Analysis of marine debris and mangrove forest density in Purnama village, Dumai city, Riau province

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Abstract. Mangrove ecosystems naturally function as trap of waste produced from anthropogenic activities including marine debris. This study aims to analyze marine debris and density of mangrove forests in the Purnama Village. The survey research method was carried out in two stations: Station I (Estuary of Sungai Masjid) and Station II (coastal waters of the Unri Marine Station), which was held from April to July 2021. Marine debris was collected in five plots in a quadrant transect measuring 100 x 50 meter. Identification results of mangrove species in Station I found 3 species of mangrove (Xylocarpus granatum, Rhizophora apiculata and Bruguiera gymnorriza), while at Station II found 3 species of mangroves (Rhizophora apiculata, Xylocarpus granatum and Aveccenia alba). This research results obtained the release of marine debris at Station II is more than that of Station I. While in Station II there are 172 items (marine debris density of 0.172 item/m²), weight of marine debris 12.665 gram/m² and mangrove density 2222 individu/ha (category very close). At Station I there are 35 items (the density of marine debris is 0.035 item/m²), the total weight of marine debris is 3.194 grams/m² and the density of mangroves is 1678 individu/ha (category very close).

1. Introduction
Mangrove forest is an important ecosystem in the coastal area which has a function as a coast line protector from waves, abrasion, as a nursery, spawning area, habitat for many types of marine biota and has an economic function for the surrounding community [1], [2]. However, there is another function of the current mangrove ecosystem, which is to function as trapping for the results of anthropogenic activities, including marine debris [3], [4]. This is very sad considering the function of the mangrove ecosystem is the habitat of many marine biotas and with a lot of marine debris trapped in this ecosystem and this can cause health problems and death for some marine biota [5], [6].

In some cases the presence of marine debris in the mangrove ecosystem changes the behaviour of marine biota, for example in some anthropods such as the coconut crab (Birgus latro) who use bottle caps and some plastic waste to protect their soft stomach [4]. That's why the presence of marine debris in the mangrove ecosystem is a major problem for the health of the ecosystem and marine biota that live there. This is exacerbated because Indonesia is ranked second out of from the top 20 countries ranked by mass of mismanaged plastic waste, with an estimated amount of plastic entering the sea of 0.48 - 1.29 MMT/years [7]. Therefore, the Government of Indonesia has stated its commitment to reduce plastic waste by more than 70% by 2025.

Seeing this phenomenon, it can be predicted that in 2025 there will be accumulation of marine debris in coastal areas in Indonesia, including Dumai City where is one of the coastal cities in Riau Province and the largest port activity center in Riau Province. The existence of marine debris in Purnama Village
Dumai City was informed by several people and also seen directly at several points on the coastal border of Purnama Village such as at the estuary of Sungai Maṣjid and the coastal waters of the UNRI Marine Station. Pollution of marine debris in coastal waters is thought to originate from anthropogenic activities originating from the mainland. According to [8], marine debris is a persistent solid object, produced or processed by humans, directly or indirectly, intentionally or unintentionally, disposed of or left in the marine environment.

Dumai City has an area of 1,727.38 km² with a water area of 71,393 ha and a coastline of 215.65 km and a coastal border area of 2,156.5 ha [9]. The coastal border area of Dumai City is ecologically dominated by mangrove forest ecosystems. According to [10], the availability of various types of food found in the mangrove forest ecosystem has made its existence very important because it functions as a nursery ground for various types of biota such as fish, shrimp, shellfish, crabs, and other types of biota, spawning ground and feeding ground.

However, the existence of the mangrove forest ecosystem can be a natural trapping that traps marine debris carried by ocean currents and tides [11]. According to community information and initial surveys, it was stated that marine debris found in the coastal border of Dumai City was found trapped in the mangrove forest ecosystem. Marine debris can have an impact on ecology, marine life and the growth of mangrove vegetation. For example, disrupting the mangrove root system (air aeration), economic factors due to the destruction of mangroves, reducing the aesthetic value by polluting marine debris and disturbing public health. These anthropogenic activities can contribute to marine debris pollution, which can be trapped into the mangrove forest ecosystem. According to [12], the direct impact of pollutants is often considered more dangerous, although the indirect impact of the accumulation of these pollutants can cause severe damage.

