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Heavy Metal Content On Sea Biota And Water At Estuary Region In East Coast South Kalimantan

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Abstract: *Coal mining activity produces pollutant which is the coal dusts with heavy metals content. If the dusts mixed into the water, it will cause water pollution. Heavy metals like Pb, Zn, Cu, Cr needed by the living organisms, but if it exceeds the threshold, it will give negative impacts to the organism. Sea biota like mangrove snail (Telescopium telescopium) and mangrove crab (Scylla serrata) can be used as bio-indicators. This descriptive study aimed to determine the heavy metals content on sea bioata. Assays of Pb and Zn did on mangrove snail and assay of Cu and Cr did on mangrove crab. The heavy metals content in water performed as a comparison. There are three locations for sampling based on mangrove vegetation density which are high density, medium density, and low density. Heavy metals content test was done using Inductively Coupled Plasma (ICP) tool. Water quality standard based on South Kalimantan's governor regulation (No. 5) 2007, and heavy metals content on sea biota based on Indonesia National Agency of Drug and Food Control (Balai POM) No 03725/B/SK/VII/1989. Specific for Cr based on Food and Drugs Administration (FDA). The results showed Cu accumulated over the threshold on mangrove crab in low density mangrove vegetation. Heavy metals content of Pb, Zn, and Cr on sea biota below the threshold. Heavy metals content on water also below the threshold. The study was conducted in physical environments that can be tolerated by sea biota.*
Keywords: *heavy metals, sea biota, mangrove snail, mangrove crab, coal stockpile*

I. Introduction

Human can survive because human can adapt theirself to nature (Soemarwoto, 2003). Wardhana (2004) stated that human can use any science inventories to exploit the environment maximally, and often causes disruption of the environmental balance. Human explore coal to take advantage the environment, as well as give a damaging impact on the environment.

The east coast of Kalimantan since early 90s became the coal temporary collection point (stockpile) before being exported. This place scattered near the river estuary that directly relate to Makassar's straits. Coal mining is not only profitable, but also result disadvantages. This thing happen if the management goes bad, it will cause critical land on the former mining area, decreasing water table, pollution, and the emergence of social insecurity.

Coal dust pollution trigger a change in a community of organisms, even lead to changes the relationship between species (Mukono, 2010). Sembel (2015) stated that heavy metals which pollute the marine environment will accumulate in aquatic biota. One of stockpile example located in Asam-Asam's estuary region, district of Tanah Laut.

Flakes and coal dust that contact directly with the water may cause pollution. Ruch et. al. (1974) as quoted by IARC (1997) stated coal contains Pb (4-218 ppm), Zn (6-5350 ppm), Cu (5-61 ppm) and Cr (4-54 ppm). Metal-containing coal dust will settle in the water and potentially become a contaminant if it exceeds the threshold.

Estuary region in east coast Kalimantan Island are habitat for sea biota (plants and animals), Houbrick (1991) explained mangrove snail has habitat in mangrove forest. This Gastropod has slow mobility, habitat in waterbed, and has detritus dietary pattern or feeding feeder. (Susanti et. al., 2008, in Rahmawati, 2014). Mangrove crab is another aquatic biota that also has important role in the absorption of heavy metals. Mangrove snail and mangrove crab with their uniqueness used as indicators of water pollution.

According to Effendi (2003) toxic pollutants resulting in impaired on aquatic biota such as morphological disturbances, behavior disturbances, and even death. Mud crabs consumed by the local community as a source of protein that has a major contribution in the inclusion of Cu and Cr into the human body. Both of these metals come into the crab's body in two ways, through the food chain where small animals are exposed to heavy metals eaten by the mangrove crab and the digestion process which flowed to the rest of the body.

Cu metal itself is an essential metal required by mangrove crabs and humans. In humans Cu needed to maintain a healthy body. While in the mangrove crab according to Mohadi, et. al. (2007) Cu-protein complex is

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part of a Hemocyanin protein used as a carrier of oxygen on a number of invertebrates such as mangrove crab. Furthermore, Cu is the largest metal element in the human body.

