Study of heavy metal content cadmium (Cd) in various sizes of blood shells (*Anadargranosa*) in coastal Bancaran Bangkalan, Madura

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Abstract. Ocean pollution occurs because of the concentration of population and industrialization in the coastal areas. The existence of heavy metals in the water can be accumulated in aquatic organisms, especially blood shells. The purpose of this study is to know the contents of cadmium (Cd) in blood shells, water, sediments and to determine the relation of blood shell's size with the contents of cadmium (Cd) in the Bancaran Coastal, Bangka, Madura. The research method used was observations of that method. The main parameters are observed that the contents of cadmium (Cd) in seawater, sediment, and blood in the Bancaran Coastal shells. Supporting parameters that observed are water quality include temperature, pH, salinity, DO and brightness. Data analysis is used to find relations of the data Obtained (regression-correlation). The results showed that the contents of cadmium (Cd) of large shells blood are higher than the small and medium blood shells, and there were the relations between the size of the blood shells with the contents of cadmium (Cd). The water quality of Bancaran Coastal was the temperature 28°C-29°C, pH 7-8, the salinity of 30 ppt, the brightness of 30 cm, and DO 5 mg/L.

1. Introduction

Indonesia Merufeed, mostly island states around 70% of its territory consists of water area [1] [2]. Indonesia's land area of 2,012,402 km² and comprehensive ± waters 5,877,879 consisting of 17,508 km² with a coastline of 81.1 km [3]. Island in Indonesia, Madura Island, which is divided into four districts, which are Bangkalan. Bangkalan Regency has an area of 1260.14 km² and located between 112°-113 ° East Longitude and 6°-7° LS bordered by the Java Sea in the north, Sampang on the east and the Madura Strait in the south and west, topography consists of gently sloping area covering an area of 68 454 ha (54.25%), choppy area covering 45 236 ha (35.85%), regions undulating area of 11 773 ha (9.33%) and hilly area of 719 ha (0.57%) [4].

Fairyoverall ocean right in Bangkalan reach 13,857,639 tons per year, with the largest production of marine fisheries is the District Klampis (5,810,509 tons). Industries located in Bangkalan, metal goods industry machinery, and equipment as much as 3 units with a workforce of 122 people and the type of processing industries other 68 units with a workforce 878 people [4].
Water Bancaran is one of the coastal areas which are in Bangkalan. The water environment problem is pollution caused by heavy metals, especially cadmium (Cd). Marine pollution occurs because of the concentration of population, tourism, and industrialization in the coastal areas, causing contamination of the water ecosystem by heavy metals [5].

Blood shell (*Anadara granosa*) is one commodity that is widely available in coastal waters Bancaran utilized as a food source of protein [6, 7, 8]. The nature of blood shells that live in bottom waters with low mobility even settle on the bottom, causing the blood shellfish poisoning is considered as a mediator danger of water pollution because of its ability as a bioaccumulator [9, 10, 11, 12, 13].

The size of the shells can be influenced by heavy metal concentrations in his body, a large shell size is positively correlated with increasing age, and increasing age is also positively correlated with increasing concentrations of heavy metals in the body [14]. With this background, it is necessary to investigate the content of heavy metal cadmium (Cd) on mussels blood and correlation of size blood shells (*Anadara granosa*) with the content of heavy metal cadmium (Cd) in the waters of Turkish Bancaran Bangkalan, Madura, so it can be used monitoring environmental pollution in waters and food safety.

2. Materials research

2.1 Place and time of research

This research was conducted in January-May month 2017 sampling blood shell (*Anadara granosa*) conducted in the waters Bancaran Beach Bangkalan, Madura. Analysis of heavy metal cadmium (Cd) in samples of water, sediments, and samples of blood shell is done at the Center for Health laboratories (BBLK) Surabaya.

2.2 Tools and materials

The tools used in the study were 500 ml plastic bottles, plastic bags of five kilograms, cool box, the pipe as well as equipment for measuring water quality, eg refractometer, DO kit, pH paper, thermometer and secchi disk. While equipment for the analysis of heavy metals cadmium in water samples, sediments and mussel is glass beaker 50 ml, analytical balance, knife, a flask of 50 ml, a fume hood, oven, micropipette, desiccator and one set of tools Atomic Absorption Spectrophotometry (AAS).

