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# Types and Abundance of Beach Litter on the East Coast of Karimun Island, Riau Islands

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**ABSTRACT**

This research was conducted in January 2025 on the East Coast of Karimun Island, Riau Islands Province. This study aimed to determine the type and abundance of Beach Litter on the East Coast of Karimun Island, Riau Islands Province. The method used in this research is a survey method with direct observation and data collection at the research location. The waste data obtained was analyzed statistically, and then the results were presented descriptively, referring to the supporting literature. The most dominant type of waste is plastic-type at Station I (Coastal Area), and the last type of waste obtained is rubber-type at Station II (Ketam Beach), for the results of the highest abundance between stations is found at Station I, namely 7,12 units/m² and the lowest abundance at station II, namely 0,84 units/m². In comparison, the abundance results between sampling times obtained the highest abundance during the Weekend of 19,48 units/m² and the lowest abundance during Weekday of 11,88 units/m². Based on the difference test of abundance between stations and between sampling times, there is a real or significant difference (P <0,05).

**Keywords:** Karimun Island, Beach Litter, Abundance, Plastic

## 1. INTRODUCTION

Global Waste is a critical issue in coastal areas because it seriously impacts humans, organisms, and ecosystems. The accumulation of waste in coastal areas occurs along with increasing human activities around the coast (Suheri et al., 2019). Human activities such as tourism, cultivation, and settlement are the primary sources of waste in the coastal environment (Galgani et al., 2010). On the other hand, the current inadequate waste management and low public awareness are also the causes of the increasing presence of waste in coastal areas (Syari, 2021). Apart from being used for tourism, the coastal area is also used for the daily needs of the surrounding community for the benefit of the local community. Tourism, along with other activities, is also inseparable from the issue of waste.

Two types of waste include waste activities and waste from the sea (Apriliani et al., 2021). If left unmanaged, waste can seriously threaten the continuity and sustainability of natural tourism areas. This beach litter not only disturbs the beauty of nature but also endangers coastal ecosystems and marine life. Many marine animals are trapped or consume this debris, which can cause injury or death. Therefore, beach litter management is an important environmental issue in maintaining the ocean's and coastal ecosystems' health.

Various problems arise due to the presence of beach litter, such as reducing the beauty of coastal areas, causing damage to marine ecosystems, threatening microplastics, reducing water quality due to pollution, and even causing pollution of marine biota that die, causing various kinds of diseases affecting the food web, as well as reducing the productivity of fish caught, so if this happens it will have an impact on the food chain, economy and public health in the area cannot be avoided (Citrasari et al., 2012).

Karimun Island has many recreational areas that have the potential to be developed into tourist objects or attractions. Most of the population has activities in coastal areas. Karimun Island is an island located in Karimun Regency, Riau Islands Province. These tourist objects will bring in many visitors, both during weekdays and weekends, of course, this condition impacts the accumulation of waste in coastal areas so that it can affect the life of biota in marine waters. This condition certainly impacts the accumulation of waste in coastal areas. Rahmawati (2011) states that the sea

experiences the threat of pollution due to human activities in coastal areas. The research results by Opfer et al. (2012); Hasibuan (2016) concluded that human activities generally cause increasing waste in coastal areas.

This study aims to analyze the types of waste and their abundance and mass and look for differences in the type and abundance of beach litter between stations and sampling times on the East Coast of Karimun Island, Riau Islands Province.

## 2. RESEARCH METHOD

### Time and Place

This research was conducted in January 2025 on the East Coast of Karimun Island, Riau Islands Province (Figure 1).

