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WATER QUALITY IN SATUI RIVER AND HISTOLOGICAL STRUCTURE STUDY OF LIVER OF BAUNG FISH (*Mystus nemurus*)

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ABSTRACT

Satui River is a river that has quite dense activity along the river flow, this is thought to result in a decrease in the quality of river waters. Fish is one of the organisms that can be used in tests to determine some chemical contamination in an aquatic environment. Baung fish are widely found in the waters of the Satui river and baung fish is thought to have properties that are sensitive to environmental changes. Histopathological testing in fish can provide a picture of tissue changes such as the kidneys and liver. Preparation of histological preparations using the paraffin method. Water quality analysis is compared with PP Water Quality Standard No. 22 of 2021 and analyzed using the Pollution Index method. Qualitative histopathological analysis is carried out by descriptive and quantitative analysis using scoring. The conclusion of this study is that the quality of the satui river is classified as lightly polluted with a value of P1 1.11 and P2 2.31. Histopathological damage to the liver of baung fish includes fat degeneration, congestion and necrosis.

1. INTRODUCTION

Satui River is a river that flows through the Tanah Bumbu district, the Satui subdistrict to be precise. This river has a length of 58,596.66 m and passes through several villages in the Satui sub-district, one of which is the East Satui village. Heavy activities along the Satui river in the East Satui village area, such as the transportation of fishing boats or large ships, agriculture, mining and households are suspected of causing water pollution. As a result of the influence of increased human activity that utilizes waters can produce uncontrolled waste, so that the waters will experience pressure (stressed), which tends to lead to a decrease in water quality (Yulista, 2020).

The quality of a water is very important because it is related to the biota that live in it. Polluted waters will result in contamination of biota that live in these waters and become unsafe for consumers who consume them (Dwiyitno *et al.*, 2008). Menurut Geonarso (1988) fish is one of the organisms that can be used in tests to determine the toxic effects of several chemical contaminants in an aquatic environment. baung fish (Mystus nemurus) is a fish native to Indonesian waters and has high economic value in South Kalimantan, because the meat has a delicious taste and has a high selling value (Komari *et al.*, 2012). Biologically, the baung fish grows and develops in tropical waters but its adaptability is relatively low, it can respond quickly to environmental changes and disease attacks. Biota that is sensitive to a water condition can be part of a biological indicator that can easily reflect the quality of an ecosystem (Muhammad & Triyoni, 2018).

Histopathological testing on fish can provide an overview of tissue changes that are thought to be due to exposure to environmental pollutants through microscopic observation through stained preparations. Tissues that can be used as indicators for observations such as kidneys and liver (Safratilofa, 2017). The increase in anthropogenic activities of the people of East Satui Village along the banks of the Satui river is thought to have resulted in a decrease in the quality of river

waters and tissue damage to aquatic biota, namely fish due to contaminants that enter the fish's body. Therefore, it is necessary to carry out research related to monitoring the quality of the Satui river waters, through measuring water quality parameters and making histological preparations of baung fish by looking at the damage that occurs in the liver.

2. MATERIALS AND METHODS

2.1. Tools and materials

The tools used in this study included fishing rods, surgical instruments, microscopes, thermometers, smartphones, bottles, pipettes, ovens, paraffin molds, microtome, microtome knife,waterbath,cover glass, object glass,refrigerator, digital DO meter, desiccator containing silica gel, oven, analytical balance and vacuum pump, UV-vis spectrophotometer, DO bottle, incubator, and DO meter. The materials used in this study included label paper, latex, distilled water, 10% BNF, series alcohol (70%, 80%, 90%, 95%, 100%), xylol, paraffin, distilled water, eosin, gelatin, haematoxylin, paraffin, xylol, Whatman Grade 934 AH filter paper with 1.5 µm pore size, and distilled water, concentrated sulfuric acid solution anddigestive solution and tissues.

2.2. Metode

2.2.1. Research Location Profile

This research was conducted in the Satui river, Satui Timur Village, Satui District, Tanah Bumbu Regency. The research was conducted in February-May 2023. Satui Timur Village has an area of approximately 33,825.4 Ha. Satui Timur Village is a village located in the lowlands, to be precise on the banks of the Satui river in the Satui sub-district. The Satui River has a length of 58,596.66 m, which originates from the Batulaki River and flows down to the West Satui coast.