Based on this, research on the analysis of marine debris and mangrove forest density in coastal waters of Purnama Village, Dumai City, Riau Province needs to be studied. This is for the sustainability of the sustainable mangrove forest ecosystem and while maintaining the natural environment of the mangrove ecosystem in Purnama Village. This study aims to analyze the marine debris and mangrove forest density in coastal waters of Purnama Village, Dumai City. The benefit of the research is to obtain information about the accumulation rate of marine debris and the density of mangrove forests in coastal waters Purnama Village.

2. Materials and Methods
This research was conducted during three months from April until July, 2021 in the mangrove forest area of the Purnama Village, Dumai City, Riau Province (1°42′44.22″ N and 101°23′10.35″ E) refer to Figure 1. The method used in the study is a survey method. This research started with a field survey first, to see the general condition of the mangrove forest and marine debris around. The next step is to determine the observation station for the density of mangroves and marine debris using purposive sampling method. This was done because from the previous field survey it can be concluded that the mangrove forest area of the Purnama Village is categorized as good and dense, so the determination of the station is based on different characteristics of the waters and the environment. Station one is located around the Estuary of The Sungai Maṣjid with sediment type is mud, while station two is located on the coastal waters of Unri Marine Station with sediment type is sand and clay.
The sampling of mangrove density was done by using the line transect plot method which the sampling for marine debris was carried out using the quadrant transect method modified from NOAA standing stock method [13], [14]. The instruments used in this research were 50 m rolled meter, wooden pegs, rope, GPS, 2 m sewing tape measure, a camera for documentation and identification book for mangrove density sampling and then for marine debris sampling used rope, GPS, 50 m rolled meter, worksheet, a camera and Gunny sack to collect marine debris.

Mangrove density data were taken by quadratic plot on the five transect lines, transects has 50 m in length, vertically with the shoreline, with a quadratic plot have a 3 sub plot, 10 x 10 m quadratic plot to sampling a tree, 5 x 5 quadratic plot to sampling a sapling and 1 x 1 quadratic plot to sampling a seedling. But for marine debris data, were taken with quadratic transect plot with dimensions 50 x 100 m starting from the backshore line to 50 m perpendicular to the land and 100 m along the backshore line. This quadratic transect at the same located with mangrove transect and then divided into five sub plot transects with a size of 50 x 20 m, all marine debris in this transect was then collected and analyzed, its type, amount and weight. Refer to Figure 2 for illustration of quadratic plot of mangrove density and marine debris.

Figure 1. Research Location Map in the coastal waters of Purnama Village.

Figure 2. Mangrove density and marine debris quadratic plot transect, the yellow is marine debris quadratic plot transect and the green is mangrove density.
2.1. Data analysis of mangrove density
Mangrove data analysis calculates the value of specific density (D), Relative Density (Rdi), Frequency (F) of each species in each quadratic plot of mangrove obtained and then analyzed using the following equation. On the transect, observation plots were made with a plot size of 20 x 20 m for the tree level (trees), a plot size of 5 x 5 m for the sapling level and a plot size of 2 x 2 m for the seedling level, as shown in Figure 3.

The data from field observations are then calculated using the formula, namely:

a. Specific Density of mangrove (Di)

\[ Di = \frac{ni}{A} \]

Where is:
- Di: Specific density (ind/ha)
- ni: Total number of mangrove stands
- A: Spacious of quadratic plot transect of mangrove density

b. Relative Density of mangrove (RDi)

\[ RDi = \frac{ni}{\sum n} \times 100\% \]

Where is:
- RDi: Relative density (%)
- ni: Total number of mangrove stands
- \(\sum n\): Total number of stands of all species

2.2. Data analysis of marine debris
Marine debris data analysis calculates the value of numbers and weights item per unit area and total numbers and weights on the quadratic transect, with equations below:

\[ Ki = \frac{mi}{A} \text{ and } TKi = \sum \frac{mi}{A} \]

Where is:
- Ki: numbers of marine debris (item/m²)
- A: Spacious of quadratic plot transect of marine debris
- TKi: Total number of marine debris per unit area (item/m²)

\[ Wi = \frac{mi}{A} \text{ and } TWi = \sum \frac{mi}{A} \]

Where is:
- Wi: Weights of marine debris (gram/m²)
- A: Spacious of quadratic plot transect of marine debris
- TWi: Total weight of marine debris per unit area (gram/m²)
3. Results and Discussion
The mangrove forest at the Purnama Village area is located around residential areas, community oil palm plantations, palm oil CPO factories and ports. Therefore, the impact of anthropogenic activities causes enormous pressure on the health of the mangrove ecosystem, especially the presence of marine debris. The first step in this research is to see the relationship between mangrove density and the numbers of marine debris found in the Purnama Village mangrove forest ecosystem.

