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1st Lekantara Annual Conference on Natural Science and Environment (LeNS 2021) IOP Conf. Series: Earth and Environmental Science 1097 (2022) 012065 IOP Publishing doi:10.1088/1755-1315/1097/1/012065 1 Bioaccumulation of Heavy Metals in Polymesoda erosa in the Batanghari River, Jambi Province Shally Yanova1*, Jalius1, Syamsyida Rozi2, Indra Laksmana3, Rosda Syelly4 12Universitas Jambi, Indonesia 3Politeknik Pertanian Negeri Payakumbuh, Indonesia 4Sekolah Tinggi Teknologi Payakumbuh, Indonesia *shallyyanova@unja.ac.id Abstract.

The water quality of the Batanghari River in Jambi Province has been categorized as polluted because it contains heavy metal contents, such as Pb, Mn, Cd, and Hg. One of the river biotas that become local people's favorite and can accumulate heavy metals is Polymesoda erosa mussels. This research aimed to investigate and analyze the heavy metals contained in mussels in the Batanghari by using AAS and ICP methods.

The results showed that the average content of lead metals (Pb) in Polymesoda erosa in Point A was 5.93 mg/kg while in Point B was 13.5 mg/kg. Mussels with such contents of Pb metal are not safe to consume because the contents exceed the threshold of SNI 7387:2009 with a maximum limit of Pb at 1.5 mg/kg. Meanwhile, the average content of manganese metal (Mn) in Polymesoda erosa in Point A was 89.24 mg/kg, while in Point B was 169.85 mg/kg.

These numbers also exceed the standard threshold of manganese metal quality for fish by 20 mg/kg based on the Turkish Guideline. The average concentration of Cd metals and Hg metals in Polymesoda erosa in Point A was 0.04 mg/kg and 0.122 mg/kg, respectively; while in Point B was 0.05 mg/kg and 0.169 mg/kg, respectively. The concentrations of Cd and Hg metals do not exceed the threshold and are safe to

consume.

However, since Pb and Mn metals have exceeded the threshold and are not safe to consume, the Polymesoda erosa mussels in the Batanghari are still not safe to consume. Keywords: Batanghari River; Heavy metals; Kerang Kepah; Polymesoda erosa ; Water pollution 1. Introduction The Batanghari River stretches across Jambi Province and West Sumatera Province.

Jambi people widely use the water of the Batanghari River for agricultural activities, industry, sand mining, and tourist attraction. Furthermore, the water of the Batanghari is the main source of PDAM (local eater supply utility) in Jambi city. However, various kinds of activities carried out along the Batanghari are feared to negatively impact water quality.

The declining quality of the river water can disrupt the life of the aquatic biota that lives in it. One of the parameters which determine the quality of river water is the content of heavy metals. According to [1], heavy metals are able to survive in their natural ecosystems for a long time and accumulate according to the level orders of the biological chain; thus, they can cause acute and chronic diseases in humans.

When the amount of waste with high content of heavy metals increases, the accumulation of heavy metals will increase. Consequently, these heavy metals will be accumulated in the body of aquatic biota in the waters. 1st Lekantara Annual Conference on Natural Science and Environment (LeNS 2021) IOP Conf.

Series: Earth and Environmental Science 1097 (2022) 012065 IOP Publishing doi:10.1088/1755-1315/1097/1/012065 2 Figure 1. Map of Research Location (Source: Google Earth Year 2020) One of the aquatic biotas found along the Batanghari and preferably consumed by Jambi people is Polymesoda erosa mussels (2errang kepah). This mussel, just like other types of shellfish, is sessile so that it can be a bioindicator of water quality.

Heavy metals can accumulate in the body of Polymesoda erosa mussels through their digestive systems [2] because Polymesoda erosa mussels get their food by sucking the river water. If people consume shellfish containing heavy metals in high enough quantities or exceeding the threshold of tolerance, it will negatively impact health.

Some of the heavy metals commonly found in shellfish are lead (Pb), cadmium (Cd), manganese (Mn), and mercury (Hg). In the human body, heavy metals consumed through food will combine with active enzymes. As a result, the enzymes become

inactive, and the synthesis of red blood cells (Hb) is inhibited; the last condition can result in anemia [2].