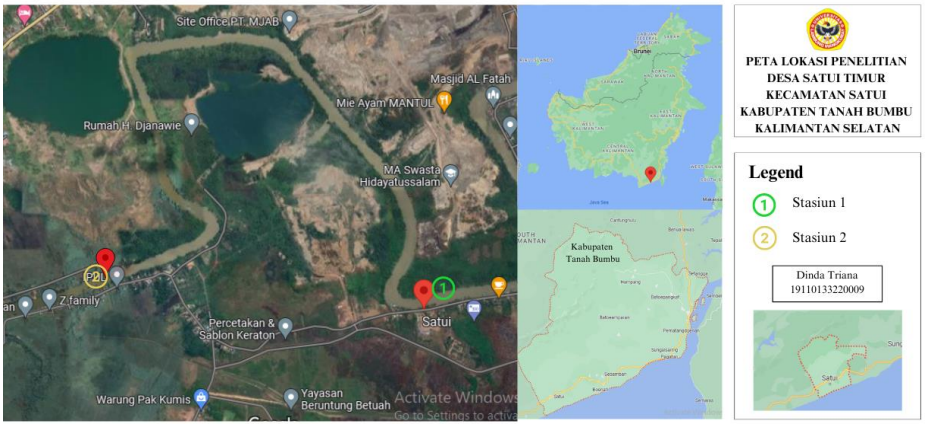

Figure 1. Research Location

2.2.2. Sampling

The collection was carried out on the outskirts of the Satui River, Satui Timur Village. Water samples were taken using plastic bottles. Sampling of baung fish (*Mystus nemurus*) carried out using fishing rods and trap tools assisted by fishermen. Fish were taken as many as 6 fish at each station, namely the area of ship activity and dense population. The size of the fish taken is done randomly, then the fish is put in a medium-sized container and given a little river water.

2.2.3. Water Quality Analysis

Water quality analysis was carried out using physical and chemical parameters. Physical parameters used include temperature, TSS and salinity. The chemical parameters used include pH, BOD, and DO in accordance with the test method that refers to the applicable SNI as shown in the following table.

Tabel 1. Parameter Physics, chemistry and methods of analysis

No	Parameter	Unit	Method Specifications
Field			
1.	Suhu	℃	Thermometer
2.	Ph	-	pH indicator
Laboratory			
3.	BOD	mg/L	SNI 6989.72:2009
4.	TSS	mg/L	SNI 06-6989.3:2019
5.	COD	mg/L	SNI 6989.2:2019
6.	DO	Mg/L	DO meter digital

2.2.4. Making Histological Preparations

Histological preparations carried out in this study used the liver of baung fish(*Mystus nemurus*).Preparation of preparations begins with fish surgery and taking liver organs. The next step is to fix the liver of the baung fish in 10% BNF, followed by graded dehydration in 70%, 80%, 90%, and absolute alcohol. Furthermore, celaring was carried out in xylol for 2 repetitions and continued with infiltration 2 repetitions for 1.5 hours each. After that, it is planted in a paraffin block until it is ready to be cut. Tissue band cutting was performed using a microtome with a thickness of 5 microns. Then, do the coloring using dyes 5 Author et al. Making histological preparations using the paraffin method refers to Angka *et al* (1984) which has been modified.

2.2.5. Analisis Data

Data analysis in this study consisted of 2 stages, namely water quality analysis and histopathological analysis. Analysis of water quality is compared according to the Water Quality Standards stipulated based on Government Regulation Number 22 of 2021 concerning Implementation of Environmental Protection and Management regarding Designation of River Water Quality Standards. Then, it was analyzed using the Pollution Index method based on the Decree of the State Minister for the Environment Number 115 of 2003. Based on the IP index class, if the score is $0 \leq Pij \leq 1.0$ then the status of the waters is classified as good, if the score is $1.0 < Pij \leq 5.0$ then the status of the waters is classified as lightly polluted, if the score is $5.0 < Pij \leq 10$ then the status of the waters is classified as moderately polluted and if the score is $Pij > 10$ then the status of the waters is classified as heavily polluted, analysis of pollution indices is carried out using the help of Microsoft Excel.