Substances used in this study was the sediment samples, water samples and samples of aquatic fauna such as blood shell (*Anadara granosa*) are grouped based on the size of that small size (<2.5 cm), medium (2.5-3 cm) and large (>3 cm) were taken from each observation station. Material for analysis of heavy metal cadmium in water, sediments, and shellfish flesh includes materials standard solution of cadmium concentration of 1000 mg/ l, solvents, concentrated hydrochloric acid, citric acid, ammonium hydroxide was concentrated, distilled water and thymol.

2.3. Research procedure

Determining the geographic coordinates of each sampling station uses the Global Positioning System (GPS). The number of sampling stations of blood shell, seawater, and sediments as much as 3 stations.

Station 1 = Water western West Village Pond RT 3 RW 6 Village Bancaran (LS: 6° 59'53.7648 " E: 112 ° 46'27.8004 ")
Station 2 = Water Village Sebaneh west RT 4 RW 6 Village Bancaran (LS: 7 ° 0'6.3756 " E: 112 ° 46'8.0436 ")
Station 3 = Water Village Sebaneh west RT 5 RW 6 Village Bancaran (LS: 7 ° 0'37.3284 " E: 112 ° 45'22.6908 ")

The water taken at each station by using a plastic bottle at 30 cm below the water surface as much as ± 500 ml and then put in a cool box with the provision of ice in order to avoid changes in biologically and chemically, then cool box is sealed and carried transport to the laboratory for
observation cadmium content.

The sediment was taken at each station using the pipe as many as three stations on the surface layer of sediment at a depth of 1-5 cm. The sediments taken as one and then put in plastic bags that have been marked for each station and stored in a cool box before observed in the laboratory.

A sampling of blood shells (Anadara granosa) was done by hand. Shellfish random blood is taken directly as much as 100 birds at each station, and then blood shell has been obtained beforehand grouped into three lengths that small size (<2.5 cm), medium (2.5 cm-3 cm), and large (3 cm-5 cm) [15]. The blood shells that have been grouped put in plastic bags that have been marked for each station and then stored in a cool box for later observation of heavy metal content in the laboratory.

2.4 Parameters research
Parameters measured include The main parameters and parameter support. The main parameters measured were the content of cadmium in water, sediment, and blood shells (Anadara granosa) in waters Bancaran Beach. Investigations include water quality parameters such as temperature, salinity, pH, dissolved oxygen (DO), and brightness.

2.5 Analysis data
Analysis of the data used was a form of descriptive presentation of data. Analysis of data obtained will be compared with the value of water quality standards and to biota. This data was performed to determine the content of heavy metal cadmium in water, sediments, and shellfish blood and determine the correlation between the concentrations of heavy metals cadmium (Cd) with the size of the oysters on the blood (Anadara granosa) in the waters of Bancaran Bangkalan, Madura. The correlation between the size of blood shells with concentrations of cadmium will be analyzed using linear regression.

3. Results and discussion

3.1 Morphometrics shellfish blood (Anadara granosa)

| Character morphometric | Shellfish size Station I | Shellfish Size Station II | Shellfish Size Station III |
|------------------------|--------------------------|---------------------------|---------------------------|
| PC (cm)                | 1-2                      | 1-2.5                     | 1-2.5                     |
| TC (cm)                | 0.5-1                    | 1.5                       | 0.5-1                     |
| TiC (cm)               | 0.5-1                    | 1.2                       | 0.5-1                     |
| TU (cm)                | 0.5-1                    | 1-2                       | 0.5-1                     |
| PC Description:        | High eggshell            | TU: Thick Umbo            | PC: Length Shells         |
| TC: Thick eggshell     | K: Small                 | S: Medium B: Big          |

The measurement results of morphometric characters were one that is used for taxonomic characteristics when identifying organisms. Each species of varying size was absolutely influenced by age, gender and the environment as food, temperature, pH, and salinity [16]. Morphometric data blood shells in the waters Bancaran, Bangkalan presented in Table 1.