3.1. Identification of mangrove type
Mangroves play a role in capturing, storing, maintaining and collecting sediment objects or particles with a dense root structure (shoreline stabilizer). The results of research that has been carried out on mangrove species found in Purnama Village can be seen in Table 1.

| No | Species Name         | Family             | Local Name   |
|----|----------------------|--------------------|--------------|
| 1  | Xylocarpus granatum  | Meliaceae          | Nyirih       |
| 2  | Rhizophora apiculata | Rhizophoraceae     | Bakau minyak |
| 3  | Bruguiera gymnorrhiza| Rhizophoraceae     | Tumu         |

Table 1. Mangrove species found in coastal waters of Purnama Village.

Based on Table 1 shows that the identification results at Station I obtained 3 mangrove species (Xylocarpus granatum, Rhizophora apiculata and Bruguiera gymnorrhiza) and at the Station II obtained 3 mangrove species (Rhizophora apiculata, Xylocarpus granatum and Aveccenia alba). The mangrove tree grows well, the characteristics of the soil are deep silt. According to [15], mangrove is one of ecosystems located in estuary and shallow coastal waters. The existence of mangroves has a significant role for life since in mangrove ecosystem there are various types of biological resources that can be utilized for human welfare.

Environmental factors such as substrate, nutrient content and system good hydrology is the cause of the factors that support the life of this mangrove species. There are other factors that greatly affect the life of the mangrove species is an element of human involvement. [16], environmental factors such as nutrients (leaf litter) also participate affect the growth and development of mangrove forest ecosystems. Water environmental conditions such as river flow, leaf litter that carries. Nutrients also affect competition in mangrove forest ecosystem.

Exploitation of mangrove forests often occurs (illegal logging, settlements, sea transportation, agriculture, marine debris pollution, and tourism activities). Uncontrolled exploitation and degradation of mangrove forests is feared to cause disturbances to the mangrove forest ecosystem such as abrasion and the extinction of various types of mangrove flora and fauna. Disturbance to the mangrove forest ecosystem that takes place continuously is thought to have the potential to affect the local economy. Therefore, to anticipate these disturbances, efforts need to be made in managing the mangrove forest ecosystem. According to [17], development activities either directly or indirectly will have an impact on coastal waters and beaches so as to reduce the negative impact of too great need for assessment and management of related special things such.

The mangrove forest ecosystem is the main link in the main link, which plays a role in as producers in the food web and has high productivity. The results of the identification of mangrove density can be seen in Table 2.
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| Type       | Amount | K (%) | KR (%) | F (%) | FR (%) | BA (%) | D (%) | DR (%) | INP (%) |
|------------|--------|-------|--------|-------|--------|--------|-------|--------|---------|
| Station I  |        |       |        |       |        |        |       |        |         |
| X. g       | 82     | 911   | 54     | 1.00  | 43     | 11222  | 0.48  | 49     | 145     |
| R. a       | 60     | 667   | 40     | 0.89  | 38     | 11307  | 0.48  | 48     | 126     |
| B. g       | 9      | 100   | 6      | 0.44  | 19     | 1095   | 0.04  | 5      | 29      |
| Total      | 151    | 1678  | 100    | 2.33  | 100    | 23624  | 1.0   | 100    | 300     |
| Station II |        |       |        |       |        |        |       |        |         |
| R. a       | 87     | 967   | 44     | 1.00  | 43     | 6492   | 0.36  | 36     | 122     |
| X. g       | 86     | 955   | 42     | 1.00  | 43     | 10758  | 0.59  | 59     | 145     |
| A.a        | 27     | 300   | 14     | 0.33  | 14     | 962    | 0.05  | 5      | 33      |
| Total      | 200    | 2222  | 100    | 2.33  | 100    | 18212  | 1     | 100    | 300     |

Based on Table 2, it can be seen that the density of mangrove in Purnama Village is Station I of 1678 ind/ha and Station II of 2222 ind/ha. This shows that the mangrove forest in Purnama Village has a good density of mangrove species with a very dense category. This shows that the mangrove forest that grows in the coastal waters of Purnama Village is still in good condition (not damaged or no disturbance). According to the Minister of Environment Decree No. 201 of 2004 that the criteria for for the density value of good mangrove species at a value of ≥ 1500 are classified as very dense category; good mangrove species density at the value of ≥ 1000-1500 classified as medium category; and the density of damaged mangrove species at a value of < 1000 is classified as a rare category.

