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Diversity of Macrozoobenthic in Aquaculture Ecosystem of Lhokseumawe Regency, Indonesia

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ABSTRACT

This research was conducted to determine the diversity of macrozoobenthos in the estuary ecosystem of Lhokseumawe Regency, Indonesia. Sampling was carried out from July to September 2022 at five sampling locations. Five transects were examined each. Each sampling location has an area (10 x 10 m). The research showed that gastropods and bivalves were present at every sampling location. Macrozoobenthos diversity at the five research stations was in the range of 1,056 to 2,825, indicating moderate diversity. Macrozoobenthos diversity at the five research stations shows vulnerability to environmental changes, so management is needed.

Keywords: macrozoobenthic, aquaculture, transect, diversity index, dominance index

1. INTRODUCTION

The aquaculture conditions influence benthic habitat sustainability and determine the number of living animals that participate in ventilation and oxidize as deposit-feeders, redistributing the sediment's organic matter (Baker, Tyler et al. 2014). Biotic and abiotic components have specific roles in maintaining the stability and abundance of the food web (Jana, Lahiri et al., 2018).

A large number of benthic habitats has become a primary prominent indicator of the role of mineralization supply of organic matter in maintaining the aquatic habitats; this is due to the advantages of macrozoobenthic, which contribute the most tolerance limits to the different pollutants derived from the chemicals contaminant (de Jong, Baptist et al. 2015). Sedimentary conditions were intensely related to macrozoobenthic distribution in the aquaculture habitat as the distinction factor (Glockzin & Zettler, 2008).

The mangrove ecosystem area contributes to the diversity of abundance of food web of living habitat, and the crustacean species has become a crucial habitat for marine fisheries production. The total percentage of crab 27%, shrimp 58% and lobster 5% have contributed to the fisheries sector since 2011(Harlıoğlu, Farhadi et al. 2018).

Lhokseumawe Regency is situated in the western coastal area with the estuary and mangrove area as the crucial area for the macrozoobenthic diversity living habitat as the predominant food web of aquatic decomposers. In this study, the potential diversity of macrozoobenthic was investigated in five stations to ensure the availability and spatial distribution of important species of benthic availability within the aquaculture area.

2. LITERATURE REVIEW AND HYPOTHESIS

Benthos are organisms that attach or rest on the bottom of water and live at the bottom of the sediment (substrate) of water. Benthos can be divided based on how they eat into filter feeders (such as shellfish) and deposit feeders (such as snails). In dynamic environments (such as rivers), aquatic macroinvertebrates assess river water quality because benthic animals can provide a clear picture of the waters (Beukema, J. 1982). Benthic animals have a relatively sedentary lifestyle

and are always in contact with waste that enters their habitat—causing this group of animals to provide an overview of changes in environmental factors over time. Among the benthic animals that are relatively easy to identify and are sensitive to changes in the aquatic environment are the types that belong to the group of macroinvertebrates. This group is better known as macrozoobenthos (Resh, V. H., et al. 1996 Macrozoobenthos has a critical role in aquatic ecology in the nutrient cycle at the bottom of the waters and is one of the links in the energy flow and cycle from planktonic algae to higher consumers. Macroinvertebrates are used more often than other groups of organisms when assessing the quality of the aquatic environment (Carter et al., 2017)

3. RESEARCH AND METHOD

This research was conducted by developing a transects sampling method. The Sampling method was prepared on five stations, and physic and chemical parameter analysis was conducted to obtain the influence factor of aquaculture parameters, respectively. Complete information regarding the area of the aim of the study, the coordinate positioning technique is prepared as a geographic information system, also well-known as a biogeographic database (Faulwetter, Pafilis et al. 2016). As depicted in the map, station 1 is located at the estuary, Station 2 is located at the reservoir, Station 3 is at the mangrove area, Station 4 is at the shrimp pond area, and Station 5 is located at different spots in the estuary.