Histopathological analysis was carried out qualitatively and quantitatively. Qualitative analysis was carried out descriptively by observing histopathological images on liver preparations microscopically by comparing the histological images obtained with references.Atlas of Fish Histologyand other references (Genten *et al.,* 2009). Then, a quantitative analysis was carried out using the scoring method. The percentage value of damage and scoring is if the damage is 0-25% = 0 is normal, 25%-50% = 1 is mild, 50%-75% = 2 is moderate, and more than 75% = 3 is severe or severe (Lestari *et al.,* 2018).

Tabel 2. Water quality status based on Pollution

No	IP Value	Water Qualitu Status
1.	$0 \leq IP \leq 1,0$	According to Quality Standards
2.	$1,0 < IP \leq 5,0$	Light Polluted
3.	$5,0 < IP \leq 10$	Moderate Polluted
4.	$IP > 10$	Heavily Polluted

Table 3. Histopathological Damage Scoring Value

Damage (%)	Score	Category
< 25%	0	Normal
25% - 50%	1	Light
50% - 75%	2	Keep
>75%	3	Heavy

3. RESULTS AND DISCUSSION

3.1.Result

3.1.1. River Water Quality Measurement

Tabel 4. River Water Quality Measurement Results

No	Parameter	Unit	Average		Class II Quality Standard According to PP No 22 Th 2021
			P1	P2	
1.	pH	-	7,5	8	6 sd 9
2.	Suhu	℃	27	28,5	28-30
3.	BOD_5	mg/l	2,9	7,8	3
4.	COD	mg/l	0	27	25
5.	DO	mg/l	6,45	5,3	4
6.	TSS	mg/l	36,1	27,5	50

Description: P1 (1st sampling) & P2 (2nd sampling)

3.1.2. Pollution Index Value

Tabel 5. River Pollution Index

Average Pollution Index Value		Index Pollution	Category
P1	P2		
1,11	2,31	1,0<IP≤5,0	Light Polluted

Description: P1 (1st sampling) & P2 (2nd sampling)

3.1.3. Histopathological Picture

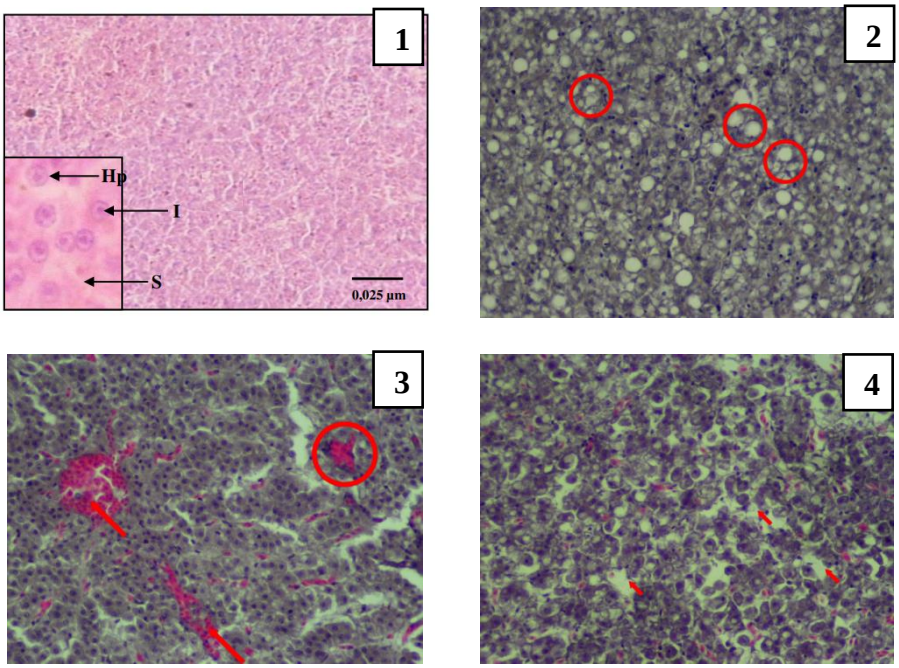

Figure 1. Normal liver structure consists of Hp (Hepatocyte), I (cell nucleus), S (Sinusoids) (1) (HE, 400X) (Jumaida *et al.*, 2022), Liver Pathology showing Cell Degeneration (2), Liver Pathology showing

Congestion (3), Liver Pathology showing Necrosis (4), Magnification 400x, 5µm.