This research aimed to determine the heavy metal content in Polymesoda erosa mussel in the Batanghari, Jambi Province. 2. Methodology This research was conducted at two locations (Figure 1): Point A (Upstream Point) in the Olak Kemang area and Point B (Downstream Point) in the Kemingking Dalam area. This research was conducted from August 2020 to January 2021.

The tools and materials used in this research were river water samples, Polymesoda erosa mussel samples (Figure 2), HNO 3 solution for preserving river water samples, sampling equipment, bottles for storing samples to test, water funnels, AAS, ICP, and laboratory materials and tools. Figure 2. Samples of Polymesoda Erosa Mussels (Source: Personal Documentation) 1st Lekantara Annual Conference on Natural Science and Environment (LeNS 2021) IOP Conf.

Series: Earth and Environmental Science 1097 (2022) 012065 IOP Publishing doi:10.1088/1755-1315/1097/1/012065 3 A sampling of river water was carried out at the river top and bottom at three sampling points. Meanwhile, sampling of Polymesoda erosa mussel was carried out by grabbing sampling at each location. Four kilos of Polymesoda erosa mussel sized 5-8 cm were selected.

The working procedures of this research were to carry out wet destruction of the river water samples and Polymesoda erosa mussel samples. Afterward, the heavy metal content was analyzed using AAS and ICP tools. The Pb and Mn metals were analyzed using the AAS tool at the Laboratory of UPTD BPSMB Jambi while the Cd and Hg metals were analyzed using the ICP tool at the Water Laboratory of the Environmental Engineering Department, Universitas Andalas, Padang.

Finally, heavy metal concentrations in the river water samples and Polymesoda erosa mussel samples were tested 3 times (triplo). 3. Result and Discussion The results of analyzing Pb, Cd, Mn, and Hg heavy metals found in the Batanghari water in two research points were compared with the threshold values of Government Regulation No. 22 the Year 2021 [3].

Meanwhile, the results of analyzing the of Pb, Cd, and Hg heavy metals in Polymesoda erosa mussel were compared with the threshold of the Indonesian National Standard (SNI) 7387:2009 [4]. Afterward, the Mn metal content in Polymesoda erosa mussel was compared to the Turkish Guideline threshold for fish because the Government of Indonesia has not stipulated the Mn metal threshold in foodstuffs. The results of these

comparisons are shown in Table 1. Table 1.

Measurement Results of Heavy Metal Concentrations in Samples of River Water and Polymesoda Erosa Mussel (Kerang Kepah) Heavy Metals Heavy Metals Concentration in River Water (mg/l) Quality Standards (mg/l)a Heavy Metals Concentration in Polymesoda Erosa Mussel (mg/kg) Quality Standards (mg/kg)b Point A Point B Point A Point B Pb 0.1±0.02 0.11±0.01 0.03 5.93±1.83 13.5±6.07 1.5 Cd 0.08±0.01 0.09±0.01 0.01 0.04±0.003 0.05±0.009 1.0 Mn 0.305±0.08 0.21±0.08 - 89.24±30.60 169.85±75.59 20.0* Hg 0.022±0.004 0.025±0.005 0.002 0.122±0.006 0.169±0.004 1.0

aQuality standards referring to the Indonesian National Standard 7387:2009 bQuality standards referring to the Government Regulation No. 22 Year 2021 Class 2 * Quality Standards referring to the Turkish Guideline for fish Table 1 denotes that all heavy metals (Pb, Cd, and Hg) have exceeded the quality standard that refers to the Government Regulation No. 22 the Year 2021 Class II [3].

The high concentration of Pb in the Batanghari water occurs due to two major reasons. First, the river is close to areas that are heavily influenced by human activities. Second, motor vehicle exhaust emissions polluted the river. The main source of Pb contamination in the river water is the waste gas from lead-addicted gasoline for fuel of motor vehicles.

Apart from the content of Pb which occurs naturally in soil and rock, [5] states that a high concentration of Pb metal is also due to human activities, especially agriculture, waste disposal, waste accumulation, and the use of fertilizers that produce leachate infiltrated into groundwater aquifers. The high concentration of Pb in river water is in line with the high concentration of Pb in Polymesoda erosa mussel[5].