The condition of damaged mangroves is characterized by mangrove density that is rarely dominant [18]; mangrove damage can also be caused by logging activities of mangrove trees for community needs and the construction of community settlements [19]. Mangrove forest areas in coastal waters of Purnama Village must continue to be preserved, such as carrying out mangrove forest conservation efforts and preventing anthropogenic activities that can cause damage to mangrove forests. This is to prevent changes in the area of mangrove forests caused by land conversion and damage to mangrove forests.

The type of mangrove that has the highest density is in the category trees, while the lowest density is at the sapling level. The high density in the tree category causes the incoming sunlight cannot illuminate the mangrove forestland. The high density of mangrove species indicates that there are many tree stands in the area. Mangrove species whose growth is tolerant to environmental conditions (such as substrate, tides, salinity and nutrient supply), especially to substrate conditions, the spread of seeds is very wide and can grow upright in various places [20]. Anthropogenic and natural disturbances can affect stand density, basal area and complexity when compared to undisturbed mangroves [21]. In addition, mangrove logging can also cause the occupation of the area to be disturbed by other types of vegetation [22].

Mangrove species of R. apiculata has the highest tolerance limit of the extreme conditions such as high salinity and muddy substrate. That highest tolerance limit is supported by the root system of R. apiculata which is aerial root (pneumatophore) in the form of long roots and branches arise from the base of stem. This root is known as the prop root and will eventually become still root if the stem is held up so that it no longer touches the ground. The root helps the upright of the tree because it has a broad base to support in soft and unstable mud. It also helps the aeration when exposed at low tide [23], [24].

The socio-economic benefits of mangrove forests are natural tourism sites, producers of firewood, mangrove charcoal, paper raw materials, tannins for tanning leather and sources of medicinal ingredients [25]. The dominant types of mangroves growing at the study site can be seen in Figure 4.
Figure 4 shows that the dominant mangrove species in Purnama Village are Station I of the *X. granatum* species and Station II of the *R. apiculata* species. The least mangrove species found were Station I of the type *B. gymnorrhiza* and Station II of the type *A. alba*. Density can be used as the basis for determining the level of mangrove damage. Based on the calculation of the total density value, it can be said that the mangrove conditions at each station are in the good category and very dense. Field observations have also proven that the mangroves at the study site are still very dense, marked by difficulties in exploring and laying transects. The mangroves at the research site are native mangroves.

Domestic waste and industrial waste also play a role in increasing damage to mangrove forests. The main source of pollution is waste from housing, hotels, restaurants and market activity. The type of waste that is commonly found around mangrove forests is plastic waste that cannot be decomposed in a fast period. The waste will disturb mangroves as the newly growing saplings will be covered up by plastic which cannot grow and die. Many mangroves have rare density because mangrove seeds cannot grow on plastic waste. The impact of plastic waste does not seem to have a major effect like the effect of oil spills, but plastic waste increases every day and collects and also covers the mangrove plants. Therefore, in a long period, plastic waste can cause mangrove damage on an ongoing basis that is greater than the oil spill [26].

### 3.2. Density of marine debris

Types of marine debris are found in the mangrove forest ecosystem of Purnama Village, namely at Station I (Estuary of the Sungai Mesjid) and Station II (coastal waters of Unri Marine Station). The density of marine at Station II (0.172 items/m²) was higher than at Station I (0.035 items/m²). Overall, marine debris found in the coastal waters of Purnama Village is 0.207 items/m² (Table 3 and Table 4).