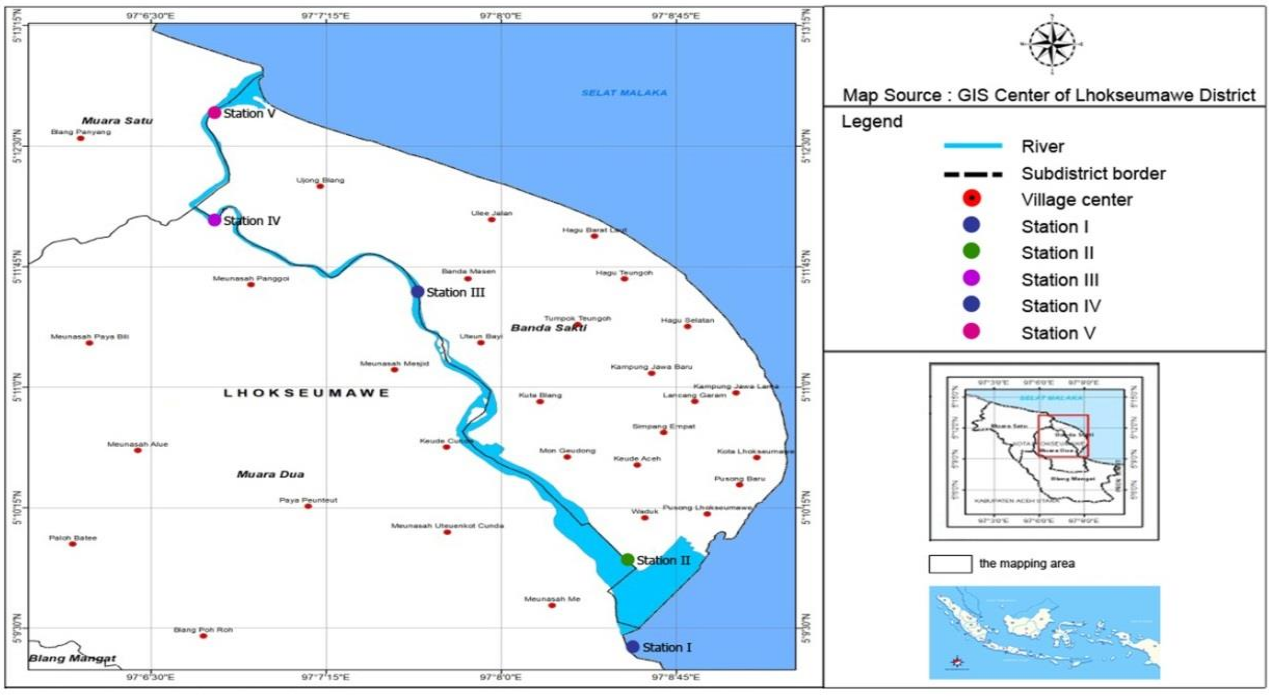

Figure1. Map of macrozoobenthic sampling point of Lhokseumawe city

In this study, every transect sampling station is divided into three substation plots with an area of (10m x 10m) to obtain accurate data on macrozoobenthic and sediment parameters.

The primary data source is data on macrobenthic diversity in the waters of Krueng Cunda, Lhokseumawe City. This research was carried out by establishing transit lines at five observation stations for taking macrozoobenthos samples**.** As depicted in the map, station 1 is located at the estuary, Station 2 is located at the reservoir, Station 3 is at the mangrove area, Station 4 is at the shrimp pond area, and Station 5 is located at different spots in the estuary.

Data analysis method

This research was carried out by developing a transect sampling method for the macrobenthic diversity index. The sampling method was prepared at five stations. In this study, every transect sampling station is divided into three substation plots with an area of (10m x 10m). A diversity index analysis was carried out to analyze the data obtained through observation. Determination of the Macrozoobenthos diversity index using the Shannon-Wiener formula (H') (Odum, 1963):

$$H' = - \sum Pi.\ln Pi, \text{ dengan } Pi = \frac{Ni}{N} \quad (1)$$

The following formula of the Shannon-Winner diversity calculation formula of diversity can be applied to the index that measures which is classified into three stages condition: low (H < 2), moderate (2 < H < 4), and high (H > 4) (Odum & Barrett, 2004). Data analysis using R-Studio.

4. RESULT AND DISCUSSION

The diversity index formula analysis shows diversity index analysis in the fifth research was formulated, the data on the diversity index yield the data range which is ranged from 1,056 to 2,500, at the first station the diversity index has 2,077, the second station has 1,514. The third station found 1,056, the fort station has 1,632, and the last sampling station, located in the estuary area, has the highest diversity index number with 2,500, the diversity of macrozoobenthic in the five research stations in the moderate level results. Moderate community conditions are community conditions that are easily changed by relatively small environmental influences. So, the Krueng Cunda water area needs environmental management for sustainability. The species composition and number of macrobenthic individuals in Krueng Cunda waters can be seen in Table 1.

