Accumulation of heavy metals Pb and Hg in feather shells (*Anadara antiquata*) in Lekok Coastal Waters, Pasuruan Regency

W Isroni¹,³ and N Maulida²

¹Department of Fish Health Management and Aquaculture, Faculty of Fisheries and Marine Universitas Airlangga, Kampus C Unair, Jalan Mulyorejo Surabaya 60115, Indonesia
²Coastal and Marine Research Center, Brawijaya University
³Corresponding author: wahyu.isroni@fpk.unair.ac.id

Abstract. This research is a quantitative descriptive study that aims to determine the heavy metal contamination of Pb and Hg. Sampling was carried out exploratively in the waters of Lekok Beach, Pasuruan Regency. The data obtained were analyzed by descriptive analysis by comparing the quality standards of the Minister of Environment Decree No. 51 of 2004. And analyzed by correlation test to determine the relationship between the content of heavy metals Pb and Hg in seawater and sediment with feather shells. The results of this study indicate that shellfish (*Anadara antiquata*) can accumulate heavy metals Pb and Hg. The average accumulation of heavy metals Pb and Hg in Anadara antiquata was 2,315 ppm and 1,100 ppm. The average heavy metal content of Pb and Hg along the sea waters of the Lekok coast are 0.204 ppm and 0.073 ppm. In the sediment the average metal content of Pb and Hg is 5.318 ppm and 1.215 ppm. The heavy metal content has exceeded the quality standard limit that has been determined by the Decree of the Minister of the Environment No. 51 of 2004 and RNO, so that it can be harmful to human health who consume shellfish. The results of the correlation test showed that there was a positive correlation between the heavy metal content of Pb and Hg in sediment and seawater and the heavy metal content of Pb and Hg in shellfish.

1. Introduction

Coastal areas have important ecological functions, including as a nutrient provider, as a spawning ground, a place for cultivation and a place to find food for marine biota. According to Astuti [1] states that coastal and marine ecosystems also play a role as coastal protection or abrasion resistance for the land area behind this ecosystem. The various ecosystems found in coastal areas are functionally interrelated and interact with each other to form a unique ecological system [2].

Very high human activity has caused various kinds of adverse effects on human life and the environmental order, resulting in a polluted environment and environmental damage. Coastal areas, especially estuary areas, often experience heavy pollution, this is due to a very slow pollution process [3]. According to Palar [4], an environment is said to be polluted if there have been changes in the environmental order so that it is no longer the same as its original form, as a result of the entry and/or inclusion of a foreign substance or object into the environmental order, thus giving an influence (impact) is bad for organisms that already exist and live well in that environmental setting.

Pollution is an important problem that must be considered, one of which is marine pollution originating from factory or industrial waste discharged directly into sea waters or through rivers. According to Mukono [5], pollution is a substance that exists in the environment and is the result of
human activity, which has a detrimental effect on living organisms. Waste is a pollutant that causes environmental conditions to change from their original form. Pollution contained in factory or industrial waste is heavy metals [6]. According to Palar [4] stated that the characteristics and groups of heavy metals are having specifications, gravity very large (more than 4), having atomic numbers 22-34 and 40-50 as well as Lanthanide and Actinide elements, having a specific (specific) biochemical response to living organisms. All heavy metals can be poisons that will poison the bodies of living things. Examples are lead (Pb), cadmium (Cd), and mercury (Hg).

2. METHOD
This research is a quantitative descriptive study using the transect method. Sampling used an exploratory method with direct observation in the field which aims to describe the condition of the object of research on water pollution from heavy metals Pb, Cd, and Hg in Lekok Coastal waters, Pasuruan Regency.

2.1. Tools and materials
The tools used to support this research are pH meter, thermometer, DO meter, BOD meter, COD meter, GPS (Global Positioning System), refractometer type S-50, shovel or Ekman Dredge, bottle or sample bag, ice box, plastic tray, label paper, digital camera, spectrophotometer, digital camera, blender, oven, hotplate, glass beaker, measuring flask, vortex and filter paper, label paper, stationery and sieve net.

