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The Impact of Tin Mining Activities on Squid (*Uroteuthis chinensis*) Fishing Ground In South Bangka

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Abstract

The Region of tin mining activities in the waters of South Bangka was also the squid fishing ground activities for fishermen. The waste of tin mining activities generates waste that directly disposes into waters that may affect the water quality. Water quality parameters include temperature, brightness, salinity, dissolved oxygen, flow, depth, heavy metal content of sea water and plankton. The waste from mining activities that are directly disposed into the waters generally containing heavy metals Pb and Fe. The purpose of this study was to determine the effect of waste tin mining activities on the squid fishing ground in the waters of South Bangka Regency. The method used in this research is descriptive method. Sampling point was determined in accordance with the squid fishing area as much as 18 points in the tin mining areas and 18 points outside the tin mining area. The content of heavy metals Pb and Fe on sea water of tin mining area is higher than outside of tin mining area.The average value of Pb and Fe in sea water mining activity areas was higher which is equal to 0,11 mg/land 0,31 mg/l compared with the outside of tin mining area which was equal to 0,006mg/l and 0,006mg/l.

Keywords: fishing ground; squid; tin mining; South Bangka.

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1. Introduction

South Bangka Regency is located in the southern part of Bangka Island which is fishery become highly dominant sector after agriculture and plantations. South Bangka Regency has marine resources to be potentially major revenue. South Bangka Islands has 10.640 km^2 with fishery potential of 64,000 tons per year [4].

The dump of the tin mining (tailings) contain heavy metals lead (Pb), iron (Fe) and cadmium (Cd) [11]. Pb heavy metal in residual tin mining showed a high value 5-8 mg/l. Pb classified as non-essential heavy metals and to a certain degree be toxic metals for living organisms [14].

Based on [2], continuous tailing disposal into the waters could cause negative effects into the aquatic ecosystems by accumulating the toxic. This process occurs when heavy metals enter the ocean and not scattered by turbulence and currents, the contaminants will be absorbed or concentrated by biophysical-chemical process. The heavy metals will suspended in sea water (by sediment drift) and accumulated in sediment to the base (disposition).

In biological processes, pollutants will penetrate the organism through active uptake mechanism (absorption and ion regulation) food consume. Whereas heavy metals penetrate the tissue through several ways, such as : respiratory, digestive and penetration through the skin [3,10]. Metals will be absorbed by blood and, bound by blood proteins and lasty distributed to all body tissues. The highest accumulation usually found in the kidneys (excretion) [3,6,11,15] therefor we observed the gills and kidney's part to test Pb and Fe contents in this study.

Squid (*Uroteuthis chinensis*) is a leading commodity fishery in South Bangka Regency. Squid is a semi-pelagic schooling in coastal and continental shelf to a depth of 400 m, while squid life style was clustered or solitary life while swimming or during breaks [1]. Some of these species penetrate through brackish waters. Squid performed diurnal movement clustered near the bottom during the day and will spread at night. Phototaxis is positive (attracted to light), therefore it is often captured by using the tools of light [13]. Some fishing ground in South Bangka Regency involved tin mining activity, therefor it is important to study the effect of tin mining dump in the fishery activities. The purpose of this study was to analyze the impact of tin mining activities in terms of chemical physics parameters in the squid fishing area South Bangka Regency and to analyze the bioaccumulation of heavy metals Pb and Fe in the squid in South Bangka Regency.

2. Materials and Methods

The study was carried out in South Bangka Sea water of Bangka Belitung Province, Indonesia (Figure 1). Research activities in the survey was conducted for 1 (one) year from March 2013 to February 2014, in the squid fishing grounds without tin mining and with tin mining which survey concentrations in 6 (six) station is comprised of three (3) areas with mining and three (3) areas without. Eighteen water samples were colected from fishing ground without tin mining and with tin mining.The six stations are as follows:

1. Areas with tin mining activities:

a. Subdistrict Toboali (point 1 – point 6)
b. Subdistrict Pulau Besar (point 7- point 12)
c. Subdistrict Simpang Rimba (point 13- point 18)

2. Areas without tin mining activities:

a. Subdistrict Tukak Sadai (point 1 – point 6)
b. Subdistrict Kepulauan Pongok (point 7- point 12)
c. Subdistrict Lepar Pongok (point 13 - point 18)

