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Residual Study on Several Gastropod Mollusks Species in the Intertidal Zone on the Reclamation Coast of Manado Bay

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Abstract : Coastal waters are a place to store various potential wastes from various human activities both on land and at sea, so that these ecosystems can be used as indicators in monitoring and assessing the condition of natural resources and the environment. The aim of the study was to determine the heavy metal content of lead, cadmium, and mercury in the clams *Cellana testudinaria* and *Cellana radiata*, which contain lead, cadmium, and mercury in the waters of the reclamation coast of Manado Bay. The problems to be studied were: (1) whether the population of *C. testudinaria* and *C. radiata* increases, (2) how much residue flows into the waters of the bay, and (3) whether changes in coastal structure have a large effect on species diversity. The results of heavy metal analysis showed that *C. testudinaria* had higher cadmium (0.53 mg/kg) than *C. radiata* (0.372 mg/kg) and the results of analysis of heavy metals lead showed that *C. testudinaria* had higher lead (2 ,3 mg/kg) compared to *C. radiata* (2 mg/kg) and also the results of heavy metal analysis mercury showed that *C. testudinaria* had higher mercury (1.01 mg/kg) compared to *C. radiata* (0.83 mg/kg) The content of these heavy metals is below the threshold determined by National Standardization Agency of Indonesia (Badan Standardisasi Nasional, BSN) (2014).
Keywords : Lead, cadmium, Mercury, *Cellana testudinaria*, *Cellana radiate*.

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1. Introduction

Ecologically, the reclamation coastal waters of Manado Bay are the living place of marine aquatic organisms consisting of population and community levels that form an ecosystem with a set of physicochemical and biological conditions of the place of life. Manado bay waters as a place to live consists of a biotic environment and abiotic environment. The biotic environment consists of components of aquatic flora and fauna including microorganisms such as micro algae, zooplankton phytoplankton and fungi and bacteria. Abiotic environment, namely: physicochemical such as temperature, currents, waves, light, oxygen, carbon dioxide, nitrate, nutrient phosphate. Ecological studies of reclamation coastal waters, Manado Bay will include physicochemical oceanography which provides an overview of water quality and metal content descriptions through the analysis of several types of gastropods. .Functions and benefits of the reclaimed coastal waters of Manado Bay, the reclamation of the coastal waters of Manado Bay have three main functions, namely ecology, sea transportation and social functions (social-economic culture) or supporting human life. The main ecological function of the waters of this bay is as a habitat for life with biotic diversity. the high value of various types of aquatic biota such as fishes, mollusks and crustaceans, both of which have ecological and economic value, while the second function is a function of sea transportation where the flow of sea traffic is quite busy with foreign tourists and the third function is a social function (social, economic, cultural). Various social activities of the office are located in the reclamation area, while economic activities are carried out in malls which are very busy with shopping activities and cultural activities carried out inside and outside the mall so that it adds to the splendor of the shopping center in the reclamation area of Manado Bay.

Beach reclamation is carried out in the bay of Manado with the aim of expanding the development of the city of Manado. Therefore, reclamation activities have a major role in the development of coastal areas. With the reclamation of the beach, the beach structure has changed, which was sloping, now it is steep and the substrate structure has changed to a rocky beach so that the diversity of biota is destroyed by the reclamation beach. Rocky beaches are generally occupied by anchoring biota such as Phylum Mollusca, and also as attachment biota in man-made installations such as reclamation beaches. Changes in coastal structure before and after reclamation can be predicted that the placement and diversity, population has changed. The distribution of the Mollusca community in the tidal area to a certain zone is limited by the presence of environmental pressures so that the Mollusca is within the limits of physiological tolerance. The lowest tidal surface area is dominated by smaller Mollusks while the highest surface area is inhabited by larger Mollusca species[1]. Gastropods are a class of the Phylum Mollusca that mostly live in the coastal intertidal zone. Gastropods are a class of mollusks that have the largest and most varied members.

