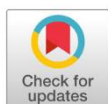


# Types of waste identification in Perintis Lake as an ecotourism conservation efforts Bone Bolango District, Gorontalo Province

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## Abstract

Perintis Lake is a lake area with potential for ecotourism. However, as activities progress, some areas have become littered with garbage. Therefore, the purpose of this study focuses on identifying the types of waste and determining the most common types of waste in the Perintis Lake area. This study uses a quantitative descriptive research method by identifying the types of waste scattered in the lake area using a sampling method categorized based on the size characteristics of mega-debris (>1 m), macro-debris (2.5 cm–1 m), meso-debris (5 mm–2.5 cm), and micro-debris (0.33 mm–5 mm). Based on the research activities, the sample collections locations are in two different transect areas, namely the Perintis Lake tourist area and the lake area directly facing residential areas. The total identification results obtained from both transects consist of 266 types of waste in five different categories: plastic waste, rubber, metal, glass, wood, and derivatives. Among the findings, plastic waste is the most dominant type of waste in the lake area, totalling 218 types. Furthermore, in terms of waste characterization based on size, macro-debris is the most abundant category in the lake area, particularly plastic waste, with a total of 168. The abundance of plastic waste in the research location is influenced by indiscriminate disposal by visitors to the environment and also by household activities directly facing the Perintis Lake area, resulting in an increasing spread of waste distribution over time

**Keywords:** Types of waste, Perintis Lake, conservation, ecotourism

## Introduction

Bone Bolango Regency is a region located directly facing mountains and the sea. As a regency, its area covers approximately  $\pm 1.984,58$  km<sup>2</sup> and possesses natural resource potentials, one of which is managed as a natural tourist attraction<sup>1</sup>. As an alternative tourist destination, the government is currently developing a natural tourist site known as Lake Perintis<sup>2,3</sup>. Lake Perintis itself is an area situated in the eastern part of Bone Bolango Regency. This area, in terms of its socio-economic aspect, has a significant influence, carrying capacity, and function suitable for use as an alternative tourist

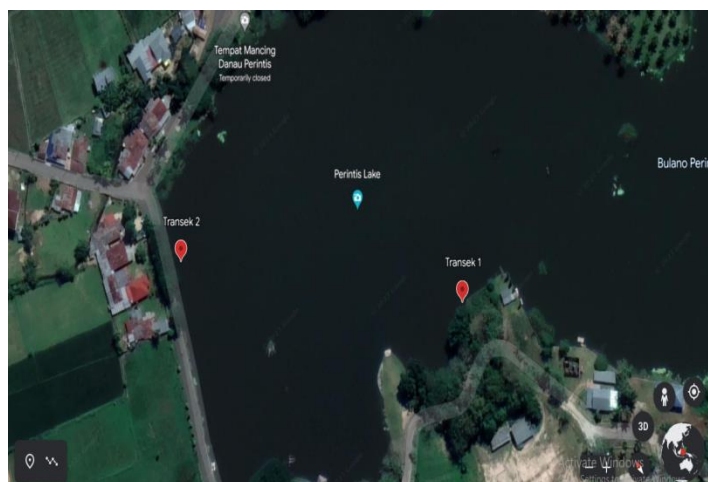


destination in Bone Bolango Regency<sup>1</sup>. However, with the ongoing ecotourism activities in the Lake Perintis area, several areas of the lake have become polluted due to the waste generated by tourists engaging in tourism activities there<sup>3,4</sup>. The presence of improperly managed waste around the lake can have negative impacts on the environment and the lives of living beings around the lake<sup>5,6</sup>. Therefore, due to the lack of research focusing on the identification of types of waste in Lake Perintis, based on the existing problem background, the aim of this research focuses on identifying the types of waste present in Lake Perintis and identifying the type of waste most prevalent in the lake area.

## Material and methods

### Study design

In order to identify the different types of waste scattered in the Perintis Lake area, this research uses a quantitative descriptive method<sup>7</sup>. Waste samples are taken and grouped according to the size characteristics of mega-debris (>1 m), macro-debris (2.5 cm–1 m), meso-debris (5 mm–2.5 cm), and micro-debris (0.33–5 mm)<sup>8</sup> (Figure 1).



**Figure 1.** Location of study collected from Perintis Lake, Bone Bolango

### Study design

Researchers at Perintis Lake, namely in Huluduotamo village, Suwawa sub-district, Bone Bolango district, Gorontalo, conducted research for the study on categorizing different sorts of garbage. The researchers chose two distinct transect locations based on where transects should be placed: transect 1 in the Perintis Lake tourist area and transect 2 in the lake area, which is directly across from community settlements<sup>9–11</sup>. The transect placements are at 0°32'44.4"N 123°08'41.8"E in the Perintis Lake tourist area and 0°32'48.8"N 123°08'37.5"E in the lake area, which is situated directly across from the public village.

## Result

The waste samples in Perintis Lake had four different waste characteristics based on the observation location: mega-, macro-, meso-, and micro-debris<sup>8</sup>. The waste materials found in the Perintis Lake are categorized as follows: plastic, rubber, metal, glass, wood, and their derivatives<sup>12</sup> (Figure 2).