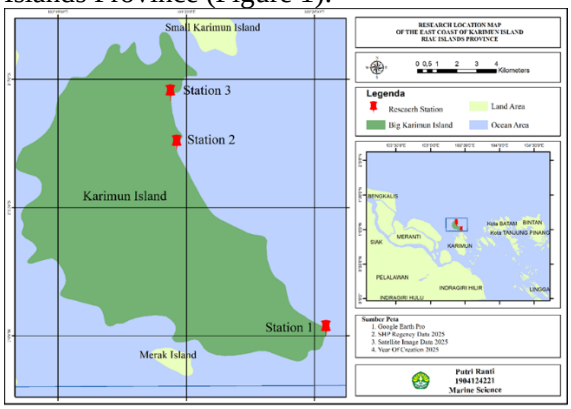


**Figure 1. Research location**

### Method

This research was conducted using a survey, where observations and data collection were directly at the research location. The data obtained from the research location were then processed for analysis. Determination of the research station was carried out using a purposive sampling method, namely, determining the location intentionally by considering and paying attention to the condition of the research area. The division of stations in this study, namely Station I is in the Coastal Area, which is the center of the crowd; Station II is at Ketam Beach, which is a tourist destination; and Station III is in Pelambung Village, a remote area at the end of Karimun Island.

### Procedures

Sampling was conducted at low tide. Sampling was conducted on weekdays (Tuesday - Wednesday) and weekends (Saturday - Sunday). According to Lippiatt et al. (2013), the data collection process was done by determining the research area along 100 m parallel to the East Coast of Karimun Island coast. Then, divide the area with a length of 20 m each so that there are five transects at each research station, where each transect is made a plot with a size of 25 m², so there will be five plots from each station. A sketch of the data collection transect can be seen in Figure 2.

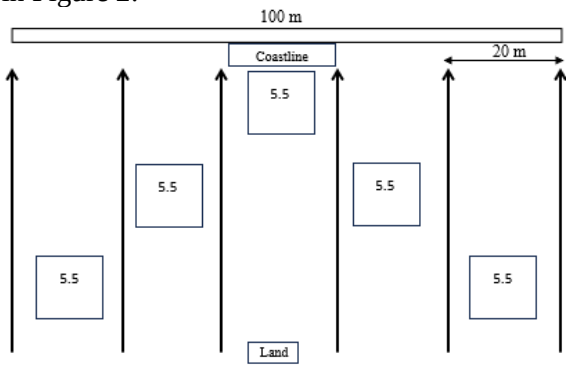


**Figure 2. Sketch of data collection transect**

Next, samples of beach litter will be characterized based on NOAA's (2013) classification. After determining the type of waste, the amount will be calculated, and the waste will be weighed using a scale.

### Types of Beach Litter

Beach litter consists of various types. To facilitate observation and analysis, the types of waste are divided into several parts in outline. According to NOAA (2013), beach litter is divided into several types: plastic, metal, glass, rubber, wood, and others. The general types of waste are further distinguished based on the categories found in the research location.

### Mass of Waste

Mass calculation can be done if the waste that has been collected is then weighed and calculated using the formula. Waste that has been weighed enters the stage of calculating each station's total mass (M). The equation used is by the provisions of NOAA (2013):

$$\text{Mass (M)} = \frac{\text{Total Waste Weigh (g)}}{\text{Length (m)} \times \text{Width (m)}}$$

### Waste Abundance

The weighed waste is then entered to calculate the abundance (K) of waste from each station. The equation used is by the provisions of NOAA (2013):

$$\text{Abundance (K)} = \frac{\text{Number of waste per type}}{\text{Length (m)} \times \text{Width (m)}}$$

**Data analysis**

After the beach litter samples are collected, data processing is continued. The data obtained from field observations include the types of waste, mass of waste, and abundance of beach litter tabulated into a table. Furthermore, beach litter on the East Coast of coastal Karimun Island was statistically analyzed using the ANOVA test to see differences in waste abundance between stations and the t-test to see differences in waste abundance between Weekdays and Weekends. The results of data analysis are discussed descriptively concerning existing sources and references.

## 3. RESULT AND DISCUSSION

**Types of Beach Litter**

Beach litter consists of various types of waste. To facilitate observation and analysis, the types of waste are divided into several parts. The types of waste found in the research location are plastic, metal, glass, rubber, and wood, as shown in Table 1.

