River Monitoring: In View of the Physical Habitat of the River and the Presence of Macroinvertebrates

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Article Info	ABSTRACT
	Monitoring of river aims to determine the condition of water quality. One alternative effort that can be used to have description of water quality is by reviewing the condition of the river's physical habitat. In this regard, the physical habitat condition will affect the presence of macroinvertebrates. The aims of this study was to determine the quality of river by observing the physical habitat of the river and the presence of macroinvertebrates. Data collection techniques are carried out spatially by dividing the river into several segments by taking into the state of the environment which include industry area, agriculture (rice field) area, housing area, pipe oil area and the springhead of the river. Based on the results of the study, it shown that the condition of river waters can be categorized in an unhealthy condition. This can be seen from the type of substrate cover, river bank stability and human activities in the river. It causes by eroding, agricultural activities, livestock, waste disposal, sand mining and garbage disposal. These conditions also affect the composition of macroinvertebrates found in this waters, which have a high level of tolerance in unhealthy physical habitat conditions such as Limnodrilus sp. and Aulodrilus sp

Introduction

River Monitoring is an effort to manage the river which aims to determine the condition of the quality of these waters. According to (Yohannes et al., 2019), water quality can be measured by measuring several parameters related to physical, chemical and biological aspects. This measure of water quality refers to the standards of water quality.

The measurements with physical, chemical, and biological parameters cannot show the quality of these waters directly because water samples must be analyzed in the laboratory first. One alternative effort that can be used to obtain a direct description of water quality is by reviewing the condition of the river's physical habitat (Trisnaini et al., 2018). Physical habitat monitoring is considered important because it can be monitored directly without going through further examination in the laboratory.

Monitoring of the river's physical habitat can be done by observing the amount of substrate cover, river bank conditions, and human activities that occur in the river. The changes in physical conditions along the river can be influenced by physical factors such as variations in sedimentation that cause changes in the quality of the waters

(Pancawati et al., 2014) procedures (Rini, 2011).

In this regard, the condition of the physical habitat of the waters will affect the presence of the aquatic organism, especially the presence of macroinvertebrates. Also, the size abundance of the macroinvertebrate will be affected by the condition of the river (Gjoni et al., 2022). Furthermore, the composition of macroinvertebrates found in waters will be influenced by organic material in the sediments in these waters (Oliveira et al., 2020). Therefore, it is necessary to study the physical habitat conditions and the presence of macroinvertebrate as an effort to monitor the water quality in the river.

The previous research have monitored the quality of river waters through measuring of the water samples based on a quality standard index (Ariani et al., 2021); (Widodo et al., 2019), In addition, the presence of macroinvertebrates as bio-indicator is associated with the quality of river waters based on the sample test of the river water (Sudia et al., 2020). However, physical habitat is an important parameter to determine the presence of macroinvertebrates because macroinvertebrates are sedentary and their existence is influenced by the conditions of the environmental habitat (Khudhair et al., 2019). Therefore, the river monitoring in this research is carried out by observing the physical habitat of the river and the presence of macroinvertebrates in the waters of the river.

Materials and Methods

This research was conducted in Kundur River, Mariana District, Banyuasin Regency. Data collection techniques are carried out spatially by dividing the river into several segments by taking into the state of the environmental conditions around for getting a view of the condition of the river based on the activities that occur in the river. The research stations are done by purposive sampling method, by determining the station by selecting an area that represents the research location. This research is determined as many as 6 stations. They are including industry area, agriculture (rice field) area, housing area, pipe oil area and the springhead of the river and natural area.

The Observation of river habitat conditions for river health assessment is carried out following work. First, the researchers did the observation to get a general view of the condition of the river in the location which will be assessed, they are industry area, agriculture (rice field) area, housing area, pipe oil area and the springhead of the river, the observation be conducted at each station. Then, the research observed physical habitat parameters such as river bed substrate composition, river sedimentation rate, river bank erosion, riverbank vegetation shade and water turbidity, also the activity of human around of the river. Furthermore, the research noted the results of observations on several river habitat parameters by giving a check mark (√) in the column to the category of river habitat conditions.

The quality of the river's physical habitat was analyzed based on the river's physical habitat assessment sheet. The results of observations of river physical habitats are related to the health of river are presented in table 1.

Tabel 1. Assessment of the River Health

Average score	Level of Rive Health
2,4 – 3,0	Health, the river provide diverse and stable habitat conditions to support the life of organism
1,7 – 2,3	Less healthy, The river provide less varied and less stable habitats to support the life of organism
1,0 – 1,6	Unhealthy, the river provide unvaried and unstable habitats to support the life of organism

Source : (Rini, 2011).