#### Table 3. Categories of marine debris at coastal waters of Purnama Village.

| Categories       | Item                                                                 |
|------------------|----------------------------------------------------------------------|
| Plastic          | Styrofoam fragments, containers, takeout, drink bottle, personal items, plastic fragment, medical mask, detergent pack, soap packaging, pampers, bag, lighter, close the gallon and rope. |
| Rubber           | Sandals, shoes                                                       |
| Item not detected| Cork, rubber, plastic                                                |
| Metal            | Cans                                                                |
| Clothing (fabric)| Cloth, mat                                                           |
| Glass            | Drink glass bottle                                                   |
| Processed Wood   | Piece of wood                                                        |
Table 4. Density of marine debris in coastal waters of Purnama Village.

| No | Type of marine debris | ST I | ST II | Amount debris per type (item/m²) |
|----|-----------------------|------|-------|----------------------------------|
| 1  | Plastic:              |      |       |                                  |
|    | a. Styrofoam fragment | 1    | 28    | 0.029                            |
|    | b. Containers         | 2    | 6     | 0.008                            |
|    | c. Takeout            | 7    | 36    | 0.043                            |
|    | d. Drink bottle       | 11   | 28    | 0.039                            |
|    | e. Personal item      | 2    | 11    | 0.013                            |
|    | f. Plastic fragment   | 6    | 8     | 0.014                            |
|    | g. Medical mask       | 3    | -     | 0.003                            |
|    | h. Detergent pack     | 1    | -     | 0.001                            |
|    | i. Soap packaging     | -    | 2     | 0.002                            |
|    | j. Pampers            | -    | 2     | 0.002                            |
|    | k. Bag                | -    | 2     | 0.002                            |
|    | l. Lighter            | -    | 2     | 0.002                            |
|    | m. Close the gallon    | -   | 1     | 0.001                            |
|    | n. Rope               | -    | 1     | 0.001                            |
| 2  | Rubber:               |      |       |                                  |
|    | a. Sandals/shoes      | 1    | 16    | 0.017                            |
| 3  | Item not detected:    |      |       |                                  |
|    | a. Cork               | 1    | -     | 0.001                            |
|    | b. Rubber             | -    | 4     | 0.004                            |
|    | c. Plastic            | -    | 5     | 0.005                            |
| 4  | Metal:                |      |       |                                  |
|    | a. Cans               | -    | 1     | 0.001                            |
| 5  | Clothing (fabric):    |      |       |                                  |
|    | a. Cloth              | -    | 1     | 0.001                            |
|    | b. Mat                | -    | 1     | 0.001                            |
| 6  | Glass:                |      |       |                                  |
|    | a. Drink glass bottle | -    | 1     | 0.001                            |
| 7  | Wood:                 |      |       |                                  |
|    | a. Piece of wood      | -    | 16    | 0.016                            |
|    | Total                 | 35   | 172   | 0.207                            |

Based on the results of observations at the research site, found 3 types of marine debris consisting of mega, macro and meso debris. Marine debris by nature of decomposition is divided into organic and inorganic. However, this research focused is only limited to organic in the form of wood >2.5 cm and processed wood, as well as inorganic that is divided into five categories among others plastic, metal, glass, rubber, processed wood, cloth/ fabric as displayed in Table 3 and Table 4. Organic and inorganic marine litter can be dangerous for ecosystem life in coastal areas.

The low level of marine debris at Station I is thought to be due to the influence of rainwater, where river water discharge will increase. This will wash marine debris from the river to the river mouth and eventually lead to sea waters. The high level of marine debris found at Station II is thought to come from community activities on land which will directly or indirectly be dumped into coastal waters.

The density of marine debris is thought to be caused by there are community activities contribute to the entry of macro plastics into waters through waterways. Marine debris comes from two sources main, namely: a) Waste disposed of from activities household and, b) Garbage from land through stream river. Garbage from land consists of three main sources, namely: industry, community waste management irregular and habituia people throw trash haphazard [27].
### 3.3. Weight density of marine debris

The density of marine debris found in Purnama Village is 15.859 grams/m². The density of marine debris at Station II (12.665 grams/m²) was higher than Station I (3.194 grams/m²). For more details can be seen in Table 5.

