.S., C.S.O. Moneva, C.A. Barazona, K.H.I. Coronel, C.G. Demayo. 2015. Qualitative and quantitative characterization of some common bivalves, 9(19): 114-122.

Tarwotjo, U., R. Rahadian, M. Hadi. 2018. Community structure of macrozoobenthos as bioindicator of pepe river quality, Mojosongo Boyolali. Journal of Physics: Conference Series, 1025(1): 1-7.

Wibowo, M., R.A. Rachman. 2020. Kajian kualitas perairan laut sekitar Muara Sungai Jelitik Kecamatan Sungailiat - Kabupaten Bangka. Jurnal Presipitasi, 17(1): 1-9.

Yusal, M.S., M.A. Marfai, S. Hadisusanto, N. Khakim. 2019. The ecological analysis of meiofauna as a water quality bioindicator in the coast of Losari Beach, Makassar. IOP Conference Series: Earth and Environmental Science, 256(1): 012024.

How to cite this paper:
Chaliluddin, M.A., S. Yusnita, T. Rizwan, S.A. El Rahimi, I. Rusdi, N. Roesa. 2022. Macrobenthos as an indicator of water quality assessment in Kutaraja Fishing Port, Indonesia. Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan, 11(1): 97-105.