Water pollution by waste can cause contamination of fishery products, both fresh water and sea water. Waste that enters the waters can be in the form of organic or inorganic materials. Most organic wastes can decompose and are easily degraded by microorganisms, but not by inorganic wastes. Inorganic waste materials originating from the remaining production of the printing industry, chemical factories, textiles, pharmaceuticals, and electronics have the potential to damage the environment because they contain hazardous and toxic materials (B3) including heavy metals, such as lead (Pb), cadmium (Cd), mercury (Hg), chromium (Cr), nickel (Ni)[2]. Most of the pollutants found in the ocean come from human activities on land. In general, these pollutants come from various industrial, agricultural and household activities. Sources of pollutants can be grouped into seven classes, namely: industry, surface wastewater, urban wastewater, mining, shipping, agriculture and fisheries. While the types of pollutants mainly consist of sediment, nutrients, toxic metals, pesticides and pathogenic organisms[3]. Environmental pollution can have a wide impact and depends on the waste, type of waste, volume and frequency. The properties of the waste are corrosive, oxidizing, toxic and irritating. Waste in small volumes with a continuous frequency will lead to gradual degradation. On the other hand, even though the volume of waste is large, it does not have a significant effect, it only occurs once, this depends on the type and nature of the waste, as well as the compounds contained in it[4]. When contaminants enter the marine environment, these contaminants will undergo three kinds of accumulation processes[5], namely physical, chemical and physical processes. The purpose of this study was to determine the heavy metal content of Pb, Cd, Hg in the clams *C. testudinaria* and *C. radiata* taken from the waters of the bay of Manado.

2. Experimental

The place and time of the research was carried out on the reclamation coast of Manado bay and the research time lasted for three months. At that location, samples of *C. testudinaria* and *C. radiata* were taken. Sampling of shellfish was carried out directly at the location of the collection of shellfish. The samples taken were put in a plastic sample. The shellfish samples that have been obtained are then taken to the laboratory for analysis to determine the heavy metal content of Pb, Cd and Hg. Laboratory of Fish Quarantine Center for Quality Control and Safety of Fishery Products (Balai Karantina Ikan Pengendalian Mutu dan Keamanan Hasil Perikanan, BKIPM) Bitung. Analysis of heavy metal content using acid digestion method with determination of levels using AAS (Atomic Absorption Spectrophotometry)[6].

Heavy metal analysis was carried out using the Atomic Absorption Spectrophotometer (AAS) in accordance with the procedures of SNI 2354.5:2011 and SNI 2354.6:2016. The types of heavy metals that will be observed in this study are lead (Pb), cadmium (Cd) and mercury (Hg). The sample standard solution was put in a test tube available on the AAS device, the use was made on the AAS device computer, the flame was turned on and the AAS cathode lamp was set, the lamp position was adjusted to obtain maximum absorption. Then the standard solution is aspirated into the acetylene flame, the indication of the measurement reading must be zero. Successively the standard solutions were analyzed using AAS. The results of the atomic absorption measurements will be recorded and then calculated to obtain the concentration of heavy metals in the sample solution. Heavy metal levels will be calculated based on the regression concentration values displayed on the AAS. The regression concentration was obtained based on the regression value of the calibration curve. Determination of heavy metal content based on SNI (2011) with the following formula.

$$\text{Heavy metal content } (\mu g/g) = \frac{(D - E) \text{ x Fp x V}}{W}$$

D = Sample concentration /L from the results of AAS readings
E = Concentration of blank sample /L from AAS reading results
Fp = Dilution factor
V = Final volume of the prepared sample solution (L)
W = Sample weight (g)

3. Results and Discussion

Analysis of heavy metal content is also one of the important chemical composition analyzes to be carried out. Analysis of heavy metals in Gastropod Shellfish types *C. testudinaria* and *C. radiata* were carried out to determine whether the shells were safe to be applied to food products or not. In food or non-food products, heavy metals have a certain threshold and if consumed in excess will have a bad impact. Based on the results of the tests carried out, the heavy metal content of Cd, Pb and Hg in Gastropod Shells of *C. testudinaria* and *C. radiata* types can be seen in Table 1 and Figure 1.