The several waste groupings that are done further divide the waste categories according to the materials that comprise the garbage, specifically as follows:

**Table 1.** Types of garbage and their categories at the study site

No.	Category	Type
1	Plastic	Styrofoam, spoons, sacks, straws, straws, bottles, packages, plastic bags, raffia, bottle caps, and similar solid plastic items.
2	Rubber	Leather cord, sandal cut.
3	Metal	Bottle tops and cans.
4	Glass	Glass, glass bottles, and broken glass.
5	Timber and by-products	Used wood, trash wood, and leftover plywood.

**Table 2.** Total types of rubbish found in each transect

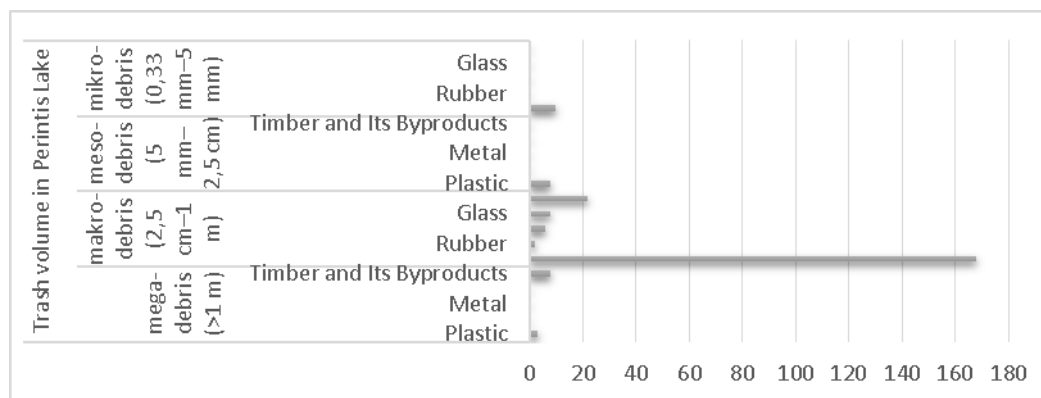
No.	Category	Transect Location		Total Waste per Type
		T1	T2	
1	Plastic	117	101	218
2	Rubber	2	2	4
3	Metal	6	0	6
4	Glass	5	3	8
5	Timber and by-products	10	20	30
	<b>Total</b>	140	126	266

T1: Lake tourism area, T2: dwelling complex.



**Figure 2.** Trash discovered at the study site

The number of waste kinds identified at the research site has been determined by categorizing them into the following groups. Waste kinds are classified as mega-, macro-, meso-, and micro-debris according to size characteristics<sup>8</sup>. Following the identification of the type of trash, Figure 3 presents the variations in waste size characteristics as follows:



**Figure 3.** A descriptive diagram illustrating Perintis Lake's overall rubbish volume

## Discussion

Based on the research activities identifying the types of waste in Lake Perintis, the researchers conducted identification activities at two different locations with 2 transect. Transect location 1 is situated in the Lake Perintis tourism area, while transect location 2 is in an area of the lake directly facing a residential area. According to the research results, the categories of waste types identified align with the research by Djaguna et al. (2019), which include categories such as plastics, rubber, metals, glass, wood, and derivatives<sup>13-15</sup>. A total of 266 types of waste were identified from each of the different transects, with 140 types in transect 1 and 126 types in transect 2. Based on the research data, it was found that plastic waste dominated Lake Perintis, totaling 218 types from both research transect locations.

In terms of the data from the waste type identification research, the researchers grouped waste characteristics based on size categories following NOAA regulations<sup>8</sup>, which include mega-, macro-, meso-, and mikro-debris. Based on this regulation, it was found that the total characteristic size of macro-debris, specifically plastic waste, dominated both transect locations during the research<sup>16-18</sup>. According to Djaguna et al.<sup>12</sup>, plastic waste is the main source of pollution and is commonly found in various environmental settings, both terrestrial and aquatic, due to consumer activities, frequent usage, and lower density compared to glass and metal.

Considering the amount and condition of waste pollution at both transect locations, transect location 1 slightly dominates with 140 types of waste compared to transect location 2 with 126 types. This is presumably due to the fact that transect location 1 is within the Lake Perintis tourism area, where visitors often dispose of waste indiscriminately. The types of waste commonly found include plastic bags, bottles, styrofoam, and others<sup>19,20</sup>. Meanwhile, transect location 2 leans more towards irregular waste management by the community, leading to indiscriminate waste disposal, thereby contaminating the waters of Lake Perintis with waste from residential areas.

## Conclusions

After identifying the types of waste, a total of 266 waste categories were recognized across the different transects, with 140 types in transect 1 and 126 types in transect 2. Notably, plastic waste dominated this categorization, comprising a total of 218 species from both research locations. Characterizing the waste by size in Pioneer Lake revealed that 168 types of plastic waste fell into the category of macro-debris,

which prevailed in both transects during the research period. The prevalence of plastic waste types can be attributed to consumer activities, as plastics are commonly used and have lower density compared to glass and metal.

## Acknowledgments

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## Conflicts of Interest

The authors declare no conflict of interest

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