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ANALYSIS OF TYPES AND ABUNDANCE OF SOLID DOMESTIC WASTE IN THE COASTAL TOURIST AREA OF DUMAI CITY

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ABSTRACT

The coastal areas of Dumai City in Riau Province are rapidly developing regions, especially in the tourism sector. This city offers several attractive beach destinations, such as Pasir Koneng Beach, Beringin Indah Beach, and Purnama Beach, attracting many local and international tourists. However, tourism growth in Dumai City also leads to an increase in solid domestic waste, which can threaten the coastal environment and the sustainability of marine ecosystems. This research aims to analyze the types and abundance of solid domestic waste in the coastal tourism areas of Dumai City. Through direct survey methods and descriptive analysis, samples of solid domestic waste were collected from three different beach locations: Purnama Beach, Koneng Beach, and Beringin Indah Beach. The results show that plastic waste is the most dominant type in all research locations, followed by wood and Styrofoam. Analysis of solid domestic waste's mass density and abundance indicates no significant difference between sampling stations or sampling times. This study provides a better understanding of the solid domestic waste issue in the coastal areas of Dumai City. It emphasizes the need for more effective management actions to maintain the sustainability of coastal tourism environments and prevent negative impacts on marine ecosystems and human well-being.

Keywords: Marine Debris, Marine Ecosystem, Coastal Tourism, Dumai City

1. INTRODUCTION

Diatoms Dumai is one of the autonomous regions that is developing well in Riau Province. The development of Dumai City cannot be separated from the development of the Dumai City tourism sector, which is one of the driving sectors of the city's socio-economic progress. Dumai City, the gateway to Riau Province on the east coast of Sumatra, has the potential for tourism development and attracting foreign and local tourists[1].

The vast coastal area of Dumai City gives Dumai several beach tourist attractions that tourists can visit, such as Pasir Koneng Beach, Beringin Indah Beach, and Purnama Beach. Well-managed beach tourist attractions can increase beach visitors over time. The development of the beach tourism sector in Dumai City has a positive impact on the economic growth of the community, especially the local community. However, the development of beach tourism can also have negative consequences, such as the growth of solid domestic waste caused by irresponsible tourist activities.

Domestic waste is a type of waste that comes from anthropogenic activities. Domestic waste is a factor that changes the quality of water[2]. Domestic waste is generally solid and liquid from human activities[3]. The activities of residents and tourists, wind, tides, wind gusts, and rainfall[4] influence the distribution of solid domestic waste. The most common solid domestic waste is plastic, rubber, paper, cloth, glass, and wood[5].

Solid domestic waste continuously entering marine waters can threaten the survival and sustainability of aquatic biota[6].

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Pollution caused by solid domestic waste can impact the food chain and human life. The amount of solid domestic waste that increases with very diverse types over time causes solid domestic waste to accumulate in large quantities in coastal environments. This can cause various kinds of losses for humans, both from economic and social aspects[2].

2. RESEARCH METHOD

Time and Place

This research was conducted in November 2022. Sampling or field data collection was conducted directly using a survey method in the tourist beach area of Dumai City, namely Purnama Beach, Koneng Beach, and Beringin Indah Beach. Processing and analyzing samples and field data were conducted at the Chemical Oceanography Laboratory, Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Method

Solid domestic waste was sampled using the purposive sampling method, where the samples taken were by the research objectives. The categories of solid domestic waste refer to the provisions of the marine debris survey monitoring of NOAA[7], which includes types of waste in the form of plastic, metal, glass, rubber, wood, and cloth. Sampling was carried out by pulling a 100 m long rope in the coastal tourist area that juts out into the sea, and then a 5 x 5 m quadrant transect was placed along the transect rope with a distance of 20 m from each plot to collect solid domestic waste.

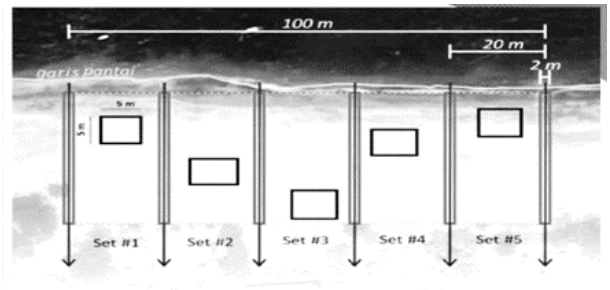

Figure 1. Transect Design

The solid domestic waste taken is included in the macro debris category with a scale of >5mm to 1m. The solid domestic waste taken will be put into a trash bag according to the sampling location. The samples that have been taken are then separated based on their type, and then the amount and weight of each sample that has been collected are calculated.