3.2 The heavy metal cadmium (Cd) content
The test results of the heavy metals cadmium (Cd) in water, sediments, and shellfish blood w
in the Center for Health Laboratory (BBLK) Surabaya Obtained Data on the cadmium content of heavy metals in water, sediments, and shellfish blood are presented in Table 2.

| Station | Cadmium content (mg/kg) |
|---------|-------------------------|
|         | Shellfish Blood         | Sea water | Sediment |
|         | Small       | Medium    | Large    |          |          |
| ST 1    | 0.02        | 0.04      | 0.06     | 0.05     | 0.02     |
| ST 2    | 0.03        | 0.06      | 0.07     | 0.07     | 0.07     |
| ST 3    | 0.01        | 0.02      | 0.03     | 0.07     | 0.02     |

3.3 The content of cadmium (cd) on shellfish blood (Anadara granosa)

The content of the heavy metal cadmium (Cd) on various measures of blood shells (Anadara granosa) ranged between 0.01 to 0.03 mg/kg for small size, medium size between 0.02 to 0.06 mg/kg and large size between 0.03 to 0.07 mg/kg. The content of the heavy metal cadmium (Cd) in the blood shells of various sizes can be seen in Figure 1.

3.4 The content of cadmium (cd) in seawater

The content of the heavy metal cadmium (Cd) in seawater ranged between 0.05-0.07 mg/L (Table 1). The content of the heavy metal cadmium (Cd) in stations 1 to 3 has not exceeded the allowable quality standards for Cd of 1.0 mg/kg (ISO 7387: 2009). The content of cadmium in all three stations was observed ranged from 0.01 to 0.07 mg/kg.
with a content of 0.05 mg/L. The content value has exceeded the limit value quality standard heavy metal cadmium in seawater that is equal to 0.001 ppm. The highest cadmium content of seawater was located at the point of station 2 and 3. This is due to the location of both stations close to residential areas around. So it can be ascertained Bancaran sources of pollution caused by wastewaters generated by human activity. Based on research that has been done, the data obtained by the content of cadmium (Cd) in seawater, which can be seen in Figure 2.

![Figure 2. The content of cadmium (Cd) at sea in the waters Bancaran](image)

**3.4.1 The content of Cadmium in sediments**

The content of the heavy metal cadmium (Cd) in sediment ranged between 0.02 to 0.07 mg/kg. At station 1 and 3 is known that the content of heavy metal cadmium (Cd) in the sediment of 0.02 mg/kg, whereas the second station of 12.07 mg/kg. The content of cadmium in sediments ranged from 0.02 to 0.07 ppm, whereas for the standard quality standard values for cadmium in the sediment the which is 1.5 ppm [18]. Cadmium dissolved in the water will run into the deposition. However, the current wind direction and speed enough to Affect the content of heavy metals in water and sediments [19]. Based on research that has been done, the data obtained by the content of cadmium (Cd) in the sediment can be seen in Figure 3.

![Figure 3. The content of Cadmium (Cd) on Sediment in Water Bancaran](image)

**3.4.2 Shellfish Size blood relationship with the content of Cadmium (Cd) on shellfish blood (Anadara granosa)**

Size blood shells (Anadara granosa) are different may cause the value of the content of cadmium (Cd) is different. Based on Data Obtained show that the size of small shells (length <2.5 cm) has an average value of the content of cadmium (Cd) the which is less than the size of medium and large shells. The size of the mussels was (length = 2.5-3 cm) had a cadmium content value less than the size of large blood shells (length> 3 cm). It means that the greater size of the mussels has a higher content of cadmium.
Based on regression-correlation calculations known correlation coefficient (R) was 0.78. X and Y relationship strong and positive, meaning that the increase is in the size of the shells. Generally, raising the content of cadmium.

The which is a determination coefficient of 0.60 is obtained, the which means of the contribution of variable X to variable Y by 60%. The regression equation that is formed is $Y = 0.01X -0.005+$ positive sign (+) indicates when the size of the shells increases, the value of heavy metals cadmium in shellfish will rise as well, and vice versa. The regression graph is shown in Figure 4.