3. Results and discussion
3.1 Heavy Metal Content in Water and Sediment
Based on the results of research that has been carried out regarding the content of heavy metals in seawater and sediment along the Lekok coastal waters, Pasuruan Regency, it can be seen in the following table:

| Station of | Heavy Metal Content (ppm) | | | | |
|---|---|---|---|---|---|
| | Water | | Sedimentary | | |
| | Pb | Cd | Hg | Pb | Cd | Hg |
| I | 0.139 | 0.166 | 0.052 | 4.449 | 3.151 | 1.020 |
| II | 0.149 | 0.167 | 0.060 | 4.458 | 3.230 | 1.128 |
| III | 0.215 | 0.189 | 0.074 | 5.271 | 3.500 | 1.268 |
| IV | 0.236 | 0.199 | 0.085 | 5.856 | 3.750 | 1.306 |
| V | 0.203 0.092 | 0.281 | 6.558 | 3.985 | 1.354 |
| average | 0.185 0.073 | 0.204 | 5.318 | 3.523 | 1.215 |
| Quality | * 0.003 * | *0.01 | 0.05 | 10-70 ** | 0.1-2** | 0.02-0.035** |

Note: *:KEPMENLH number 51 in 2004; **:RNO

Table 4.1 shows that the heavy metal content of Pb, Cd, and Hg in seawater varies greatly at each station. The average values of heavy metal content of Pb, Cd, and Hg were 0.204 ppm, 0.185 ppm, and 0.073 ppm. Pollution of sea water along the waters of Lekok Beach in the heavy metal content of Pb more than 0.05 ppm, Cd metal content exceeding 0.01 ppm, and Hg metal content exceeding 0.003 ppm, according to the Decree of the Minister of the Environment No. Heavy metals in the waters of Lekok Beach, Pasuruan Regency, have exceeded the threshold.

3.2 Heavy Metal Content in Mussels
Based on the results of research that has been conducted on the content of heavy metals in feather shells (Anadara antiquata) in the coastal waters of Lekok, Pasuruan district, it can be seen in the following table:
Table 2. Heavy metal content of Pb, Cd, and Hg in shellfish

| Station | Pb     | Cd     | Hg     |
|---------|--------|--------|--------|
| I       | 1,926  | 1,257  | 0.829  |
| II      | 2,079  | 1,381  | 0.936  |
| III     | 2,338  | 1,640  | 1,169  |
| IV      | 2,582  | 1,740  | 1,259  |
| V       | 2,649  | 1,930  | 1,309  |
| Average | 2,315  | 1,590  | 1,100  |

Based on table 2 shows that the heavy metal content of Pb, Cd, and Hg in Shellfish (*Anadara antiquata*) has a heavy metal content that varies greatly at each station. The average values of heavy metal content of Pb, Cd, and Hg in sea mussels (*Anadara antiquata*) along the waters of Lekok Beach were 2,315 ppm, 1,590 ppm, and 1,100 ppm. The shell size of the feather shells observed was 4-6 cm.

The accumulation of heavy metal content in feather shells, Pb heavy metal at each station exceeded 0.008 ppm, Cd metal content exceeded 0.001 ppm, and Hg metal content exceeded 0.001 ppm, according to the Decree of the Minister of the Environment No. 51 of 2004 it can be said that heavy metal content in clams have exceeded the predetermined quality standard threshold. It can be said that consuming feather shells can harm human health.

According to Connell and Miller [6] stated that the decrease in the number of species and diversity in heavily polluted areas with an increase in the biomass of living things that are tolerant. As the distance from the dumps increases, such areas gradually become clear with intermediate situations that show a shift of surroundings. The initial entry of organic matter into an area causes a series of transient changes in dissolved oxygen and related factors, as well as their consequent effects on biota.

The metal content of Pb, Cd, and Hg in seawater, sediment, and shellfish can be seen that the highest heavy metals are found at station V, this is because at station V is a factory industrial area and near residential areas and there is a lot of organic and inorganic waste seen in when sampling is carried out. It is possible that the existing waste comes from the flow of ocean currents, as well as from the garbage of the surrounding residents in the residential area.

