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Spatial Distribution of Marine Debris in Jakarta's bay Waters and the Seribu Islands with Maritime Security Concept

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Abstract

Marine debris is a waste that comes from the land, water and coastal flow into the sea or waste derived from the activities in the sea. This is a big problem around the world. This research is aimed to knowing the types, the sizes, the mass and spread of marine debris carried out on the three beaches of DKI Jakarta and four beaches in the Thousand Islands in August to October 2018. Data collection method used are primary and secondary data. Primary data of field surveys, visual, direct observation (retrieval, collection and weighing). Secondary data of retrieval in relevant agencies about currents, winds and tides. The concept of maritime security contains four elements namely maritime power, maritime security, blue economy, and human security. The blue economy is focused on the pollution in the sea. Therefore, the importance of assessing the distribution of waste in the sea to control pollution at sea is not getting worse. Based on the size of the most widely found is a macro as many as 1120 pieces, wastes found at each station is 576 pieces kind of plastic and 63 pieces of other categories. The highest weights of 23.76 kg is the other category and the lowest of 0.195 kg is a type of metal. The spread of marine debris in the waters of Jakarta bay and Thousand Islands with wind from the east and the current to the northeast (South China Sea) from the southeast (Flores Sea) passing through the Java Sea which dominates plastic is a marine debris with a 48% percentage. One of the management of plastic waste into items that can be used is creating Ecobrick.

Keywords: Marine debris; Jakarta Bay; Thousand Islands.

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1. Introduction

According to the Presidential Regulation of the Republic of Indonesia Number 83 of 2018 concerning Handling of Marine Debris Article 1, waste is the remains of human daily activities and / or natural processes in solid form. Marine debris is rubbish originating from land, water bodies and coasts that flows into the sea or rubbish originating from activities at sea. Marine debris (marine debris) according to NOAA[1], can be defined as solid objects, produced or processed by humans, directly or indirectly, intentionally or unintentionally, dumped or left in the marine environment [2]. In 1998 there was a paradigm shift in the management of coastal and marine resources in a dramatic or even contrary way from the previous period, i.e. not damaging but preserving. Or they no longer implement the cowboy economic system but rather the economic system [3]. Comfort and security are vital factors in tourism destination with great tourism potential. However, this potential will not be desirable if the conditions are not created by comfort and security. This proves that there are factors that affect the comfort, community understanding of tourism awareness, and community participation in comfort and security of tourists. The study was conducted aimed to determine the factors that affect comfort and safety, the level of community understanding of tourism awareness, and community participation in the comfort and security of tourists [4]. Marine debris is defined as any persistent solid material that is created or processed and is directly or indirectly, intentionally or unintentionally, dumped or disposed of into the marine environment. Marine debris includes consumer goods such as glass or plastic bottles, cans, bags, balloons, rubber, metal, fiberglass, cigarettes and other manufactured materials which end up in the oceans and along the coast [5]. According to Law Number 18 of 2008 concerning waste management, it states that waste is a national problem so that its management needs to be carried out comprehensively and integratedly from upstream to downstream in order to provide economic benefits, be healthy for the community, and safe for the environment, and can change people's behavior [6]. Several things that need to be considered regarding materials to be disposed of into the waters, including coastal areas, namely [7] the type, nature, quantity and continuity of the waste material. Carrying capacity and water thinning in relation to local oceanographic conditions. Possible interactions between the chemical and biological properties of the waste material and the aquatic environment. Effects of waste on life and the food chain. Process of degradation and biogeochemical changes. Prognosis for the amount and variety of additional pollutants in the future. Other typical factors [8]. Jakarta Bay, which is located in the north of DKI Jakarta Province which has an area of 514 km² is a place for various kinds of human activities (Septiananda and his colleagues 2017). Jakarta Bay is located at position 06º 0 '35.6 "- 05º 56' 49 " South Latitude to 106º 40 '28.5" - 106º 58' 58 "East Longitude stretches from Tanjung Karawang to Tanjung Pasir with a beach length of ± 89 km [9]. The DKI Jakarta area, as the capital city of Indonesia, is an area with an increasing level of economic development every year. With an area of approximately 664.01 km² and a population of 10,075,300 inhabitants, DKI Jakarta is a city with a high density. industry and residents along the DKI Jakarta area will directly and indirectly enter the river and empties into the DKI Jakarta Coast [10]. Administratively, the Thousand Islands region is part of the Special Capital Region of Jakarta, located in a geographical position between 106 ° 25'-106 ° 40 'East Longitude and 05 ° 24'-05 ° 45' LS [11]. These waters have the potential as a fishery resource [12]. The Thousand Islands region consists of 110 islands and has sea waters covering an area of 699,750 ha, with the islands which are inhabited by about eleven islands [13]. The administration of the Seribu Islands District Administration is divided into 2 sub-districts and 6 sub-districts, the