**Table 5. Density of marine debris in coastal waters of Purnama Village.**

| No | Type of marine debris | ST I  | ST II | Weight density of debris (grams/m²) |
|----|-----------------------|-------|-------|-------------------------------------|
| 1  | Plastic:              |       |       |                                     |
|    | a. Styrofoam fragment| 70    | 750   | 0.820                               |
|    | b. Containers         | 1890  | -     | 1.890                               |
|    | c. Takeout            | 25    | 415   | 0.440                               |
|    | d. Drink bottle       | 235   | 2419  | 2.654                               |
|    | e. Personal item      | 305   | 335   | 0.640                               |
|    | f. Plastic fragment   | 254   | 600   | 0.854                               |
|    | g. Medical mask       | 80    | -     | 0.080                               |
|    | h. Detergent pack     | 25    | -     | 0.025                               |
|    | i. Soap packaging     | 5     | 87    | 0.092                               |
|    | j. Pampers            | -     | 150   | 0.150                               |
|    | k. Bag                | -     | 195   | 0.195                               |
|    | l. Lighter            | -     | 60    | 0.060                               |
|    | m. Close the gallon   | -     | 40    | 0.040                               |
|    | n. Rope               | -     | 10    | 0.010                               |
| 2  | Rubber:               |       |       |                                     |
|    | a. Sandals/shoes      | 135   | 1255  | 1.390                               |
| 3  | Item not detected:    |       |       |                                     |
|    | a. Cork               | 170   | -     | 0.170                               |
|    | b. Rubber             | -     | 244   | 0.244                               |
|    | c. Plastic           | -     | 55    | 0.055                               |
| 4  | Metal:                |       |       |                                     |
|    | a. Cans              | -     | 120   | 0.120                               |
| 5  | Clothing (fabric):    |       |       |                                     |
|    | a. Cloth             | -     | 70    | 0.070                               |
|    | b. Mat               | -     | 40    | 0.040                               |
| 6  | Glass:                |       |       |                                     |
|    | a. Drink glass bottle| -     | 155   | 0.155                               |
| 7  | Wood:                 |       |       |                                     |
|    | a. Piece of wood      | -     | 5665  | 5.665                               |
|    | Total                | 3194  | 12665 | 15.859                              |

The high amount of marine debris is caused by marine debris that is discarded by residents around the research location, or it can also come from waste disposed of by residents who live around the research location and originate from the upstream of the river and adjacent to the river estuary. Types of marine debris that have low density will float in the waters and usually easily carried by ocean currents. Physical and oceanographic phenomena in coastal waters will have a major influence on the amount of waste that is stranded in coastal waters [28].

The weight density of marine debris in coastal waters has not affected the existence of mangrove forests in Purnama Village. This can be seen from the density of mangrove species with a very tight category. According to [29], the problem of rubbish in the Muara Angke Mangrove area has an impact on decreasing the beauty of tourism and impacting the disruption of human health to the destruction of marine resources in the region.
3.4. Composition of marine debris

Based on Figure 4 shows that the percentage of the highest density of marine debris found is from the type of plastic (50%), processed wood (35%) and rubber (9%). This is because the mass of plastic, rubber and processed wood has a light mass. The existence of currents and tides around the coastal waters of Purnama Village will carry waste into sea waters and will be thrown back to the beach (mangrove forest area). According to [30], the direction, waves, tides and ocean currents will be directly proportional to the source from which marine debris originates. One of the oceanographic characteristics of waters can be understood from the current. According to [8], factors that also influence are the conditions of tides and tides, wind and speed of ocean currents. Currents and wind direction greatly affect the distance or proximity of marine debris moving in a seawater column, all of which originate from the remnants of human activities both on land and fishing activities at sea.

Figure 5. The percentage of the heavy density of marine debris in coastal waters of Purnama Village.

It can be seen in Figure 5, the amount and weight of marine debris that dominates the mangrove forest at coastal waters of Purnama Village is inorganic which includes plastic, glass, metal, clothing and rubber. Where as processed wood waste is considered as organic which will decay over the time. Plastic, rubber and wood waste is easier to float, carried by currents and stirred by waves so that it can accumulate in the coastal waters of Purnama Village. [31] Stated that the magnitude of the current and wave what happens in the waters can cause stirring, trash on the bottom of the water will rise to the surface of the water and will form an accumulation trash on an area.

