Analysis Of Hazardous Heavy Metal Content in Maritime Ecosystems

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Abstract. Maritime ecosystems, rich in diverse biota and natural resources, are an essential element in maintaining global ecological balance. However, the sustainability of these ecosystems is threatened by harmful heavy metal contamination, which can jeopardize the health of maritime ecosystems and the well-being of humans who rely heavily on marine resources. This study aims to identify heavy metal content in the maritime environment. Using a literature review method on data from 2019 to 2023, it was analyzed and corroborated with journal articles. The results highlighted nine hazardous heavy metals, such as copper, lead, cadmium, zinc, chromium, nickel, iron, manganese and mercury, which are capable of contaminating seawater and causing toxic effects on marine organisms. Therefore, serious efforts are needed to reduce and manage heavy metal contamination in the maritime environment to maintain ecosystem sustainability and protect the well-being of humans who depend on marine resources

1 Introduction

Maritime ecosystems, with their diverse biota and natural resources, form a complex web of life and are important for global ecological balance [1-5]. However, the sustainability of these ecosystems is threatened by serious problems related to hazardous heavy metals [6-10]. Heavy metal contamination, such as mercury, cadmium and lead, has become a real threat to the health of maritime ecosystems and, by extension, to the well-being of humans who depend on marine resources [11-15].

The problem of harmful heavy metals in maritime ecosystems requires thorough and sustainable solutions [4]. This research aims to detail the heavy metal content in the maritime environment. This solution is expected to provide in-depth insight into the environmental and geographical aspects that affect heavy metal concentrations [16-19].

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To provide a better understanding of the impact of heavy metals on maritime ecosystems, which can be used as a basis for the development of effective mitigation strategies [20-21]. The benefits of this research include contributing to the global scientific understanding of heavy metal threats to aquatic environments, while providing a foundation for conservation policies that can be practically implemented. Thus, this research is expected to make a real contribution to efforts to protect the sustainability of maritime ecosystems and ensure the survival of humans who are closely connected to ocean sustainability.

2 Research Method

The overall study began on November 30, 2023 in stages. The first stage of pre-research for theme selection was accompanied by data collection on November 30-December 01, 2023. Furthermore, the second stage is the data analysis stage starting from December 01-December-06, 2023. The last stage was the preparation of the work which was carried out from October 06 to October 13, 2023. Each step was carried out without being tied to a single location because the method used was the literature review method and the data was obtained online.

The literature review method is used to analyze the results presented in journal articles to make them more concise. The journal articles collected in the 2019-2023 time span totaled 40 articles, while the journals used by researchers in this study were 30 articles. The journal articles were analyzed using content analysis techniques to obtain the type of harmful heavy metal content. Not only that, the technique is carried out with a quantitative approach in presenting data and results.

The diagram of the literature search or sampling process is as follows:

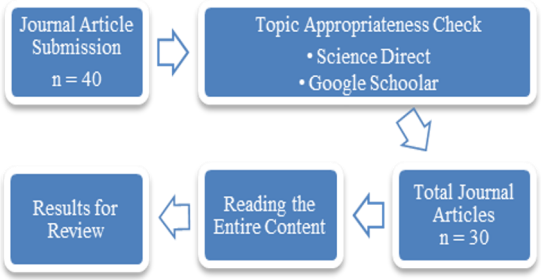

Fig.1. Literature Search Diagram

3 Result and Discussion

Hazardous heavy metals are a group of chemical elements with certain properties that can have negative impacts on the environment and human health when accumulated in high concentrations. High density, toxicity, and the ability to remain persistent in the environment are characteristics commonly shared by hazardous heavy metals [22-29].

Table 1. Literature Review Results 30 Journal Articles

Types of Heavy Metals	Source
Cuprum (Cu)	[30-32]
Plumbum (Pb)	[4-8]
Cadmium (Cd)	[12-22]
Zink (Zn)	[22-27]
Chromium (Cr)	[17-22]
Nickel (Ni)	[23-29]
Iron (Fe)	[21-25
Manganese (Mn)	[15-19]
Mercury (Hg)	[1-6]

Based on the table presented above, there are various types of hazardous heavy metals in the maritime ecosystem. The discussion can be presented as follows:

Cuprum or coppen is a metal with atomic number 29 in the periodic table. It is used in a variety of industries, including ships and mining. In maritime ecosystems, copper can contaminate seawater through industrial and ship effluents. High concentrations of copper can poison marine organisms, inhibit plankton growth, and damage the structure of marine ecosystems [7].

Plumbun or lead is a heavy metal with atomic number 82. Used in batteries, paints, and other industries. Lead can contaminate seawater through industrial waste and ship paint. Lead toxicity can damage the nervous system and marine organisms, and disrupt the balance of marine ecosystems [8].

Cadmium is a heavy metal with atomic number 48. Used in industry and phosphate fertilizers. Cadmium can accumulate in fish and marine creatures. It is a carcinogenic substance and can damage marine organisms, causing disruptions in the food chain and marine ecosystems [9].

Zinc is a heavy metal with atomic number 30. Used in industry and agriculture. High concentrations of zinc can poison marine organisms, disrupt the growth and development of fish larvae, and damage other organisms in the maritime ecosystem [10].

Chromium is a metal with atomic number 24. It is used in steel production and the chemical industry. Some chromium compounds are carcinogenic and can poison marine organisms. Chromium pollution can threaten the sustainability of marine ecosystems [11].

Nickel is a heavy metal with atomic number 28. It is used in steel production, batteries, and other industries. Nickel can contaminate maritime ecosystems through industrial waste. High concentrations can damage marine organisms and affect ecosystem sustainability [12].

Iron is a heavy metal with atomic number 80. An essential metal that is widely used in various industries. Excess iron can trigger excessive algal growth, causing algal “blooms” that can damage marine ecosystems and disrupt biological balance [13].

Manganese is a heavy metal with atomic number 25. Used in industry and agriculture. Manganese can contaminate seawater and affect marine organisms and biochemical processes in maritime ecosystems [14].

Mercury is a heavy metal with atomic number 80. It is used in fluorescent lamps, thermometers, and other industries. Mercury is very dangerous and can accumulate in fish, causing damage to the nervous system and health of humans who consume it. Mercury can also contaminate seawater through industrial waste and coal combustion [15].

4 Conclusion

Based on the analysis of heavy metals in maritime ecosystems, there are nine heavy metals that need attention, such as cuprum or coppen (Cu), plumbum or lead (Pb), cadmium (Cd), zinc (Zn), chromium (Cr), nickel (Ni), iron (Fe), manganese (Mn), and mercury (Hg). These metals can contaminate seawater and have potentially toxic effects on marine organisms. As a result, when these heavy metals accumulate in the marine food chain, they can pose health risks to humans who consume contaminated seafood. Therefore, human activities in marine ecosystems can have a negative impact on the ecological balance. It is important to remember that each heavy metal has different characteristics and potential hazards to marine organisms and the overall ecosystem.

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