Cr is a type of heavy metals that are harmful to the human body and it's not an essential metal. According Widowati, et. al., (2008) Cr (III) on the human body is needed to metabolize the insulin hormones and control blood glucose levels.

II. Method

This descriptive study was conducted over five months (August-December 2015) in Asam-Asam's estuary region, district of Tanah Laut. Data collected through observation, metal content test on meat samples of mangrove snail and mangrove crab in the laboratory using a tool named Inductively Coupled Plasma (ICP).

Mangrove snail and mangrove crabs obtained from their habitat at the sample points based on the mangrove vegetation density (high density, medium and low). Water as a comparison sample obtained from the water in the estuary. The tools that used for this study are nets / sack, cool box, hammer, label paper, ruler, timber or small shovel, analytical balance, plastic clips, and camera. The tools that used for testing the water on this study are Kemmerer water sampler, measuring cups, bottles, pH meter, thermometer, stopwatch, flow ball, *jerigen* (a container with a lid to hold waters), sechi disk, cool box, camera, pipette, and ICP.

Sampling the mangrove snail was done through 1) determine the water sampling areas and mangrove snails, 2) set the sampling point, 3) explore the mangrove mud to take the snail, and 4) storing in and preserved in a cool box. Sampling the mangrove crab was done by 1) set a trap, 2) release the mangrove crabs that caught on the trap 3) storing in a bucket, 4) make the crab dead, 5) separating the crabmeat, 6) wrapped with plastic and preserved in a cool box, water sampling is done using Kemmerer Water Samplers, and sterilized with a drop of H2SO4 solution,.

The test was done in Health Laboratory Province South Kalimantan. The study results data based on 1) POM Directorate General' decree No. 03725/SK/VII/1989. 2) FDA Journal about maximum limits of heavy metal pollution on the crab meats. 3) Water quality standard based on South Kalimantan's governor regulation (No. 5) 2007.

III. Result

The analysis results of heavy metal content on sea biota presented at Table 1.

Table 1. Heavy Metal Content on Sea Biota.

Heavy Metals Type	Sea Biota	Level of Heavy Metals (mg/Kg)		
		I	II	III
Pb	Mangrove Snail	< 0,10	0,1802	0,5216
Zn	Mangrove Snail	11,9761	11,9761	10, 1078
Cu	Mangrove Crab	12,5446	14,9657	22,6619
Cr	Mangrove Crab	0,7129	0,7255	0,6905

Information: I = High mangrove vegetation/estuary region, II = Medium mangrove vegetation /settlement region, III = Low mangrove vegetation/Nipa palms.
Threshold: Pb = 2.000 ppb, Cu = 20.000 ppb (Anon., 1989). Zn = 100 mg/kg (Hasti, 2013, Cr = 2,5 mg/kg (Budiati, 2014).

Table 1 show heavy metals Pb, Zn, and Cr content are below the threshold which has been set. Cu content in station III exceed the threshold, the area with low mangrove vegetation area. Heavy metal that contained on water presented on Table 2. Content of Heavy metals (Pb, Zn, Cu, and Cr) on the table 2 shows the result lower than the threshold that has been set. The results showed Cu exceeded the threshold on the mud crabs in the low density mangrove vegetation. Heavy metal content in the water also shows below the threshold. Research was conducted in physical environments that are measured and can be tolerated by sea biota such as in Table 3.

Table 2. Content of Heavy Metals in Water Samples

Heavy Metals Type	Level of Heavy Metals (mg/L)			Normal Range (mg/L)
	I	II	III	
Pb	< 0,0069	< 0,0069	< 0,0069	< 0,1
Zn	0,0350	0,2796	0,0213	< 2
Cu	0,0099	0,0108	< 0,0093	< 2
Cr	0,0251	0,0151	0,0234	< 0,5

Informastion: I = High Mangrove Vegetation/estuary, II = Medium mangrove vegetation /settlement region, III = Low mangrove vegetation/Nipa palms.