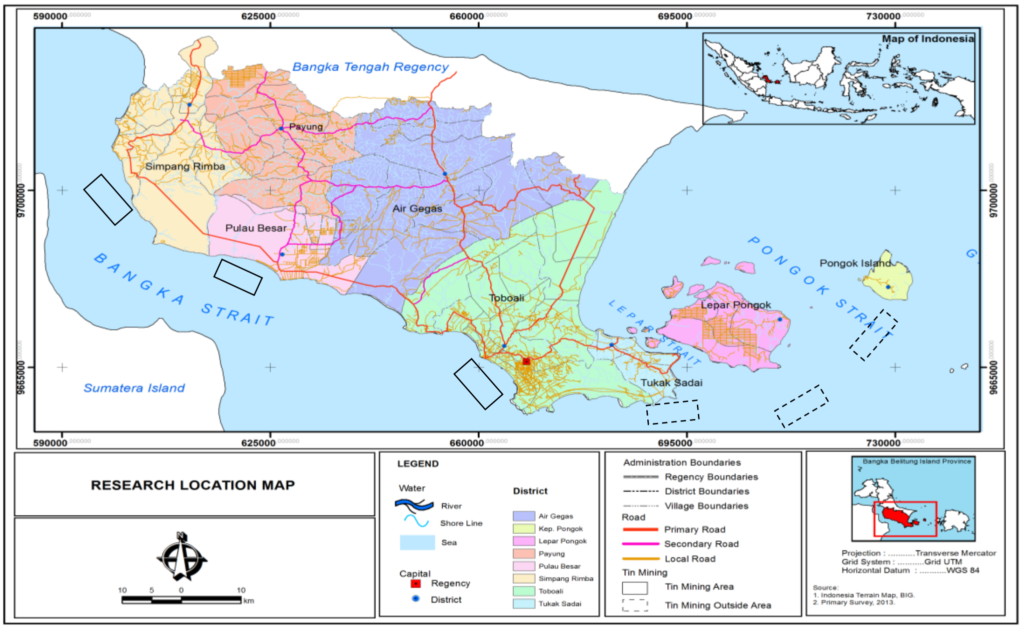

Figure 1: Research location

The methods of this research carried out by direct observation in the field by,data collection and laboratory testing. Determination of sampling points using transect. Data line drawn in the form of water quality parameters, residual waste washing, seawater, sediment. The result of the heavy metal content than the heavy metal environmental quality standards for marine sea water based on decree number 51/MENLH/ 2004, sediment based IADC/CEDA. Methods of extraction and analysis of water quality can be seen in table 1.

To determine the content of heavy metals in water and squid using SNI (Indonesian National Standard) by using a spectrophotometer. Analysis of heavy metals was carried out by:

1. Comparison of heavy metals in sea water Pb in area with and without tin miningactivities.
2. Effect of heavy metals Pb and Fe to the squid.
3. Bioaccumulation of heavy metals Pb and Fe in sea water, gills and kidney squid in tin mining areas.

Table 1: Method and instrument for measuring water quality

Parameter	Unit/unit	Instrument/Method
DO (Dissolved Oxygen)	Mg/l	Tetration Winkler / Laboratory
Brightness	NTU	sechidisc/ Insitu
TSS (Total Suspended Solid)	Mg	Grafimetric/ Laboratory
Tides	m/s	Current meter
Heavy Metal Pb dan Fe	mg/l	Spectrophotometer

3. Results

3.1 DO (Dissolved Oxygen)

Tin mining activities in the territorial waters of the South Pacific Regency can indirectly affect the DO in the region. Dissolved oxygen is a gas compound for respiration in the aquatic environment. Based on the ecosystem value, the level of DO determine the metabolic and respiration rate. Moreover, DO levels influences the growth and survivorship of the organisms. The DO level will decrease as the increasing of temperature and salinity

Figure 2 showed us the average value of DO sea water to regions outside of the tin mining in the amount of 5.30 mg/l and 4.63 mg/l for tin mining area. The average value of DO sea water indicated almost the same value from the Indonesian National Standard (INS). This value is still the average value of the minimum DO sea water ISO 06-6989. 14-2004 at 5 mg/l and showed a high out rate. The high daily DO content and seas on al fluctuations allegedly depend on mixing and movement of water mass, photosynthesis activity, respiration, and waste into the water body. The DO solubility in the water takes an effect on BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand).