![Figure 4. Contents Cadmium](image)

### 3.4.3 Relations Cadmium (Cd) concentration in seawater with on blood shellfish

The content of cadmium (Cd) also in the seawater influences the content of cadmium (Cd) on blood shell. This is related to the nature of the meal blood shells are filter feeders. Blood shells Obtain food by filtering the water that goes into the body.

Based on regression-correlation calculations known correlation coefficient is 0.01, respectively. X and Y relationship is positive, meaning that the increase is in the content of cadmium (Cd) of seawater. Generally, raising the content of cadmium (Cd) on blood shell. $R^2$ the which is the result of a determination coefficient of 0.0001, the which means of the contribution of variable X to variable Y a 0.01%. The regression equation that is formed is $Y = 0.03+0.003X$, positive sign (+) in the variable content of cadmium (Cd) Showed a rise of seawater, so that when the content of cadmium (Cd) of seawater rise, the heavy metal content of cadmium (Cd) shells will go up, and vice versa.

![Figure 5. Graph of the relationship of seawater cadmium with cadmium shells](image)

### 3.4.4 Relations cadmium content (cd) in sediments with the content of cadmium (cd) on shellfish blood

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Based on regression-correlation calculations known correlation coefficient is 0.65. X and Y relationship is positive, meaning that the increase is in the content of cadmium (Cd) content of sediments in general raise of cadmium (Cd) on blood shell. R2 the which is the result of the determination coefficient 0.422, the which means of the contribution of variable X to variable Y 42.2%. The regression equation that is formed is Y = 0.0135 + 0.55 X. The positive sign (+) in the variable content of cadmium (Cd) showed increased sediments, therefore, if the content of cadmium (Cd) sediments increases, the heavy metal content of cadmium (Cd) mussels will go up, and vice versa.

![Figure 6. The relationship of cadmium in sediments and shells](image)

### 3.4.5 Water Quality Water Bancaran, Bangkalan

Water quality measured include pH, DO, brightness, temperature, and salinity. Bodies Bancaran research results indicate that the pH in Water Bancaran ranged from 7-8 in each station. Levels of dissolved oxygen (DO) at all observation stations in the waters Bancaran have a DO concentration of 5 mg/L, this shows the content of DO on Aquatic Bancaran evenly. Water transparency in the waters Bancaran has the same value in each research station that is 30 cm. Water temperature at the point Bancaran in the study ranged from 28-29°C, while salinity ranges between 30-32 ppt. Reviews These Data From the results of water quality at each station is still in normal condition. Optimal water quality for shellfish life is pH 6-9, temperature 26-32°C, DO of 3-8 mg/L and salinity of 15-34 ppt [20]. Data from the seawater quality measurements can be seen in Table 3.

| Station | pH | DO (mg/L) | salinity (ppt) | temperature (°C) | brightness (cm) |
|---------|----|-----------|----------------|------------------|----------------|
| ST 1    | 7  | 5         | 30             | 28               | 30             |
| ST 2    | 7  | 5         | 32             | 29               | 30             |
| ST 3    | 8  | 5         | 30             | 28               | 30             |

### 4. Conclusions

Based on the research that has been done, it can be concluded that the content of cadmium (Cd) in the blood shells (*Anadara granosa*) in waters Bancaran, Bangkalan, Madura, the which is between 0.01 to 0.07 mg/kg. This indicates that the content of cadmium in blood shells has not exceeded the standard limit value of cadmium allowed quality standards for shellfish at 1.0 mg/kg (ISO 7387: 2009). There is a relationship between the size of blood shells with the content of cadmium in shellfish with a correlation coefficient of 0.78. Blood large blood shells have a higher cadmium content than the blood shells were medium-sized and small.

We recommend that if you eat blood shells better chose the mussels are smaller because of the content of cadmium in the body shells are Also lower Compared to large-sized shells. Boiling mussels...
are also very important to do before the process into food. Because it can reduce the levels of cadmium in shellfish. Minimizing the consumption of shellfish also needs to be done even though the content of cadmium within safe limits, since the heavy metals that enter the human body also will accumulate in the body.

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Acknowledgment
The authors gratefully acknowledge the financial support from the Annual Budget of the Faculty of Fisheries as well as the instrument support.