**Table 1. Types of beach litter**

| Category | Type |
|---|---|
| Plastic | Food packaging, plastic bags, plastic bottles, toothpaste packaging, pipes, tarpaulins, straws, CD tapes, insulation, jerry cans, bottle caps, plastic plates, rice packaging, bubble wrap, detergent packaging, styrofoam, cell phone scratchers, mats, sacks, and clotheslines. |
| Metal | Iron materials, scissors, cans, batteries. |
| Glass | Broken glass, glass bottles, and ceramic pieces. |
| Rubber | Tire scraps, sandals, hoses, and cables. |
| Wood | Tree branches and pieces of bridge/building timber. |
| Others | Coconut shells, corks, matches, shoes, cigarette butts, cloth, cigarette boxes, and nets. |

**Total Beach Litter**

Table 2 shows the amount of waste obtained on weekdays (Tuesday-Wednesday) and Weekends (Saturday-Sunday)

**Table 2. Total beach litter**

| Type | Number of Waste (Unit) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Weekday | | | Average | Total | Weekend | | | Average | Total |
| | I | II | III | | | I | II | III | | |
| Plastic | 87 | 19 | 49 | 51.67 | 155 | 265 | 76 | 47 | 129.33 | 388 |
| Metal | 1 | 1 | 3 | 1.67 | 5 | 4 | 8 | 1 | 4.33 | 13 |
| Glass | 7 | 3 | 7 | 5.67 | 17 | 10 | 6 | 8 | 8 | 24 |
| Rubber | 2 | 0 | 0 | 0.67 | 2 | 0 | 0 | 5 | 1.67 | 58 |
| Wood | 48 | 8 | 14 | 23.33 | 70 | 15 | 13 | 29 | 19 | 57 |
| Others | 15 | 3 | 13 | 10.33 | 31 | 11 | 19 | 8 | 12.67 | 38 |
| Total | 160 | 34 | 86 | 93.33 | 280 | 305 | 122 | 98 | 175 | 578 |

Note: I: Coastal Area; II: Ketam Beach; III: Pelambung Village

According to Djaguna et al. (2011), beach litter comes from two primary sources: (a) waste disposed of from household activities and (b) waste from land through river flow. The same thing was also stated by Nurdiansyah & Helena (2014) that plastic waste is considered to have the most significant potential to change the environment, adversely affecting biota and humans, because it floats on the surface, is widely transported by ocean currents, persists in the environment for years, and is not easily digested when consumed.

**Mass of Beach Litter**

The waste mass at the research location is presented in Table 3 based on the research results conducted on the East Coast of Karimun Island.

**Abundance of Beach Litter Between Stations**

Based on the results of the waste research at station I (Coastal Area), the highest abundance was found among the three stations. This is because the research location is the center of the capital of Karimun Regency. The area is the center of community activities, as well as for tourists, and there is a port, where much waste

comes from the large number of visitors who travel in coastal areas and awareness from tourists who are still low where tourists still often litter. The existence of mangroves in the coastal area also has the potential to trap waste because mangroves border and sea, and there are shipping lanes which, of course, the waste is carried away by the shipping activity. According to Aditya et al. (2019), marine debris originating from activities on land is estimated to be 60-80% entering the marine environment or waters through runoff flows, while activities carried out at sea, such as fishing, sea transportation routes, and tourism can also contribute waste. The abundance of beach litter from the three stations is presented in Table 4.

**Table 3. Mass of Beach Litter**

| Type | Waste Massive (g) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Weekday | | | Total | Weekend | | | Total |
| | I | II | III | | I | II | III | |
| Plastic | 17,333 | 440 | 1,040 | 18,813 | 4,310 | 1,080 | 1,440 | 6,830 |
| Metal | 40 | 80 | 120 | 240 | 400 | 360 | 120 | 880 |
| Glass | 1,060 | 280 | 680 | 2,020 | 1,280 | 640 | 1,200 | 3,120 |
| Rubber | 280 | 0 | 0 | 280 | 0 | 0 | 320 | 320 |
| Wood | 4,140 | 4,280 | 6,120 | 14,540 | 1,290 | 2,840 | 5,960 | 10,090 |
| Others | 5,570 | 720 | 1280 | 7,570 | 1,240 | 1,160 | 2,685 | 5,085 |
| Total | 28,423 | 5,800 | 9,240 | 43,463 | 8,520 | 6,080 | 11,725 | 26,325 |