Procedures

Calculation of Density and Abundance of Solid Domestic Waste

station points were carried out directly by purposive sampling in the mangrove forest area, divided into three stations considered representative sampling locations. Station I is in the Ketapang Beach Marine Tourism area, and Station II is in an area classified as natural and does not have significant anthropogenic pressure. Station III is in an area near residential areas.

The solid domestic waste that has been calculated in terms of quantity and weight of each type will then be calculated against the density and abundance of solid domestic waste from each sampling station. The calculation of the density of solid domestic waste is carried out using the equation:

$$\text{Mass (M)} : \frac{\text{Total Waste Weight (g)}}{\text{Area (m2)}}$$

Meanwhile, the calculation of the abundance of types of solid domestic waste is carried out using the equation:

$$\text{Abundance (K)} : \frac{\text{Number of Waste Per Type}}{\text{Area (m2)}}$$

Data Analysis

Data analysis was carried out using the data from the data processing obtained and then described descriptively. ANOVA tests were conducted on solid domestic waste data at each station and the differences between the collection times. Data analysis of the characteristics of solid domestic waste samples became descriptive data that explained the differences in the distribution of types of solid domestic waste found in the coastal tourist area.

3. RESULT AND DISCUSSION

Density of Solid Waste

Solid domestic waste samples were taken at three different periods: before, during the week, and after the weekend. The other elected solid domestic waste was categorized based on the marine debris survey monitoring of NOAA[7], which can be seen in Table 1.

Table 1. Types of marine debris[7]

No	Types of marine debris
1	Plastic
2	Metal
3	Glass
4	Rubber
5	Wood
6	Clothing/fiber and others

The classification process involves sorting solid domestic waste according to its constituent materials. The sorted solid domestic waste is then dried and weighed to obtain data that will be used to calculate its density.

Based on the calculation of solid domestic waste that has been done on all samples from 3 different sample stations, the total density of solid domestic waste obtained was 345.38 g/m^2. Solid domestic waste with the highest density is plastic, with a total density reaching 169.7 g/m^2, then wood waste at 51.4 g/m^2, glass waste at 30.3 g/m^2, metal waste at 14.75 g/m^2 and Styrofoam waste at 12.2 g/m^2. Each sample station has a different density of solid domestic waste, as will be explained.

Table 2. Density of solid domestic waste from Purnama Beach

Waste Type	Sampling time			Quantity
	Before weekend	weekend	After weekend	
Plastic	25.2	25.2	24.3	74,7
Fabric	27	27	15	69
Metal	2.5	2.5	2.2	7,2
Wood	6.6	6.6	7.1	20,3
Glass	2.5	2.5	2	4,75
Styrofoam	0.27	0.27	0.14	0,68
Quantity	64.07	64.5	50.74	176,63

Table 3. The density of solid domestic waste at Koneng Beach

Waste Type	Sampling Time			
	Before weekend	Weekend	After weekend	Quantity
Plastic	6,1	6,1	4	16,2
Fabric	10	7	-	17
Metal	1	7,5	-	8,5
Wood	7	3	3	13
Glass	9,5	8,6	5,2	23,3
Styrofoam	1,93	2,1	10,97	15
Quantity	35,53	34,3	23,17	93

Based on Table 3, the highest density of solid domestic waste in the Koneng Beach area occurred before the weekend, with a total density of 35.53 g/m^2. The solid domestic waste with the highest density is glass waste, with a total glass density of 23.3 g/m^2, cloth 17 g/m^2, plastic 16.2 g/m^2, Styrofoam 15 g/m^2, wood 13 g/m^2, and metal 8.5 g/m^2, which is the waste with the lowest waste density found on Koneng Beach.

Glass waste is a type of waste that is classified as inorganic waste, which is an object produced from the melting process of several materials. The melted material is solidified through a cooling process. The primary material for making Glass is silica, melting at a temperature of 140^{0}C[8].