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Table 1. Species composition and number of macrobenthic individuals in Krueng Cunda Waters

Sum of Total			Stasiun					
Kelas	Famili	Jenis	1	2	3	4	5	Individu/3m2
Annelida	Chironomidae	*Chironomus sp.*		127		4		131
Bivalvia	Acroloxidae	*Acroloxus lacustris*	2					2
	Arcidae	*Anadara granosa*	2	2		15	1	20
		Anadara pilula		2				2
		Anadonta sp.	1					1
		Anapella cycladea				9	2	11
	Mesodesmatidae	*Anapella cyladea*	1					1
	Mytilidae	*Septifer sp.*		10				10
	Mytiloidae	*Perna viridis*	158					158
	Neritidae	*Septaria tesselata*		1				1
	Ostridae	*Saccostrea cucullata*	8	21	4			33
	Semelidae	*Semele propicua*	2	2				4
	Solenidae	*Solen sp.*					1	1
	Unionidae	*Pilsbryoconcha exilis*	2					2
	Veneridae	*Dosinia lupines*					3	3
		Marcia opima	1					1
Crustacea	Gecarcinucidae	*Parathelpusa convexa*			8			8
	Palaemonidae	*Macrobrachium rosenbergii*	1		1		1	3
Gastropoda	Ampullariidae	*Pila ampullaceae*	3					3
		Pomacea canaliculata		2				2
	Ancylidae	*Ferrissia rivularis*	4					4
	Buccinidae	*Anentome helena*		2				2
	Cerithiidae	*Clypeomorus moniliferus*	5	1			3	9
		Rhinoclavis aspera	2					2
		Rhinoclavis vertagus	2					2
	limnaeiinae	*Lymnaea rubiginosa*	6					6
	Littorinidae	*Littoraria melanostoma*		1				1
		Littoraria scraba		5				5
		Littorina undulata		1				1
	lymnaeidae	*Lymnaea acella*	2					2
	Melongenidae	*Volema myristica*	1	1				2
	Nassaridae	*Nassarius luridus*	17					17
		Nassarius pullus	18	4			6	28
	Neritidae	*Chiton faba*				1		1
		Clithon squarrosus	1					1
		Nerita lineata		1				1
		Neritodryas cornea	1					1
	Olividae	*Oliva reticulate*			1			1
	Pachychilidae	*Sulcospira tetudinaria*	1					1
	Planaxidae	*Planaxis sulcatus*					4	4
	Planorbidae	*Polypylis kennardi*	1					1
	Pleuroceridae	*Leptoxis praerosa*		1				1
		Pleurocera acuta		1				1
		Pleurocera canaliculatum	5					5
	Potamididae	*Cerithidea cingulata*	13	2	9	15	1	40
		Cerithidea quadrata		2			2	4
		Terebralia palustris	6					6
		Terebralia sulcata		2				2
	Terebridae	*Tebralia sulcata*				6	3	9
	Thiaridae	*Melanoides granifera*	3					3
		Melanoides punctata	1					1
		Melanoides turolosa			77			77
		Tarebia granifera			9			9
		Thiara pantherina	3				1	4
		Thiara rufis	11					11
		Thiara scaraba	1					1
	Trichotopidae	*Trichotropis borealis*		1				1
Holothuroidea	Aspidochirota	*Hirudo scara*		2			1	3
Insecta	Chironomidae	*Chiromonas plumosus*					1	1
Malacostraca	Portunidae	*Scylla serata*	8			1		9
Oligochaeta	Naididae	*Prionospio ehlers*					1	1
Individu/3m2			**293**	**194**	**109**	**51**	**31**	**678**
number of species (S)			33	23	7	7	15	61
diversity index (H')			2,077	1,514	1,056	1,632	2,500	2,825

The distribution of the macrozoobenthos class, which was found in the waters of Krueng Cunda, Lhokseumawe City, is shown in Graph 2. The picture shows that the highest percentage of the macrozobenthos class in Krueng Cunda waters is represented by the Gastropoda class, namely 40%. The highest percentage of the macrozobenthos is possible because the Gastropoda class can adapt well to the environmental conditions in the research area. Besides, Gastropods have thick shells, which causes these organisms not to be easily preyed upon by predators. The high adaptability of this organism allows its existence to be abundant (Muchlisin, Z. A. et al. 2016).