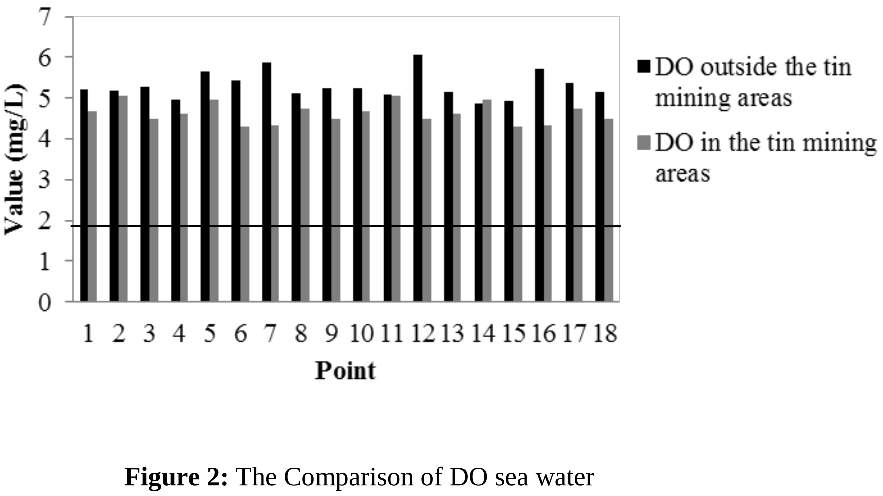

Figure 2: The Comparison of DO sea water

3.2 TSS (Total Suspended Solid)

The measurement results of TSS water showed that the location of the observations in the tin mining area has a higher value than the one. TSS values in the tin mining areas ranging from 55-1101 mg/l. The highest TSS was found at 17 stations located in Simpang Rimba and plays a role as cruise line fishing boats.

In addition, the end result of mining activity is directly discharged into the waste water and solids suspended in seawater. Finally, the solids suspended in water contained tin mining activity are very high. TSS values in all sampling sites have exceeded the water quality standard for marine sea by Ministral Decreeof Environment number 51 of 2004 (> 20 mg/l). This is due to the high suspended solids of tin mining activities at sea as seen from the dredge mining methods and sucking sea floor.

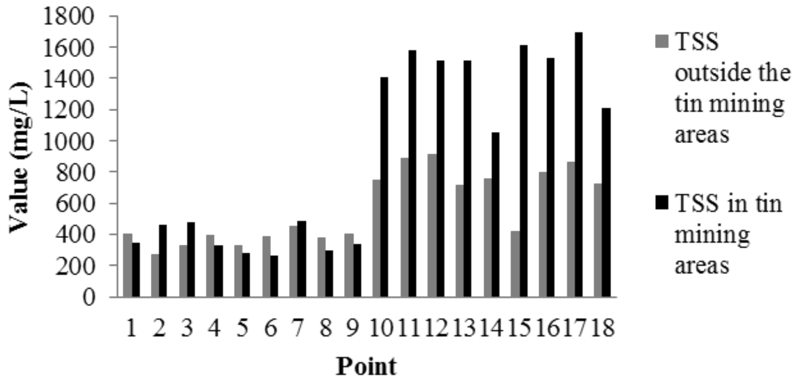

Figure3: The observation of TSS seawater

Results of field measurements (Figure 3) acquired the entire point was on the TSS quality standards for marine biota. The smallest TSS number in tin mining area is located at point 2 is equal to 229 mg/l and the highest was 17of1.697mg/l.It is suspected as a result of water turbulence, consequently the sediments will move up to the water surface. Moreover, there was sediment transport from tin mining location and drifted by the currents.

3.3 Flow Velocity

Flow in the study area is influenced by the current condition of tidal waters. The tidal flow occurs in coastal waters and relatively in narrow strait. The flow direction usually alternating flows, which is during the tidal conditions (increased water level), currents will flow in, and vice versa [12].

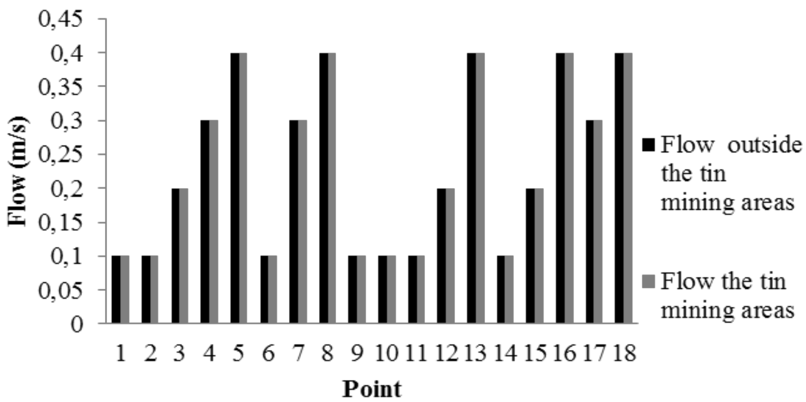

Figure 4: The observation of the flow

The speed of water flow observations indicates that the flow velocity location in the tin mining areas has equal value to the outside location of the tin mining areas. The flow velocity values in tin mining area ranged from 0.1-0.4m/s with the highest value was found at the point 5, 8, 13, 16 and 18 (Figure 4).

