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WATER STRIDERS (*Gerris sp*) AND ITS POTENTIAL AS MERCURY BIOINDICATORS IN LAKE TALIWANG, WEST SUMBAWA, INDONESIA

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Abstract: This study aims to determine the mercury accumulation in *Gerris sp* and its potential as a bioindicator. This type of research is experimental research. This research was conducted at Lake Taliwang and the UGM Integrated Research and Testing Laboratory. The sampling point in this study was determined based on the distance to the pollutant source. It was divided into station 1 (inlet), an area close to the pollutant source, and station 2 (outlet), far from the pollutant source. There are 3 test tests: the accumulation of mercury in water and sediment, mercury in the gerris, and the gerris as a bioindicator of mercury pollution. Analysis of the test results data is presented in descriptive statistics. The results of this study are (1) The waters of Lake Lebo are polluted by mercury, found in sediments and water, and enter the food chain, namely gerris. The mercury concentration in the inlet area is greater than the outlet area because it is closer to the pollutant source (2). Gerris can be used as a bioindicator of mercury pollution in Lake Lebo Taliwang because it can accumulate heavy metals. It meets the criteria of bioindicator organisms and is very strongly correlated with water. The finding suggests that the local government makes regulations regarding mercury metal pollution in Taliwang Lake because mercury metal can enter other food chains and is toxic to living things.

Keywords: *Mercury, Gerris (Gerris sp), Bioindicator*

INTRODUCTION

Mercury is one of the global environmental problems because of its toxic nature, harming living things. Mercury in the environment comes from volcanic and geological activities. It can also be caused by human activities such as coal burning, gold mining, and industrial activities [1]. The aquatic environment has the highest potential for contamination by mercury compounds since atmospheric deposition and water-runoff originating from industrial activities will mostly culminate in aquatic ecosystems [2].

Taliwang Lake is a lake located in West Sumbawa Regency, West Nusa Tenggara Province, covering an area of 1,406 hectares. Administratively, Lake Lebo is located between two sub-districts, namely Taliwang sub-district and Seteluk sub-district, which direct contact with 5 villages, namely Meraran Village and Ai Suning Village, Rempe Village, Seloto Village, and Sampir Village, West Sumbawa Regency. Currently, Lake Taliwang has the status of a natural tourism park based on a decree from the Ministry of Forestry and Plantations.

Lake Taliwang is suspected of being polluted by mercury compounds due to illegal gold mining activities around the lake. One approach to know the mercury pollution is by studying sentinel species is needed. Sentinel species are organisms that have a high sensitivity to pollutants. Sentinel species are very accurate in reflecting environmental contamination and can be routinely and continuously used in monitoring environmental pollution [3].

Algae are organisms that can be used as bioindicators of environmental pollution, including because; 1) Has a long life span 2) Is a predatory invertebrate that preys on aquatic insects and land insects. [4]. 3) meet the criteria as sentinel organisms (accumulators), including distribution and abundance, wide-body, easy to identify, and sedentary life. Research on the accumulation of mercury in algae and its potential as a bioindicator in Taliwang Lake has never been done. Therefore, it is interesting to do with a purpose; 1) study the accumulation of mercury in algae; 2) study the algae as bioindicators of environmental pollution.

RESEARCH METHODS

The research was carried out from November 2017 to April 2018 at Lake Taliwang and the UGM Integrated Research and Testing Laboratory. The sampling point in this study was determined based on the distance to the pollutant source. It was divided into station 1 (inlet), an area close to the pollutant source, and station 2 (outlet), which is far from the pollutant source. At each sampling point, 3 bottles of 250 mL of water were taken, 3 ziplock plastic bags of sediment, and 3 gerris were taken. The samples that have been taken are stored in a cool box then taken to the laboratory for testing.