The sample of macroinvertebrate was taken using an Eckman Grabb (15x15 cm). The samples took at 6 research stations. At each station three sampling points were taken representing the right, left and middle of the river. The collected sediment was filtered using a benthic sieve which has a 1.0 mm mesh size. Then, the samples of macroinvertebrate were identified using a binocular stereo microscope. Identification activities are carried out using identification books, river health guidebooks (Rini, 2011).

Furthermore, the number of macroinvertebrate samples was counted according to the species of macroinvertebrate which are found.

Results and Discussion

The quality of the Kundur River can be assessed based on the condition of the river's physical habitat and the presence of macroinvertebrates as bioindicators. Physical habitat conditions are assessed through an assessment of the physical habitat of the river as presented in Table 2, then an assessment of the water quality conditions in the river will be associated with the presence of macroinvertebrate.

Tabel 2. Physical Habitat Parameter of The River (Rini, 2011)

Parameter	Result	
	Description	**score**
Substrate cover in the littoral zone	>90% the substrate is dominated by sand, or silt; most of the substrate is eroded or removed from the river, the habitat for macroinvertebrate and diatom colonies is very little	1
Mud-covered riverbank substrate	More than 75% submerged substrate in fine mud; rock must be pryed to lift it from the river	1
Fluctuations in water level fluctuation	the difference in cross-sectional width of the river flowing with water and the height of the river water level during the rainy and dry seasons > 25%-75%	2
Flow change due to dredging Or straighten river	No straightening or dredging of river rocks and sand	3
The stability of the river bank on the left	Unstable many parts of the river bank are eroding	1
The stability of the river bank on the Right	Unstable many parts of the river bank are eroding	1
Vegetation Width River border on the left	river border width 6-15 meters	2
Vegetation Width River border on the Right	river border width 6-15 meters	2
Human activities in around the river	rivers and riverbanks are damaged due to the impact of agricultural activities, livestock, waste disposal, sand mining and garbage disposal	2
Human activity at a radius of 2 km in part upstream	Less than 5% the upstream area has large-scale sand and stone mining activities, waste disposal industry and house hold	2
Average Score		**1,6**

Based on tabel 2, the indicators for assessing the physical habitat of the river, it is known that the average score is 1,6 for the condition of the physical habitat of the river. The value indicates that the health level of the river's physical habitat is in an unhealthy condition. The unhealthy condition is in range 1,0 – 1,6 based on Assessment of the River Health. According to (Rini, 2011). Unhealthy physical habitat conditions will cause the life of aquatic organisms to be less stable since the habitat of macroinvertebrate is less varied thus it is not suitable for the life of several species. Unhealthy physical habitat conditions will cause the life of aquatic organisms to be less stable since the habitat of macroinvertebrate is less varied thus it is not suitable for the life of several species.

Fluctuations in water level fluctuation can affect the quality of the river water. According to (Siahaan, 2012), in the dry season, the level of water pollution in the river increases due to a decrease in surface level, this condition causes the diversity index decrease but the density of macroinvertebrates in certain species increases. This is in accordance with table 2. and table 3 that fluctuations in river surface

levels reach 25-75%, so that macroinvertebrate diversity is low and high levels of dominance are found in certain species.

Flow change due to dredging or river straightening can cause the habitat of macroinvertebrate. The dredging of the river causes the transformation of the river ecosystem so that it has an impact on the diversity of macroinvertebrates. This is because dredging and straightening activities can provide relatively stable macroinvertebrate habitat, and have an impact on the restoration of river ecosystems (Nakano & Nakamura, 2006). Based on the result observations of river habitats (table 2) there is no dredging and s straighten river, this is also one of the causes of macroinvertebrate diversity found in this river is low.

Low river bank stability can affect the rate of erosion to the river body. It can cause high sedimentation in the river. according to (Saputra et al., 2017), the rate of sedimentation in river can affect the diversity and dominance of macroinvertebrates. This condition indicates the environmental degradation. The result of observations of physical habitats on the rivers show that the stability of the river bank is low but still has vegetation width river border reaching 6 -15 meters (table 2) which is still able to inhibit the rate of erosion into the river flows.

Human activities can cause environmental degradation in the river. It can have an impact on the destruction of the physical habitat of macroinvertebrates in these waters. Human activities that can cause changes in the river water environment such as agriculture, industry, and domestic activities (Yogafanny, 2015), (Kospa & Rahmadi, 2019), (Riyandini, 2020).