3.4 The Brightness

The brightness observations was made at 18 points from three squid fishing grounds located outside the mining areas and in the areas of mining in South Bangka Regency. Brightness on the outside of the tin mining areas ranged between162- 274 cm. In tin mining area, the brightness range 27-138 cm. This brightness is under the environmental quality standards SNI 05-2413-1991 (brightness>5m) (Figure 5). The main factor of turbidity is the dredging the bottom waters and waste disposal of tin mining activities in the sea.

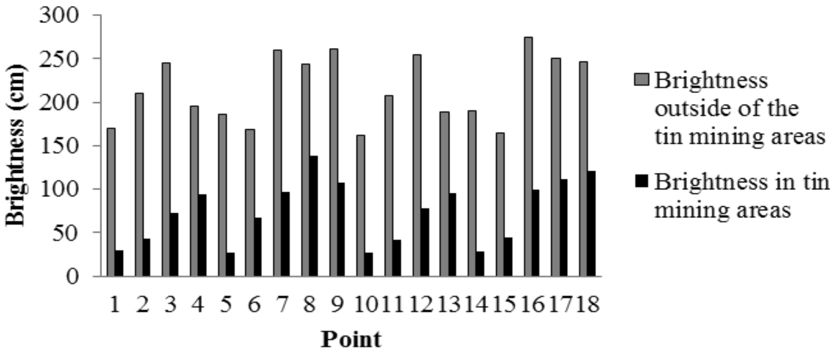

Figure 5: The observation of sea water clarity

3.5 Comparison of Heavy Metal Content of Pb and Fe in Sea Water

This research generally indicates that the high content of Pb and Fe in tin mining areas than outside the tin mining area. It is because of no advance disposal of heavy metal and simply discharged into the waters. Many authors mentioned that the rest of the tin mining (tailings) contain heavy metals Pb, Cd and Cr. Pb, Cd and Cr happen to contaminate the surrounding habitat [7, 8, 9].

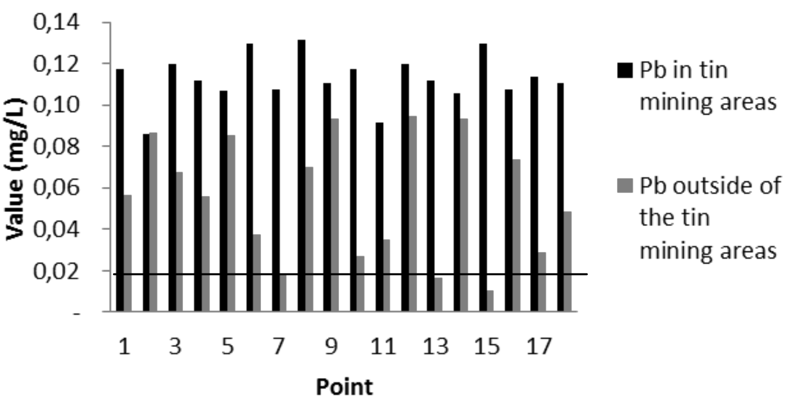

Figure 6: The comparison of Pb content in sea water

Pb, Cd and Cr classified as non-essential heavy metals and to a certain degree be toxic metals for living organisms [14]. On average, the Pb content in the mining areas equal to 0.11mg/l and outside the mining area 0.06 mg/l, indicating Pb content in tin mining areas is higher than outside (Figure 6).

According to the SNI standard, Pb content in sea water for marine life is 0.008 mg/l. When it is compared with the SNI, the value already far above the maximum limits. Waste water from mining activities containing Pb was discharged directly into waters without filtration and can cause contamination in the area around the mine [11].

Figure 6 showed the average value of Pb in the bottom sediments of tin mining area is 0.18 mg/l and outside the tin mining area is 0.1088 mg/l, indicating higher Pb content in tin mining. In line with the content of Pb in sea water, sea water content of Pb in tin mining area are higher than the outside area of tin mining activities. This correlation showed the same influence pattern of mining activities on both Pb content in sea water and in sediments. On average Fe content in the bottom sediments of tin mining area and outside were equal to17.46 mg/l and 11.32 mg/l respectively (Figure 7). Fe content in the bottom sediments of tin mining area is higher than outside.