The test procedure for determining mercury levels was carried out by weighing a sample of 0.5 Kg. The gerris does not reach a weight of 0.5 Kg. It is weighed as it is. The sample was then put into a 100 mL Erlenmeyer tube. Next, add 10 mL of $HNO3:HClO4$ (1:1) and 2 mL of H_2SO_4 in turn. Then heat it on a hotplate at 180° until white smoke comes out. Allow to cool; then, the sample is filtered

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and adjusted to 50 mL by adding distilled water. Then make a blank solution with the same treatment but without the sample. Then 10 ml of the sample was taken and put into a test tube. Add 0.1% KMnO_4 0.1 mL then shake. Next, add 0.1 mL of Hydroxylamine hydrochloride, shake again. Finally, add 0.1 mL of SnCL2. The sample is then inserted into the tube contained in the mercury analyzer for reading the results. Furthermore, the test data analysis is presented in descriptive statistics by describing the data analysis results in tabular form. The Pearson correlation test was carried out to determine the correlation between gerris with water and sediment.

RESULTS AND DISCUSSION

Mercury Accumulation in Water and Sediment

There is mercury contamination in the water and sediment of Taliwang Lake due to gold processing activities operating around the lake. The concentration of mercury in the water and sediment of Lake Taliwang by area and coordinates is shown in table 1, while the analysis of mercury concentration is shown in table 2.

The mean mercury concentration in sediment was higher than that of water, ranging from 160-400 times (Table 5.2). Differences in mercury concentrations in water and sediments can be caused when mercury enters the waters. Most of it, about 85%, will settle in the sediment and bind to organic materials [5], such as humic acids, carbohydrates, amino acids, and hydrocarbons. Meanwhile, mercury in water bodies, in the form of methyl, is in the range of up to 10% [6]. Bonanno, Lo Giudice [7], and Malczyk and Branfireun [8] also showed that Hg in sediment was higher than that of water.

Table 1. The concentration of mercury in water and sediment of Lake Taliwang by area and coordinates

No	Location	Water ($\mu g\ L^{-1}$)	Sediment ($\mu g\ kg^{-1}$)	Coordinate	
				LS	BT
1	Inlet 1	1.82	0.225	S8º 41'40. 5168”	116º 51'29.0952”
2	Inlet 2	1.25	0.679	S8º 41'41. 8416”	116º 51'37.2312”
3	Inlet 3	1.22	0.303	S8º 41'38. 1768”	116º 51'19.7208”
4	Outlet 1	1.29	0.220	S8º 42'40. 318”	116º 51'28.474”
5	Outlet 2	0.73	0.183	S8º 42'40. 5864”	116º 51'31.464”
6	Outlet 3	0.86	0.138	S8º 42' 43. 5384”	116º 51'33.1128”

Table 2. Mercury concentration in water and sediment of Lake Taliwang

Sample	Location	Min	Mean±SD	Max
Water ($g\ L^{-1}$)	Inlet (n=3)	1.22	1.43±0.33	1.82
	Outlet (n=3)	0.86	0.96±0.39	1.29
Total Mean ±SD			1.95±0.34	
Sediment ($g\ kg^{-1}$)	Inlet (n=3)	225	404±242	679
	Outlet (n=3)	138	160±31.8	220
Total Mean ±SD			291±180	

The Hg concentration at the inlet is generally higher than at the outlet. Due to the distance from station 1 (inlet) to gold ore processing activities, river water entering Taliwang Lake carries mercury. The high mercury concentration was shown in the area close to the pollutant source [9-10]. The low speed of lake water currents and the presence of aquatic plants Myriophyllum spicatum growing at the bottom of the water cause mercury concentrated in the inlet area to not be spread evenly to the outlet area.

Heavy metal mercury is easily soluble and changes the stability of the carbonate form to hydroxide, which forms particulate bonds in the waters. Then precipitation occurs and ends in the formation of mud [19-20]. Mercury metal is not easily detected. It is because mercury has properties that easily bind organic matter and settle to the bottom of the waters on the surface of the waters. There will likely be greater content in the sediment [21]. It is also in line with Rochyatun's opinion, which revealed that heavy metals in sediment are higher than in water because it accumulates from precipitation and heavy metals in water are smaller due to the dilution process and the influence of current patterns [22-24].