Table 1. Heavy metal test results of *C. testudinaria* and *C. radiata*

Shellfishes	Heavy Metal Test Results		
	Cadmium(Cd)	Lead (Pb)	Mercury (Hg)
C.testudinaria	0,53 mg/kg	2,3 mg/kg	0,01 mg/kg
C.radiata	0,372 mg/kg	2 mg/kg	0,83 mg/kg

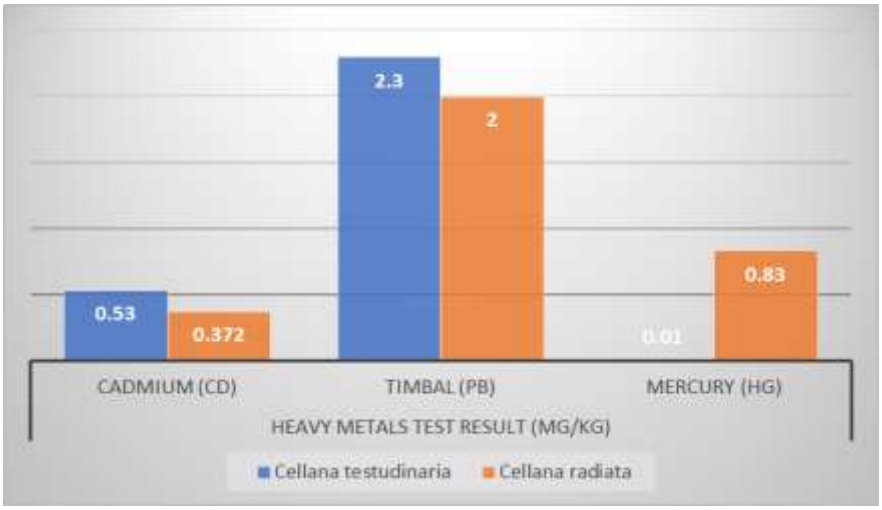

Figure 1. Heavy metal test results of *C. testudinaria* and *C. radiata*

a. Cadmium

The results of heavy metal analysis showed that *C. testudinaria* had higher cadmium (0.53 mg/kg) than *C. radiata* (0.372mg/kg). The content of these heavy metals was below the threshold determined by BSN (2014). Thus, the Gastropod shells of *C. testudinaria* and *C. radiata* are safe to be applied to food and non-food products. The low content of heavy metals in *C. testudinaria* and *C. radiata* indicates that the waters of Manado Bay were safe and not polluted by heavy metals.

One of the heavy metal compounds that become contaminants in marine biota is cadmium. Cadmium metal is one of the heavy metal compounds that become contaminants in foodstuffs. Cadmium metal can be produced from zinc and lead mining and combustion in vehicle engines. Cadmium is also contained in the soil due to the use of fertilizers containing cadmium metal. This makes cadmium present in all foodstuffs, both plant and animal, so that food is the main source of exposure to cadmium in humans. Cadmium levels in green mussels originating from the waters of Cilincing, DKI Jakarta ranged from 0.03 mg/kg – 0.53 mg/kg[7]. Heavy metals commonly found in shellfish are lead, cadmium, copper, and zinc. In the human body, heavy metals will combine with active enzymes to become inactive enzymes, so that the synthesis of red blood cells can be inhibited, resulting in anemia. Shellfish have the potential to be contaminated with heavy metals because they live in sediments (mud).

b. Lead

The results of analysis of lead showed that *C. testudinaria* had higher cadmium (2.3 mg/kg) compared to *C. radiata* (2 mg/kg) The content of these heavy metals was below the threshold determined by BSN (2014). Thus, the Gastropod shells of *C. testudinaria* and *C. radiata* are safe to be applied to food and non-food products. The low content of heavy metals in *C. testudinaria* and *C. radiata* indicates that the waters of Manado Bay were safe and not polluted by heavy metals.

Heavy metals that pollute marine waters are lead and cadmium metals. Lead metal can enter the body through breathing, food, and drink. Lead metal is not needed by humans, so when food is contaminated by the metal, the body will remove some of it. The rest will accumulate in certain body parts such as kidneys, liver, nails, fat tissue, and hair[8]. The presence of metals in water bodies can come from natural sources and from human activities. Natural sources that enter can be in the form of erosion of mineral rocks found in the aquatic environment. Some metals and metal compounds such as lead can enter water bodies, break down into ions and form complex compounds with particles contained in water before settling to the bottom of the waters[9].