Tabel 6. Liver Histological Damage Score Average *Mystus nemurus*

No	Group	Stasiun	Liver Histology Damage Score (Mean ±SD)		
			Degenerasi	Congestion	Nekrosis
1	P 1	1	0.26 ± 0.30[a]	0.13 ± 0.23[a]	0.13 ± 0.23[a]
		2	0.06 ± 0.11[a]	0.60 ± 0.20[a]	0.00 ± 0.00[a]
2	P 2	1	0.00 ± 0.00[a]	0.93 ± 0.61[a]	0.00 ± 0.00[a]
		2	0.33 ± 0.30[a]	0.66 ± 0.98[a]	0.33± 0.57[a]

Note: Numbers followed by the same letter in the same column show no significant difference

3.2. Discussion

The quality of the river will undergo changes in accordance with the development of the river environment which is influenced by various activities and human life ((Mardhia & Abdullah, 2018). The water quality of the Satui River, seen from the physical and chemical parameters of the water, indicates that there has been a decrease in quality. This can be seen from several water quality parameters that have exceeded the quality standards required in Government Regulation Number 22 of 2021 concerning Implementation of Environmental Protection and Management regarding Designation of River Water Quality Standards.

The results of measuring the degree of acidity of the Satui river water showed that the pH of the water in the 1st and 2nd sampling was in normal conditions in the range 6-9 at class II water quality standard. The increase in PH from the 1st sampling was 7.5 with the 2nd being 8. According to Yuliastuti (2011), the increase in the value of the degree of acidity or pH was influenced by organic and inorganic waste that was disposed of into the river. so that the increase in the pH of the Satui river water from the 1st and 2nd samples was due to industrial, domestic and waste disposal activities from agricultural activities that entered the Satui river. As a result of the waste released by the industry can cause a decrease in the pH value which will be fatal to aquatic organisms (Yulis, 2018).

The results of measuring the temperature of the Satui river water, taking the 1st and 2nd samples, which include stations 1 and 2, show that the water temperature is between 27-29℃. The highest temperature on the 2nd sampling reached 29℃. The optimum temperature for the life of organisms in water is 25 ℃ to 30 ℃ (Mardhia & Abdullah, 2018). The high water temperature is caused by the high intensity of sunlight entering the water body because the sample measurement location is an open area exposed to direct sunlight. The more intensity of solar radiation that hits a body of water, the higher the temperature of the river water (Marlina *et al.*, 2017).

Chemical Oxygen Demand (COD) shows the amount of oxygen needed to chemically oxidize organic matter, both of which can be degraded biologically (biodegradable) and those that are difficult to biodegrade (non-biodegradable)(Marlina *et al.*, 2017). The results of measuring the COD parameters of the Satui river water showed significant or undetectable results (0) in the 1st sample, while the COD measurement results in the 2nd sample were 27 mg/l. The COD quality standard value according to Government Regulation Number 22 of 2021 is 25 mg/L. The COD value which exceeded the quality standard in the 2nd sampling was possibly caused by the presence of a ship docking near the sampling point and disposal of domestic waste from the surface which was carried away by the currents. A high COD concentration indicates a greater level of pollution that occurs in a waters (Yudo, 2010).

The results of the analysis of the BOD concentration of Satui river water were 2.9 mg/L in the 1st sample, while in the 2nd sample it was 7.8 mg/L. The greater the concentration of BOD indicates that the water has been polluted, the concentration of BOD whose pollution level is still low and can be categorized as good waters has BOD levels ranging from 0 - 10 mg/l, while waters with BOD concentrations of more than 10 mg/l are considered polluted (Mahyudi *et al.*, 2015). From the results of measurements of the BOD parameter in the Satui river, it is still categorized as

good waters, but when compared with the class II water quality standard criteria of 3 mg/L, the Satui river's water quality conditions are not suitable for their designation based on the BOD parameter. A high BOD value indicates a high level of organic matter in water, because the BOD value is a value that indicates the need for oxygen by bacteria to oxidize organic matter in water (Yohannes *et al.,* 2019). The highest BOD level was in the 2nd sample of 7.8 mg/L, this is because in the 2nd sample taken in the morning many residents dispose of domestic waste such as dishwashing waste, bathing and clothing washing waste. In addition, during the second sampling, many ships were moored on the banks of the river. So that many types of pollutant received from domestic waste and industrial waste.