Due to the unhealthy condition of the river's physical habitat, the diversity of macroinvertebrates which were found in the river is low. The macroinvertebrates found are presented in table 3.

Tabel 3. Makroinvertebrata

Family	Spesies	∑Organism
Tubificidae	*Limnodrilus* sp.	4720
Tubififidae	*Aulodrilus* sp.	1295
Naididae	*Dero* sp.	70
Nereididae	*Namalicastis* sp.	66
Chironomidae	*Chironomous* sp.	10
Chironomidae	*Clinotanypus* sp.	16
Corbiculida	*Corbiculidae* sp.	588

Based on the table 3, it can be seen that in the river only 5 families and 7 species of macroinvertebrates were found and the dominant macroinvertebrate group is Tubificidae. The picture of macroinveetebrate which found shown in figure 1.
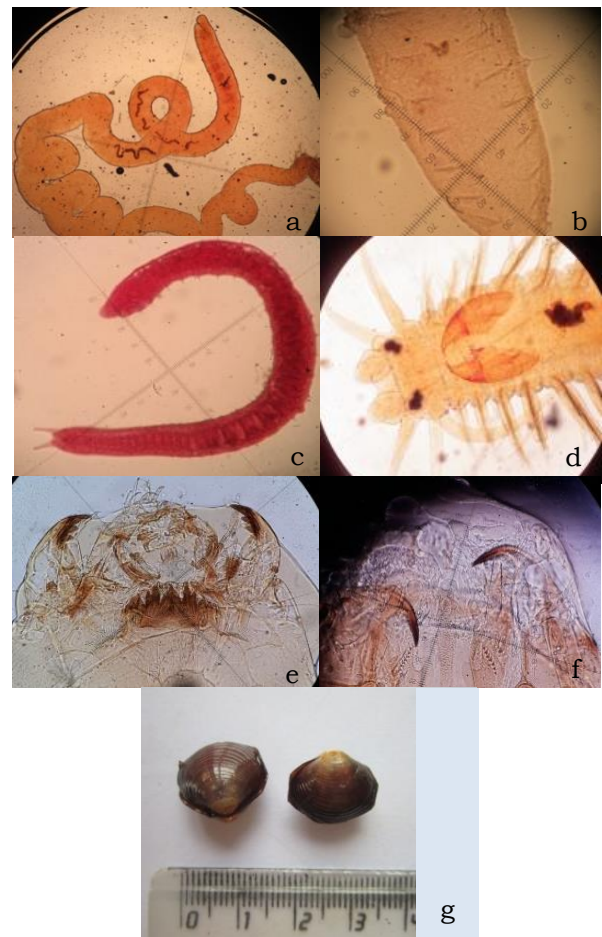

Figure 1. Macroinvertebrates (a) *Limnodrilus* **sp (b)** *Aulodrilus* **sp (c)** *Dero* **sp (d)** *Namalicastis* **sp (e)***Chironomous* **sp (f)** *Clinotanypus* **sp (g)** *Corbicula* **sp**

The Tubificidae is an Oligochaete class that has the ability to live in rivers that have high organic matter content, are cloudy, muddy, have low dissolved oxygen content and are tolerant of pesticides that enter water bodies (Putri et al., 2017). This is in line with the results of observations that the river flow is heavily influenced by human activities such as agricultural activities such as rice fields. In agriculture, the farmer usually used the pestiside for the plant. Pesticide residues from agricultural activities can be carried to river bodies and cause changes in river water quality (Atifah et al., 2019). Therefore, this condition is very supportive of the life of the Tubificidae in this river.

Limnodrillus sp. is the most abundant organism found in this river. *Limnodrillus sp.* live on muddy bottom substrates. The results of the study stated that the muddy sediment content had a high C-Organic content (Yolanda et al., 2019). The high availability of C-Organic can be a source of food for *Limnodrillus* sp. (Setiawan et al., 2015). It is in line with observations in the field that more than 75% of the substrate is submerged by fine silt (muddy). In this regard, the eroded part of the riverbank has the potential to add sediment to the riverbed. Erosion on riverbanks can cause changes in the elevation of the river bottom (Setyani, 2020). Therefore, this physical habitat is suitable with abundance of *limnodrilus* sp.

Conclusion

Based on the results of the research, it can be concluded that the condition of river waters can be categorized in an unhealthy condition. This can be seen from the type of substrate cover, river bank stability and human activities in the river which cause by agriculture, industry, and domestic activities. These conditions also affect the composition of macroinvertebrates found in these waters. The diversity of macroinvertebrates which were found in the river is low with family of Tubificidae dominated because they have a high level of tolerance in unhealthy physical habitat conditions.

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