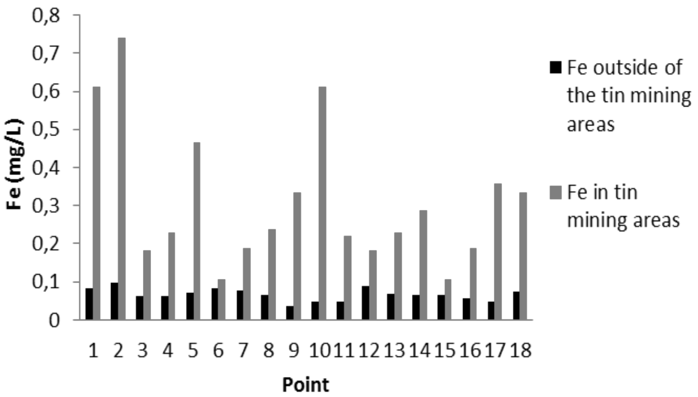

Figure 7: Comparison of Fe content in seawater

Fe content of heavy metals in sea water tin mining areas is higher than the outside of the tin mining areas. The average value of Fe sea water in the area of mining activity is higher 0.31 mg/l compared to the outside of tin mining area is equal to 0.006 mg/l. The concentration of continous waste water be accumulated into high level [2]. This evidence showed that the Fe content in the tin mining activities is higher than those areas (Figure 7).

3.6 Comparison of Heavy Metals Pb and Fe in Basic Sediment

Heavy metals that transferred into water, both in rivers and the sea will be removed from the water bodies through several processes called precipitation, adsorption, and absorption by aquatic organisms. Heavy metals have a simple binding properties of organic materials to settles in the water bed and united with sediment so that the levels of heavy metals in sediments was higher than in water.

The threshold of Fe content from the bottom sediment quality of heavy metals standards have not been in charge. This is in accordance with the opinion of that the quality standards of heavy metals in the sludge or sediment in Indonesia has not been established, whereas compounds of heavy metals in sediment is more accumulated (due to the deposition process) in organism [5]. The resistant organism after polluted by heavy metals can be used as indicators of pollution in the environment.

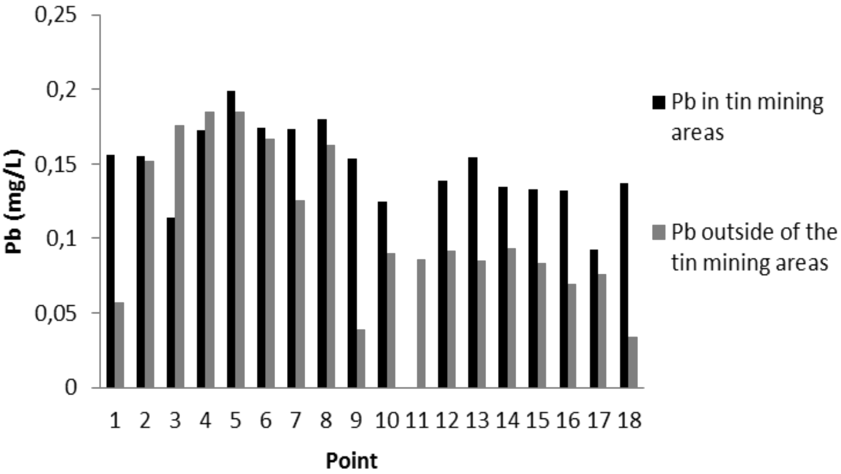

Figure 8: Comparison of Pb content insediments

The waste of dredgers and cutter suction dredges and floating TI directly discharged into waters containing solid waste and liquid waste. The suspended solid waste will encounter turbulence and deposited in the bottom because the force of gravity.