The lowest heavy metal content at station I, is a coastal area where there are several tributaries of the Rejoso river, it can be seen that this river is an industrial or factory waste disposal stream. However, the heavy metal content at this station is the lowest, this is probably because the waste discharged does not directly enter the waters of Lekok Beach, but through the river flow and is deposited in river sediments. So the heavy metal content will pollute the river first.

3.3 Correlation Relationship between Heavy Metal Content in Seawater and Sediment with Heavy Metal Content in Shellfish

Based on the results of research on the correlation test, namely to determine the correlation between heavy metal content Pb, Cd, and Hg in seawater and sediment with heavy metal content Pb, Cd, and Hg in shellfish. The type of correlation used is simple correlation, which is to determine the direction of the close relationship between two variables and to determine the direction of the relationship that occurs, testing this correlation with the help of the program *Spss 06* obtained the following data:

Remarks: *: KEPMENLH number 51 of 2004;
Table 3. Correlation test results of heavy metal content between seawater and sediment with seashells Feather

| Station | Heavy Metal Content | Shell (Anadara antiquata) |
|---------|---------------------|---------------------------|
| Seawater| Pb                  | 0.973**                   |
|         | Cd                  | 0.975**                   |
|         | Hg                  | 0.988**                   |
| Sediment| Pb                  | 0.964**                   |
|         | Cd                  | 0.987**                   |
|         | Hg                  | 0.994*                    |

Remarks: **: Correlation is significant at the 0.01 level (2-tailed).

Based on the analysis of the relationship Pb heavy metal content in sea water with mussels fur (Anadara antiquata) of a significant level of both variables is 0.005 (≤ 0.05) and 0.003 (≤ 0.05) can be said to be correlated significantly, so that H1 received and H0 is rejected, it indicates that there is a relationship between Pb heavy metal content in sea water with heavy metal content of Pb in mussels fur (Anadara antiquata). The correlation content between the heavy metal of Pb between Shellfish (Anadara antiquata) and seawater was 0.973.

Palar [4] states that physiological processes that occur in each biota also affect the level of heavy metals that accumulate in the body from the waters. The size of the amount of heavy metals contained in the body will be toxic caused by heavy metals. In addition, this physiological process also affects the increase in heavy metal content in water bodies. Shellfish is an organism that has the ability to neutralize (tolerate) certain heavy metals to a certain concentration (has a high tolerance). According to Conell and Miller [7] states that absorption from solution by most animals occurs by passive diffusion, possibly as metal compounds dissolve through stages caused by absorption on the body surface and binding by body constituents.

4. Conclusion
Based on the results of the research that has been done, it can be concluded that the average values of heavy metal content of Pb, Cd, and Hg in seawater along Lekok Beach are 0.204 ppm, 0.185 ppm, and 0.073 ppm. In the sediment, the average metal content of Pb, Cd, and Hg was 5.318 ppm, 3.523 ppm, and 1.215 ppm. The existence of a positive correlation indicates that the increase in heavy metal content of Pb, Cd, and Hg in seawater and sediments with heavy metal content in feather shells and blood clams. The higher the level of heavy metals in seawater and sediments, the higher the level of accumulation of heavy metals in feather shells and blood clams.

5. Reference
[1] Astuti A 2000 Aktivitas Proses Dekomposisi Berbagai Bahan Organik dengan Aktivator Alami dan Buatan Prodi Agronomi Fak. Pertanian UMY Yogyakarta
[2] Tuwo A Rohani A R A Saru C Rani 1996 Kajian Struktur Komunitas Makrozoobentos Pada Hutan Bakau Hasil Rehabilitasi Fakultas Ilmu Kelautan dan Perikanan Universitas Hasanuddin Ujung Pandang
[3] Darmono 2001 Lingkungan Hidup dan Pencemaran Jakarta: UI Press
[4] Palar H 2004 Pencemaran dan toksikologi logam berat Jakarta: Penerbit Rineka Cipta
[5] Mukono H J 2005 Toksikologi Lingkungan Surabaya: Airlangga University Press
[6] Connell Does W and Gregory J Miller 1995 Kimia dan Ekotoksikologi Pencemaran Jakarta: UI Press