4. Conclusion

This research results obtained the release of marine debris at Station II is more than that of Station I. While in Station II there are 172 items (marine debris density of 0.172 item/m²), weight of marine debris 12.665 grams/m² and mangrove density 2222 individu/ha (category very close). At Station I there are 35 items (the density of marine debris is 0.035 item/m²), the total weight of marine debris is 3.194 grams/m² and the density of mangroves is 1678 individu/ha (category very close). Overall, accumulation of marine debris at both research stations quite different. This may be influenced by the regular cleaning of tidal currents occurred at the different zoning and community structure of mangrove forests at the two stations. Conservation efforts in coastal waters of Purnama Village are carried out by replanting damaged mangrove forests and carrying out maintenance by protecting them with nets and cleaning plastic waste.
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References
[1] G. Senoaji and M. F. Hidayat. 2016. Peranan ekosistem mangrove di pesisir Kota Bengkulu dalam mitigasi pemanasan global melalui penyimpan karbon. *J. Mns. dan Lingkung.* Vol. 23, No. 3, pp. 327–333. Doi: 10.22146/jml.18806
[2] Karimah. 2017. Peran ekosistem hutan mangrove sebagai habitat untuk organisme laut. *J. Biol. Trop.* Vol. 17, No. 2, pp. 51–57. Doi: 10.29303/jbt.v17i2.497
[3] M. G. Kahar, J. N. W. Schaduw, N. D. C. Rumampuk, W. E. Pelle, C. Sondakh, and J. F. Pangemanan. 2020. Identifikasi sampah anorganik pada ekosistem mangrove Desa Talawaan Bajo Kecamatan Wori Kabupaten Minahasa Utara. *J. Pesisir Dan Laut Trop.* Vol. 8, No. 1, pp. 1–16. Doi: 10.35800/jplt.8.1.2020.27200
[4] Abreo, N. S. A, S. K. V. Siblos, and E. D. Macusi. 2020. Anthropogenic marine debris (AMD) in mangrove forests of Pujada Bay, Davao Oriental, Philippines. *J. Mar. Isl. Cult.* Vol. 9, No. 1, pp. 38–53. Doi: 10.21463/jmic.2020.09.1.03
[5] R. C. Thompson, B. E. La Belle, H. Bouwman, and L. Neretin. 2011. Marine Debris as a Global Environmental Problem. STAP Information Document. Global Environment Facility, Washington, DC. 32 p
[6] National Oceanic and Atmospheric Administration Marine Debris Program. 2016. NOAA Marine Debris Program Report. Habitat marine debris impacts on coastal and benthic habitats. Silver Spring. [Online]. Available: https://marinedebris.noaa.gov
[7] R. Jambeck, r. Geyer, C. Wilcox, T. R. Siegler, M. Perryman and A. Andrady. 2015. Plastic waste input from land into the ocean. *Mar. Pollut. Vol. 347, No. 6223,* pp. 768–771
[8] National Oceanic and atmospheric administration marine debris program. 2013. Report on the Occurrence and Health Effects of Anthropogenic Debris Ingested by Marine Organisms. NOAA Marine Debris Program. *Silver Spring*
[9] Pertiwi, R. P. 2018. Politik tata ruang Kota Dumai 2012-2016. *JOM FISIP.* Vol. 5(2):1–11
[10] Febriansyah, F; D. Hartono; B. F. Negara; P. P. Rentah dan Y. P. Sari. 2018. Structure of mangrove community in Pulau Baii of Bengkulu City. *Jurnal Ilmiah Teknik Lingkungan,* 2 (1): 11-18
[11] Mulyadi, E. dan N. Fitriani. 2014. Konservasi hutan mangrove sebagai ekowisata. *Jurnal Ilmiah Teknik Lingkungan,* 2 (1): 11-18
[12] Patuwo, N. C; W. E, Pelle; H. W. K. Manengkey; J. N. W, Schaduw; I. S. Manembu dan E. L. A, Ngangi. 2020. Karakteristik sampah laut di pantai Tumpaan Desa tateli Dua Kecamatan Mandolang Kabupaten Minahasa. *Jurnal Pesisir dan Laut Tropis.* Vol 8 (1)
[13] Y. M. Assuyuti, R. B. Zikrillah, M. A. Tanzil, A. Banana, dan P. Utami. 2018. Distribusi dan jenis sampah laut serta hubungannya terhadap ekosistem terumbu karang pulau Pramuka, Panggang, Air dan Kotok Besar di Kepulauan Seribu Jakarta. *Maj. Ilm. Biol. Biosf. A Sci. J.* Vol. 35, No. 2, pp. 91–102. Doi: 10.20884/1.mib.2018.35.2.707
[14] S. Masiyah and S. Sunarni. 2015. Komposisi jenis dan kerapatan mangrove di Pesisir Arafura Kabupaten Merauke Provinsi Papua. *Agrikatan J. Agribisnis Perikan.* Vol. 8, No. 1, pp. 60–68. Doi: 10.29239/j.agrikatan.8.1.60-68
[15] Tuwo. A. 2011. Pengelolaan ekowisata pesisir dan laut: suatu pendekatan ekologi, social ekonomi, kelembagaan, dan sarana wilayah. *Brilian Internasional Surabaya.* Vol. 1: 11–26
[16] Buwono, Y. R. 2017. Identifikasi dan kerapatan ekosistem mangrove di kawasan Teluk Pangpang Kabupaten Banyuwangi. *Samakia: Jurnal Ilmu Perikanan.* Vol. 8, No. 1. P 32-37
[17] Dahuri, R. 2004. Resource management of coastal and Ocean Areas Are Integrated. Jakarta: PT Pradnya Paramita