Table 3. Environment Parameters

Parameters	Unit	Sampling Points			Normal Range
		I	II	III	
Water temperature	ºC	28	30	34	< 38
Acidity degree (pH)	-	7,1	7,5	7,6	6-9
Water brightness	cm	28,2	17,6	22,7	-
Flow velocity	m/s	0,054	0,066	0,051	-
BOD_5	mg/L	12,80	12,10	8,60	< 100
COD	mg/L	32,19	30,36	21,66	-
Salinity	ppm	-	-	-	500-30.000

Informastion: I = High Mangrove Vegetation/estuary, II = Medium mangrove vegetation /settlement region, III = Low mangrove vegetation/Nipa palms.

IV. Discussion

Zn content on the sea biota is below the set threshold, it is in line with the results of previous studies (Hasti , 2013 ; Rochyatun et al. , 2006). She found the Zn content is detected on an anchovy with the value is still below the maximum limit of Zn concentrations that allowed on the sea biota muscles as big as 100 mg / kg dry weight. Zn content in the water is below the threshold, it is different with previous findings (Houbrick , 1991). Low tide causes the metal ions accumulate so that the metal content in the water is high. The more frequent the mangrove snail doing this activity, the higher the concentration of metal that accumulates in the flesh.

Zn content on the water below the set threshold, it is supported with another studies (Hasti, 2013). The low Zn content in the water caused by Zn metal concentration in the water can settle on the bottom of the water (sediment), so that the metal content in the sediment dissolved in the water that causing high metal concentration in the water. Water in Asam-Asam estuary is a river estuary that containing silt, it can be used as a reason for the low Zn content in the water.

The Pb content on the sea biota also below the threshold, it's in the line with previous studies (Palar, 1994), Pb sediment's formation on brackish water are very low, but there're still possibilities that the metal will also settle on the bottom of the water and continue to increase over time. Pb will go into the air layer in previously, crystallize, and then brought by rain and pollute water and soil. The small metal particle size, ease the movement of Pb metal crystal to elsewhere.

Pb content in the water is show below the threshold. The low Pb content at the water may be related with the mangrove characteristic that can accumulate metal. According to Kariada (2014) mangrove plants have tendency to accumulate heavy metals in the surrounding areas, but the ability to accumulate different for each species. According to Slamet (2004) the absorption process can be happen through the plants organs like roots, leaves, and stomata. Besides relying on the absorption of organic compound in the water, Pb content also be influenced by the presence of the vegetations in surrounding.

The Cr content on sea biota also below the set threshold, it's different from the studies that have been reported before (Suprapti, 2008). She found that Cr content on the sediment and Mussels Blood (Anadara granosa) found as big as 0,1278-0,1617 ppm, means has exceeded a specified threshold (0.0500 ppm). According to Corrˆea Junior et. al., (2005) in Pinheiro, et. al., (2012) the Cr metal go into the mangrove crab body through the gills and after that go into the body flow and go to the claws until stop at hepatopancreas, or change into, from the gills to the hepatopancreas and then go into the claws. Even in this research, the Cr content is below the threshold, consumers can avoid the Cr poisoning, because they just eat the meat crab only.

The Cu content on mangrove crab exceeded the threshold, especially at mangrove vegetation with low density. This is different with the previous studies (Priyanto, et.al., 2008). They found that Cu on the fish still below the allowed threshold. Cu content in the water is below the threshold, this is also different with the previous studies (Priyanto, et.al., 2008). They did the study in Cirata Resevoir, different with the studies in Asam-Asam River Estuary as it is shallow water.

The mangrove plants can absorp heavy metals, go into the tissue through the roots (Yanti, 2009). If the mangrove density become higher, then the mangrove ability also becomes greater to absorp heavy metals. Furthermore, the heavy metals that already collected will distributed to the all parts of the plant (Siburian, 2015). This study was conducted in Asam-Asam River Estuary with a weak flow. According to Sanusi (2005) in Priansyah (2012) argue that distribution patterns of metal concentration is generally followed the pattern of the flow.

The study result shows that Cu accumulated exceed the threshold on mangrove crabs in mangrove vegetation with low density. Pb, Zn, and Cr content on sea biota are below the threshold. Heavy metals content in the water also below the threshold. Research was conducted in physical environments that can be tolerated by sea biotas.

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