Accumulation of mercury in gerris

The levels of accumulation of mercury in gerris are presented in Table 3. The concentration of mercury in gerris, in the inlet area, is higher than that of gerris caught in the outlet area. It is directly proportional to the mercury concentration in the water and sediment, higher than the outlet area close to the pollutant source. Gerris accumulate mercury because they prey on small insects such as mosquito

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larvae and other small insects that live in Lake Taliwang, which is contaminated with mercury. The algae also accumulate mercury by drinking contaminated lake water.

The mercury concentration in the gerris in this study was lower when compared to the gerris in other studies [11-12]. It may be due to mercury concentrations in the environment and species differences. Mercury uptake in an organism can be caused by the type of species [13]. The algae used in this study may be the type that cannot accumulate more mercury.

Table 3. The concentration of mercury in the algae (g kg^{-1})

Sample	Location and coordinates	Min	Mean±SD	Max
Gerris (*Gerris sp*)	Inlet (n=3) 8º41'43.4184" LS 116º51'22.2444" BT	70	99.1±22.3	136
	Outlet (n=3) 8º42'13.4028" LS 116º51'21.8844" BT	29	44.5±4, 7	54.5
Total mean ± SD			79.8 ± 38.8	

Algae as a bioindicator of mercury pollution

A bioindicator is an organism or biological response that can reveal the presence of pollutants in the presence of certain symptoms or measurable responses [14]. Environmental indicators are species or groups of species responsive to a damaged environment or changing environmental conditions [15]. Environmental indicators are further divided into 5, namely sentinels, detectors, exploiters, accumulators, and bioassays of organisms. The high and low abundance of macrozoobenthos is related to the physical and chemical characteristics of the waters [16]. Aquatic organisms are important indicators of environmental change because organisms, especially benthic organisms, keep a history of processes occurring in the waters. Variations also influence this density level in the physical and chemical conditions of the waters, bottom substrate, and currents [18].

The test results showed the presence of mercury accumulation in the body of the algae. Thus, the gerris can be categorized as a bioaccumulator environmental bioindicator, namely a bioaccumulator of heavy metal mercury contamination. *Gerris* the Ciliwung River as a Water Quality Bioindicator shows that *gerris* can be used as a bioindicator in waters because of its presence in unpolluted waters [17]. The use of gerris as a bioindicator also meets the following criteria, including:

1. it has a long life span. The long life span allows the gerris to accumulate mercury for a long time to describe the environmental conditions at a certain period.
2. It is a predatory invertebrate that preys on aquatic insects and land insects [4]. Preying on other aquatic insects and land insects can represent the accumulation of pollutant compounds both on land and in water.
3. It meets the criteria of sentinel organisms (accumulators), including distribution and abundance, wide-body, easy to identify, and sedentary life.

The results of the Pearson correlation test, the mercury concentration of gerris with sediments shows a strong correlation and with water shows a very strong correlation.

Table 4. Pearson correlation between algae, water, and sediment.

	Sediment	gerris
Water	0.19	0.80
Sediment		0.61

CONCLUSION

The research findings show that: (1) The waters of Lake Lebo are polluted by mercury, found in sediment and water, and enter the food chain, namely gerris. The mercury concentration in the inlet area is greater than the outlet area because it is closer to the pollutant source (2). Gerris can be used as a bioindicator of mercury pollution in Lake Lebo Taliwang. It can accumulate heavy metals, meet the criteria of bioindicator organisms, and strongly correlate with water. From the results of this study, it is suggested that the local government make regulations regarding the prevention of mercury metal pollution in Taliwang Lake because mercury metal can enter other food chains and is toxic to living things.

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