The results of the dissolved oxygen (DO) measurement of Satui river water in the 1st sample were 6.45 mg/L, while in the 2nd sample it was 5.3 mg/L. A water can be said to be good and has a low level of pollution if the dissolved oxygen (DO) level is greater than 5 mg/l (Salmin, 2005), while the dissolved oxygen concentration (DO) in unspoiled waters has a DO value of less than 10 mg/L (Effendi, 2003). When compared with the class II water quality standard for the DO parameter based on Government Regulation Number 22 of 2021, which is 4 mg/l, the Satui river water quality conditions for the DO parameter are still in accordance with their designation, except for the 1st sample. The amount of DO concentration in this water can be influenced by several factors such as TSS content, salinity, temperature, degradation of organic matter (Christiana *et al.,* 2020).

Total Suspended Solids (TSS) are suspended materials (diameter > 1 μm) which are retained on the Millipore filter with a pore diameter of 0.45 μm. TSS consists of silt and fine sand and micro-organisms, which are mainly caused by soil erosion or soil erosion carried into water bodies (Djoharam *et al.,* 2018). . The results of river water TSS measurements in the 1st sample were 36.1 mg/L, while in the 2nd sample they were 27.5 mg/L. The TSS value of the Satui river is still below the threshold for class II water quality standard PP NO 22 of 2021 of 50 mg/L, so it can still be used according to the designation in TSS parameters. The suitability of TSS values for fisheries, according to Effendi, (2003) ranges from 25-80 mg/L. High turbidity values can interfere with the osmoregulation system of aquatic organisms. The results of TSS measurements in the Satui river ranged from 21-37.5 mg/L, this did not affect fish cultivation, because it was in accordance with its designation.

Analysis of River Water Quality Status shows the level of contamination of a water source in a certain time, compared to the set water quality standards. A river is said to be polluted if it cannot be used according to its normal designation. Based on the results of the calculation of the pollution index, it can be seen that there has been an increase from the results of the pollution index taking the 1st sample of 1.11 by the 2nd sample of 2.31. The water quality status of the Satui river is included in the slightly polluted category based on the results of the calculation of the pollution index. This makes the quality of the Satui river water that flows through the East Satui village area cannot be utilized in accordance with Class II water designation, namely water that can be used as water recreation facilities/infrastructure, freshwater fish cultivation, animal husbandry, water for irrigating plantations and or other uses that require the same water quality as said use. So that it is necessary to control pollution of the Satui river water so that it can be utilized and maintain the quality of the Satui river water in accordance with water quality.

This study also showed histological changes in the liver of baung fish. Histological changes in the liver showed cell degeneration, congestion and necrosis. Cell degeneration is characterized by the presence of a cell nucleus that begins to shrink, the color is more intense and in the cytoplasm there are vacuoles which contain fat inside. Degeneration occurs due to the presence of fat that is not removed from the cell (Lekatompessy *et al.,* 2021). According to Silviany's research (2004), states that fish exposed to lead metal causes the liver to experience fatty degeneration so that complex liver functions are lost. Furthermore, cells that experience continuous degeneration will experience congestion (Juanda & Edo, 2018). Congestion is a condition where there is a very dense accumulation of red blood cells in the blood vessels which indicates an abnormal condition in the fish liver (Sulistyorinie *et al.,* 2020). Necrosis is one of the advanced stages of damage to cell

degeneration which is characterized by the loss of tissue structure and the area of necrosis has bleeding spots. With necrosis, there is inflammation in the living tissue (Lekatompessy *et al.*, 2021). Based on the average result, the histopathological scoring value on liver tissue damage is <1, which means normal.

4. CONCLUSIONS

The conclusion of this study is to show that the quality of Satui River waters is classified as lightly polluted based on pollution index analysis with values in the 1st take 1.11 and 2nd 2.31. Histopathological damage to the liver of baung fish includes fatty degeneration, congestion and necrosis.

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