[18] Tablaseray, V. E., M. R. A. Pairin, N. Fakdawer dan B. Hamuna. 2018. Pemetaan sebaran dan kerapatan mangrove di Pesisir Timur Pulau Biak Papua menggunakan citra satelit landsat 8. *Jurnal Perikanan dan Kelautan*. Vol. 8 No. 1. P 31-39

[19] Katiandagho, B. 2015. Analisis struktur dan status ekosistem mangrove di perairan timur Kabupaten Biak Numfor. *Jurnal Ilmu Agribisnis dan Perikanan*. Vo. 8, No. 1. p 8-12

[20] Usman, L., Syamsuddin dan S. N. Hamzah. 2013. Pemetaan sebaran dan kerapatan mangrove di Pesisir Timur Pulau Biak Papua. *Jurnal Perikanan dan Kelautan*. Vol. 8 No. 1. P 11-17

[21] Urrego, L. E., E. C. Molina and J. Suarez. 2014. Environmental and anthropogenic influences on the distribution, structure and floristic composition of mangrove forests of the Gulf of Uraba (Colombian Caribbean). *Aquat. Bot*. 114, p 42-49

[22] Radhika, D. 2006. Mangrove ecosystem of Southwest Madagascar: an ecological, human impact and subsistence value assessment. *Tropical Resources Bulletin*. Vol. 25. P 7-13

[23] Ng, P.K.L. and N. Sivasothi, (Ed.). 2001. A guide to mangroves of Singapore. Volume 1: The ecosystem and plant diversity and Volume 2: animal diversity. Singapore: The Singapore Science Centre

[24] Hogarth, P.J. 2015. The Biology of Mangroves and Seagrasses. Third Edition, Oxford University Press, UK. 300 p

[25] Mulyandari, H. 2011. Pengantar arsitektur kota. Yogyakarta: Penerbit Andi Yogyakarta

[26] Anwar, Y. I., Setyasih, Ardhiansyah, D. Partini, R. P. Dewi dan Y. A. Wibowo. 2021. Identification of mangrove forest damage and effort to conservation in Balikpapan City, East Kalimantan Indonesia. *GeoEco*. Vol. 7 No. 2. P 121-134

[27] Stevenson, C. 2011. Plastic debris in the Calofornia marine ecosystem. A summary of current research. Solution Strategies and Data Gaps. University of Southern California Sea Grant. Synthetic Report. California Ocean Science Trust, Oakland, CA

[28] Yusra, Y. and R. Erlini. 2021. Komposisi dan kepadatan sampah laut (marine debris) Pantai Purus Kota Padang. *Jurnal Katalisator*. Vol. 6 No. 1

[29] Zakiyah, L. F. 2020. Produksi bersih pada home industri dalam rangka pengendalian pelestarian lingkungan. *Jurnal Green Growth dan Manajemen Lingkungan*. Vol. 9 (2), pp. 86-91

[30] Adibhusana, M. N. I. G., Hendrawan dan W. G. Karang. 2016. Model hidrodinamika pasang surut di Perairan Pesisir Barat Kabupaten Bali. *Journal of Marine and Aquatic Sciences*. Vol. 2(2):54-59

[31] Brunner, K. 2014. Effect of wind and wave-driven mixing on subsurface plastic marine debris concentration. Thesis : University of Delaware