Furthermore, insects are the fewest organisms and the class with the lowest percentage of presence and number is thought to be due to their way of life, which does not stay in a body of water and tends to move around. Some others may experience metamorphosis and change habitat. Most aquatic insects are Hemimetabola, namely insects that undergo an incomplete type of metamorphosis. In the young or larval phase, they have additional organs in the form of gills so they can live in the water as benthos. When they are adults, the gills disappear, and they live outside the water (Ward, 1992). Insects are indicator species that are intolerant of pollution. Types of aquatic insects are organisms that are intolerant of changes in environmental factors so that they can be used as bioindicators for good quality waters. Several genera, sensitive to specific contaminants or pollutants, experience reduced growth and survival (Ayu et al., 2022).
According to (2002), the low or non-appearance of organisms may result in polluted water flows or community conditions being disturbed. The low percentage of presence is because not all benthic aquatic animals can live in polluted environmental conditions, especially organic waste contamination. The Krueng Cunda water area is suspected to have a high content of organic waste originating from domestic activities.

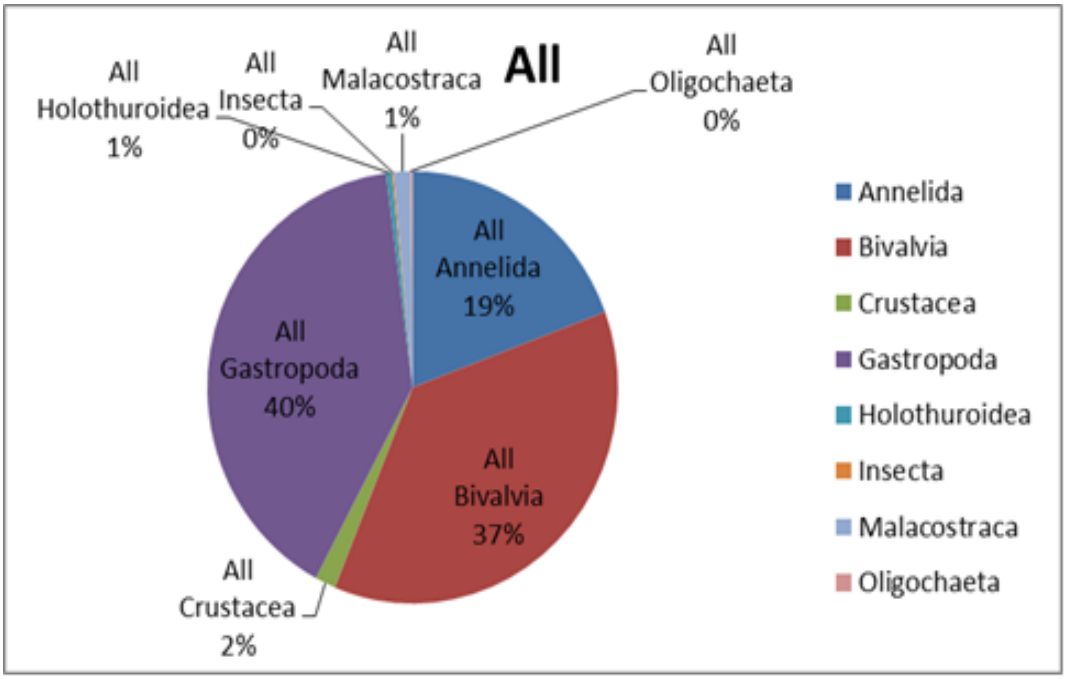

Figure 2. The distribution of the macrozoobenthos class

5. CONCLUSION

Based on the results of the discussion in the previous chapter, it can be concluded that:

1) Macrozoobenthos diversity at the five research stations was in the range of 1,056 to 2,825, indicating a moderate level of diversity
2) The low occurrence of intolerant organisms such as insects indicates pollution
3) There needs to be environmental management efforts to stabilize Krueng Cunda waters

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