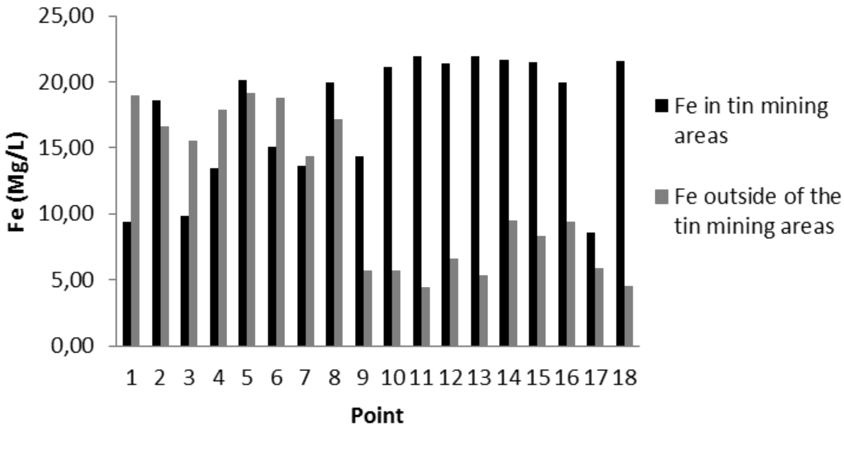

Figure 9: Comparison of Fe content insediments

3.7 Impact of Tin Mining Activity Against Catching squid Fishing Grounds

Judging from the influence of physico - chemical above, tin mining activities directly and indirectly affect fishing areas. The direct impacts that can be observed from the results of observations include brightness, TSS and depth. If the brightness of a water is low, meaning the murky waters. A good brightness value for fish survival is greater than 45 cm.

Direct impact directly observable is the TSS. TSS would contribute into water turbidity by limiting light penetration for photosynthesis and waters visibility. In addition, TSS may also affected respiration in aquatic biota. Moreover, brightness and TSS in the water greatly affects the rate of incoming solar radiation. Thus affecting the abundance of producers for photosynthesis. Indirectly, the low abundance of the manufacturer will lead to level 1 of the food chain and influencing potential of fish resources, including squid fishing area.

Heavy metal is one of the parameters of waste as a source of impact on coastal waters [2]. Therefore, to see the effects of pollutants, especially heavy metals in the water, it is necessary to test animals that are directly related to the content of heavy metals in sea floor. In other words, it needs to be tested in related organisms, especially seabed organisms [11].

The content of Pb and Fe values on squid fishing grounds contained tin mining activity has exceeded the threshold, here in after can affect the squid (quality or quantity). The biological processes of contaminated water, pollutants will enter the body of water biota through the active uptake mechanism (absorption and ion regulation) and the food chain. The presence of Pb and Fe in the bloodstream and the brain can cause blood hemoglobin synthesis disorders, neurologic (nervous), disorders of the kidneys, reproductive system, acute or chronic disease of the nervous system, and impaired lung function. If the content that goes into the body of the squid has exceeded the threshold it will be toxic and affecting the availability of stock and can ultimately affect the amount of squid catch.

3.8 Heavy Metal Bioaccumulation of Pb in Sediments, Gills and Squid Kidneys

Bioaccumulation is the accumulation of a substance or compound in the tissues of living organisms[2]. The process by which chemical substances affect living organisms and is characterized by an increase in the concentration of chemicals in the body of an organism compared to the concentration of the chemical itself.

Table 2: Bioaccumulation of heavy metals Pb and Fe in gill and kidney squid tin mining area

Information	Parameter	Pb (mg/l)	Fe (mg/l)
A	Seawater	0.11	0.32
B	squid’s gill	0.20	0.01
C	Squid’s kidney	0.001	0.002
Bioaccumulation	B/A	1,77	0.03
Bioaccumulation	C/A	0.008	0.01

Table 2, show that the Pb bioaccumulation occurs in the squid gills with expected value of 1.77 mg/l, and while the Fe in the gills and kidneys squid showed values smaller than 1, so it does not run into expected Fe categorized. Heavy metals penetratesinto the tissue through several ways called respiratory, digestive and penetration through the organisms skin. The test in the squid’s gill as respiration from the table above indicates there has been a bioaccumulation [3,16,17].

Bioaccumulation of Pb in the gills squid indicated as high level of Pb content above the environmental quality standards. Ehile there was no heavy metals bioaccumulation in kidney squid. Metals in the animal's body is located in blood, and binds to blood proteins then distributed to all body tissues. The highest accumulation of heavy metals usually found in the kidneys part (excretion).

4. Conclusion

Pb and Fe content of sea water in the tin mining area was higher than the outside of the tin mining area and the quality standard threshold is equal to 0.08mg/l. Compounds that penetrates the body of the squid in higher level will be toxic and can affects the availability of stock and ultimately affects squid fishing grounds. There was a bioaccumulation of heavy metals Pb in the gills of squid that is equal to 1,771 mg/l.

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