**Table 4. Abundance of Beach Litter**

| Type | Waste Abundance (Unit/ m²) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Weekday | | | Total | Weekend | | | Total |
| | I | II | III | | I | II | III | |
| Plastic | 3,48 | 1,08 | 1,96 | 6,52 | 10,6 | 3,04 | 1,92 | 15,56 |
| Metal | 0,2 | 0,04 | 0,04 | 0,28 | 0,12 | 0,32 | 0,08 | 0,52 |
| Glass | 0,24 | 0,12 | 0,28 | 0,64 | 0,4 | 0,28 | 0,28 | 0,96 |
| Rubber | 0,08 | 0 | 0 | 0,08 | 0 | 0 | 0,16 | 0,16 |
| Wood | 1,84 | 0,32 | 0,48 | 2,64 | 0,6 | 0,52 | 1,16 | 2,28 |
| Others | 0,6 | 0,16 | 0,6 | 1,36 | 0,48 | 0,76 | 0,32 | 1,56 |
| Total | 6,44 | 1,72 | 3,36 | 11,52 | 12,2 | 4,92 | 3,92 | 21,04 |

The abundance of garbage at station II (Ketam Beach) is the least among the three stations because each beach has garbage cans that are already available. However, there are still those who throw garbage out of place, and there are cleaners and garbage collection so that visitors who want to travel enjoy a cleaner and safer beach area.

The abundance of garbage at station III (Pelambung Village) is due to the location of the boat stop activity, where there is also a stream from the local community settlement that is carried away by the boat activity and the lack of public awareness of the impact of littering causes the disposal of household waste and also fishermen's waste, such as nets, hooks, and others and the amount of garbage from community activities is filtered by the presence of mangroves on the coastal location.

**Beach Litter Abundance between Sampling Times**

At the statistical analysis stage using the T-test to determine the difference in waste abundance between the Weekday and Weekend periods, the abundance of waste was found to have a significant difference with a result of 0,031 <0,05. This means that the abundance of waste on weekdays and Weekends increases daily due to visitor activity. Aditya et al. (2019) also stated that the higher the number of tourists visiting, the higher the waste production. The increase in visitors occurs during the Weekend due to the high number of visitors, increased consumption activities, and challenges in waste management in crowded locations. Based on sampling time, the abundance of beach litter during weekdays and weekends is presented in Figure 3.

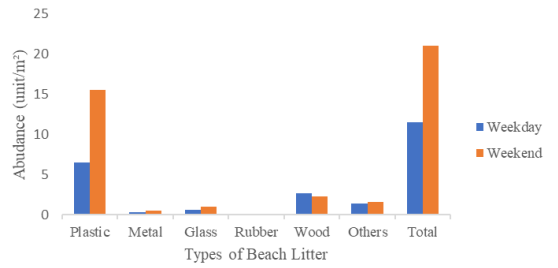


**Figure 3. Abundance of beach litter between sampling times**

The highest waste was found due to the presence of incoming tourism visits, so from the three stations, there were different amounts of abundance at each station. The increase in waste on Weekend days is due to the activities of tourists or local people who visit to spend time around the beach by throwing or leaving garbage unattended, which can result in an increase in the amount of garbage waste from the previous day. On the Weekend, people tend to buy food and drinks in larger quantities, especially from street vendors or fast-food places, which produces more food and packaging waste. The statement is corroborated by Asia & Arifin (2017), who state that tourist activities and merchant activities are sources of contributing waste in coastal areas.

## 4. CONCLUSION

Based on the study results and the objectives to be achieved, it can be concluded that the types of beach litter found are plastic, metal, rubber, glass, wood, and others. Plastic waste is the most common type; the abundance of beach litter found was 32.56 units/m². The overall mass of waste found was 63.68 g in 125 m². There is a significant difference in the abundance of beach litter between stations and sampling times on the East Coast of Karimun Island, Riau Islands Province.

It is necessary to conduct further research on coastal waste on beaches and tourist areas on Karimun Island using different methods so that there are uniqueness and differences from previous studies. This research can be an evaluation, recommendation material, and benchmark for waste pollution in coastal areas in waste management efforts, especially in plastic waste. Local governments can provide policies related to waste management pro, vide socialization, and provide adequate waste management facilities and infrastructure.

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