Table 4. The density of solid domestic waste at Beringin Indah Beach

Waste Type	Sampling Time			Quantity
	Before weekend	weekend	After weekend	
Plastic	20,3	27,1	22,4	69,8
Fabric	-	0,6	0,3	0,9
Metal	2,9	1,1	-	4
Wood	6	6,3	5,8	18,1
Glass	-	-	-	0
Styrofoam	0,8	3,1	1.5	5,4
Quantity	30	38,2	30,05	98,25

Based on Table 4 at Beringin Indah Beach, the weekend is the time before the weekend with the highest total density of solid waste, totaling 38.2 g/m^2. The solid domestic waste that dominates in this area is plastic waste, with a total density of 69.8 g/m^2, followed by wood waste at 18.1 g/m^2. Styrofoam waste is 5.4 g/m^2, metal waste is 4 g/m^2, cloth waste is 0.9 g/m^2, and no glass waste is in the Beringin Indah tourist beach area.

Abundance of Solid Waste

The abundance of types of solid domestic waste in the area of the solid domestic waste sampling station, which includes Purnama Beach, Koneng Beach, and Beringin Indah Beach, has obtained data on the calculation of the abundance of types of solid domestic waste that have been carried out, received the results of the abundance of the kinds of solid waste taken after the weekend, weekend and before the weekend which can be seen in Table 5.

Based on Table 5, it can be observed that the spike in the abundance of solid domestic waste occurs on average around the weekend, especially in the Purnama Beach and Beringin Indah Beach areas. The abundance of each type of solid domestic waste can be seen in the presentation in Table 6.

Table 5. The amount of solid waste abundance at different times

Sampling Time	Sampling Station		
	Purnama Beach	Koneng Beach	Beringin Indah Beach
Before Weekend	61,07	35,53	30
Weekend	67,07	27,55	38,2
After Weekend	50,74	14,11	30,05

Table 6. The abundance of solid waste types

Types of Solid Waste	Abundance of Waste Types (Pieces/m^2)		
	P. Purnama	P. Koneng	P. Beringin Indah
Plastic	2,03	1,08	3,53
Fabric	0,35	0,21	0,12
Metal	0,47	0,13	0,17
Wood	0,37	1,17	0,68
Glass	0,18	0,31	0
Styrofoam	0,62	0,43	0,30

Based on the abundance data of solid domestic waste types obtained in Table 6, the results of the highest abundance of solid domestic waste received at the research sampling station came from plastic waste, Styrofoam waste, and wood waste. The dominance of plastic waste on the beach at the research location is evidenced by the

total abundance of plastic waste types of 6.64 pieces/m^2. The abundance of plastic waste types is divided into 2.03 pieces/m^2 of plastic waste at Purnama Beach, 1.08 pieces/m^2 of plastic waste at Koneng Beach, and 3.53 pieces/m^2 of plastic waste at Beringin Indah Beach.

Composition of Solid Waste

Solid waste at the research locations, including Purnama Beach, Koneng Beach, and Beringin Indah Beach in Dumai City, is domestic waste in the form of unused waste from human and natural activities[9]. The types of solid waste consist of plastic waste, cloth waste, wood waste, glass waste, metal waste, and Styrofoam waste. The percentage of the total combined amount from each research location can be seen in Figure 2.

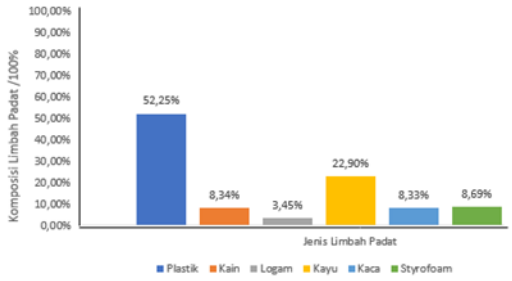

Figure 2. Total composition of solid waste

Based on the image, it can be seen that the highest waste presentation is in the type of plastic waste, which is 50% of the total amount, followed by wood waste with a percentage value of 22%, then Styrofoam waste with a percentage of 9% each. Metal waste is the type of waste with the lowest percentage obtained with a value of 3%. The solid waste rate is directly proportional to the abundance of the kinds of solid waste, where the waste that dominates is plastic waste, wood, and Styrofoam waste.

4. CONCLUSION

Based on research conducted at Purnama Beach, Koneng Beach, and Beringin Indah Beach in Dumai City, Riau Province, the total abundance of solid domestic waste types was 12.36 pieces/m2, and the total density of all solid domestic waste samples obtained was 354.38 g/m2. The composition of solid domestic waste types found at the research location consisted of plastic, cloth, wood, metal, glass, and Styrofoam. Plastic waste dominates the total number of waste types obtained with a percentage of ± 50%, a total density of 169.7 g/m^2, and a total abundance of 6.64 pieces/m^2 of the total amount.

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