Heavy metal compounds are one of the contaminant compounds in food. Sources of metal contamination include industrial waste, household waste and agricultural activities. The metal content, both in the soil and in the water, will drain and accumulate into the sea. Pollution of sea water by heavy metals will cause metal

contamination of marine biota. Heavy metals such as lead in the waters will drop and settle to the bottom of the waters and then form sediments, and this will cause organisms at the bottom of the waters such as shrimp, crabs and clams to have a great opportunity to be exposed to heavy metals that have been bound to the bottom of the waters and form sediments. The accumulation of lead in shellfish can occur through the absorption of water, particles and plankton by filtering. The detection of lead in the shellfish is suspected because this type of organism does not move or its mobility is slow so it cannot excrete lead properly so that it accumulates in the tissues according to the increase in lead in wate[10].

Lead is one of the oldest metals known to man. Since the Middle Ages has been found and used widely, because, very often found in nature. However, lead is dangerous and highly toxic. The most important natural sources of lead in the environment are weathered rocks. The lead content of rocks is avalanche by fast river flows and carried for long distances. Dust blown by the wind, forest fires, volcanic eruptions, and emitted sea salt are some other natural phenomena that make the distribution and concentration of lead occur in nature[11].

c. Mercury

The results of the analysis of heavy metals Mercury showed that *C. testudinaria* had higher mercury (1.01 mg/kg) compared to *C. radiata* (0.83 mg/kg) The content of these heavy metals was below the threshold limit determined by BSN (2014). Thus, the Gastropod shells of *C. testudinaria* and *C. radiata* are safe to be applied to food and non-food products. The low content of heavy metals in *C. testudinaria* and *C. radiata* indicates that the waters of Manado Bay are safe and not polluted by heavy metals.

Mercury is a dangerous heavy metal that can cause acute and chronic poisoning. In addition, mercury can be biomagnified in the human body, which causes mercury levels to be multiplied in the body even though it is entered in small amounts. The limit of mercury levels in shellfish that meet the requirements is set in SNI 7387:2009 below 1 ppm. This study aims to describe the level of mercury in shellfish. Mercury is a metal in the form of a liquid at room temperature (25°C) with a silvery color. The properties of mercury are the same as chemical properties that are stable, especially in sedimentary environments, namely binding to proteins, volatile and emitting or releasing toxic mercury vapors even at room temperature. Mercury vapor in the atmosphere can last for three months to three years, whereas water-soluble ones last only a few weeks.

This study examines how much heavy metal content is in the body of aquatic biota, especially *C. testudinaria* and *C. radiate*. The nature of heavy metals that are harmful to health, which can be infected in animal and human bodies, makes this research necessary to determine how the heavy metal content of Hg, Cd and Pb in Gastropod shells in Manado bay waters. Shellfish have the potential to be contaminated with heavy metals because they are filter feeders, namely organisms that feed by filtering water so that they have the ability to accumulate pollutant materials.

Heavy metals dissolved in waters at certain concentrations will be toxic to aquatic organisms. The presence of heavy metal content of lead in the body of the shellfish is a result of the bioaccumulation process. Bioaccumulation is the continuous accumulation of pollutants in the body's organs or the entry of chemicals from the environment through the food chain, which ultimately results in a very high concentration of chemicals in organisms. The accumulation of heavy metals that occurs in shellfish is mainly through their eating habits that utilize organic matter in the bottom waters[12]. Heavy metals dissolved in water bodies at certain concentrations will change their function to become a source of toxins for aquatic life. Although the toxicity caused by one heavy metal to all aquatic biota is not the same, the loss of a certain group of organisms can cause a break in the chain of life. At an advanced level, this situation can of course destroy an aquatic ecosystem order[13].

4. Conclusions

Based on the research that has been done, it can be concluded that *C. testudinaria* and *C. radiata* contain Pb 0.53 mg/kg and 0.372 mg/kg, Cd 2.3 mg/kg and 2 mg/kg, and Hg 1.01 mg/kg, and 0.83 mg/kg. This value meets the standards set by the National Standardization Agency. The heavy metal content of shellfish from both treatments of *C. testudinaria* and *C. radiata* was below the threshold set by the National Standardization Agency so that it was safe to be applied to food and non-food products.

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