The nature of lead (Pb) is non-essential; thus, the concentration of Pb metal will increase in the network when heavy metals content in water bodies increases. The high levels of lead (Pb) in Polymesoda erosa mussel occurs because the concentration of heavy metals enters the body of the mussels and is completely absorbed into their body tissues [6]. Meanwhile, Cd heavy metal is relatively small in water, but its concentration can increase due to the process of industrial waste disposal.

The high concentration of Cd metal content near industries is probably caused by the domestic waste or household waste contaminating the waters as well as by the number of fishing painted-boats operating in the water. The high parameter of Hg metal is probably caused by the existence of unlicensed gold mining activities in the upstream of the Batanghari, such as in Tebo and Sarolangun Regencies.

The measurement results assume that unlicensed gold mining activities in upstream of the Batanghari has impacted water quality in downstream of the Batanghari, especially in the research sites. Furthermore, high concentrations of Cd and Hg metals in the water of the Batanghari were inversely proportional to the concentrations of Cd and Hg metals in Polymesoda erosa mussels. The 1st Lekantara Annual Conference on Natural Science and Environment (LeNS 2021) IOP Conf.

Series: Earth and Environmental Science 1097 (2022) 012065 IOP Publishing doi:10.1088/1755-1315/1097/1/012065 4 low concentration of Cd and Hg metals in the mussels' body was probably caused by the Cd and Hg metals that entered their body and were not absorbed into their body tissues. This phenomenon is reinforced by [7], who state that heavy metals that are dissolved or contained in the sediment can enter the shell's body tissue.

Moreover, depuration of the shellfish causes heavy metals not to be accumulated into the shells' bodies and are then eliminated and dissolved back into the water [7]. The age of the mussel also affects the low concentration of heavy metals in it; for example, since an older mussel has a larger size, it will only be contaminated by lower heavy metal content. Amriani et al. [8] explain that small mussels have a greater accumulation ability than larger mussels.

The larger the mussel's size, the better its ability to eliminate heavy metals [8]. Furthermore, Mn had no quality standards set for river water from Class 2, 3, and 4. Since the analysis was conducted based on the utilization of the Batanghari water as a source of PDAM raw water (local water supply utility) of Jambi City, the water of this river should be more appropriately categorized to Class 1. This categorization is re ferring to Government Regulation No.

22 Year 2021, which states that river water is classified as Class 1 if it can be used as drinking water and/or other designations that require the same water quality. However, the Government Regulation No. 22 the Year 2021 stipulates that the quality standard of Class 1 is 0.1 mg/l of Mn metal in river water. Referring to this regulation, the Mn metal in this case has also exceeded the quality standards set by the Government of Indonesia.

A high concentration of Mn in the waters of the Batanghari is caused by domestic waste from several activities, such as bathing, washing, and toileting. In addition, agricultural activities contribute to the high concentration of Mn in the river water. Soil excavation activities are suspected to lift Mn metal to the surface, which then pollutes the river.

On the riverside of the research sites, sand mining lifts Mn to the surface during the excavation. In addition, the source of metals that enter the river water can be affected by the erosion of mineral rocks found around the waters. Metal particles in the air carried by rain can also be a source of metals in the waters [9].

Manganese metal in the river can enter the body of the mussel through the food chains, gills, and diffusions from the skin surface. The accumulation of Manganese (Mn) in mussels can occur through the absorption of water, particles, and plankton by filtering. This condition is also supported by mussels' habitat that lives underwater or in the bottom of the mud.

The ubiquitous nature has considerably increased the spread of manganese that collects in clam meat [10]. 4. Conclusion This research concludes that the Pb, Cd, Mn, and Hg metals in the Batanghari River water have exceeded the quality standards stipulated in Government Regulation No. 22 the Year 2021.

This regulation stipulates that Pb and Mn metal contents in Polymesoda erosa mussel in the Batanghari have exceeded the quality standard of SNI 7387:2009 (for Pb) and the Turkish Guideline (for Mn). Consequently, Polymesoda erosa mussels are not safe to consume and will negatively impact public health. References [1] N. A. Saputra, "Analisis Kandungan Logam Berat Pada Sedimen dan Kerang Hijau (Perna Viridis) Di Kabupaten Gresik, Jawa Timur," Universitas Brawijaya, 2018. [2] N.

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