two sub-districts are the North Seribu Islands District and the South Seribu Islands District, while the Kelurahan Pulau Kelapa, Pulau Harapan Village, Pulau Panggang Village, Tidung Island Village, Pari Island Village and Untung Jawa Village [14]. Beaches' development on small islands has become increasingly important due to touristic appeals on their unique landscapes and natural endowments. However, compared with large islands and continental areas, the natural conditions of these islands are quite poor, their degree of development is relatively low, and they are insufficiently managed. Therefore, it is urgently necessary to undertake comprehensive management activities for tourist beaches on small islands [15]. The purpose of this research is to determine the type, size, mass and distribution of marine debris in the waters of Jakarta Bay and the Thousand Islands. Security is a contested concept between perspectives in science international relations. Throughout the Cold War, the view of realism dominated thoughts about security. The realist's view of security is pictured as a competition event because of its assumption that the country is difficult to cooperate. Idealism takes the stance that peace is a condition under which the state and individuals enjoy freedom, prosperity, and no threat [16]. Liberalism view the international peace base not the balance of power between countries as realists believe, but based on compliance with the norms and international law and more optimistically look at the possibility of countries to cooperate. The above views (realist, idealistic and liberalist) are classed by international relations scientists as a traditional or classical perspective, where the classical view faltered with the emergence of constructivists, critical theories, feminism, and postmodernis [17]. Christian Bueger [18] stated that maritime security contains four security concepts, namely sea power, marine safety blue economy, human security. The concept of sea power describes the role of the navy, namely protecting the sustainability of the country, protecting sea transportation routes for trade and improving the economy. It can be concluded that Indonesia's maritime security should be able to protect Indonesia's national interests in the maritime sector. Based on the elements that are influential in building sea power, Indonesia has some of these prerequisites. With the vast territory of the country and the sea in Indonesia, the Indonesian people actually have a great opportunity to exploit natural resources. With the position of the state of Indonesia between two continents and large oceans, it has become the world's main shipping route. With a very large population, Indonesia has great potential to dominate the maritime sector both regionally and globally. According to the US DoD Dictionary Military Terms, national interests are defined as the basis or foundation for developing national goals that define goals and objectives. National interests are also the needs and desires set by a sovereign state in dealing with other sovereign states, non-state actors, and opportunities and situations in an evolving strategic environment are presented as goals to be achieved. This definition explains the dynamics of a strategic environment in which various actors, opportunities, and interactions play their roles, both internal and external components [19].

2. Methods

This research was conducted from August to October 2018, in the waters of Jakarta Bay (3 stations namely Pantai Indah Kapuk, Ancol Beach and Marunda Beach (Figure 1.), and in the waters of the Thousand Islands (4 stations namely Pramuka Island, Pulau Panggang, Pulau Opak and Pulau Kayu Angin Bira (Picture 2.).

Data collection methods used are primary data and secondary data. Primary data are in the form of field surveys, visuals, direct observation (collection, collection and weighing of marine debris). Secondary data is in the form of data collection in related institutions regarding currents, winds and tides. By using rope tools, meter rollers

and wood or bamboo for marine debris collection transects. Gloves and garbage bags for media for collecting and storing marine debris. Ruler and scale for measuring the length and mass of marine debris. Cameras to document types, sizes, visual observations and transects of marine debris collection. The material used is waste samples.

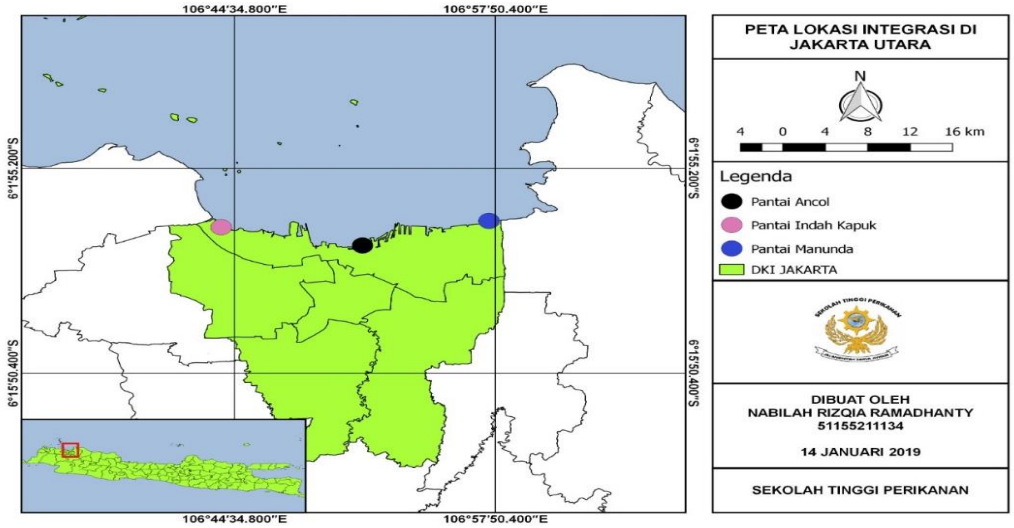

Figure 1: Location of sampling in Jakarta Bay.

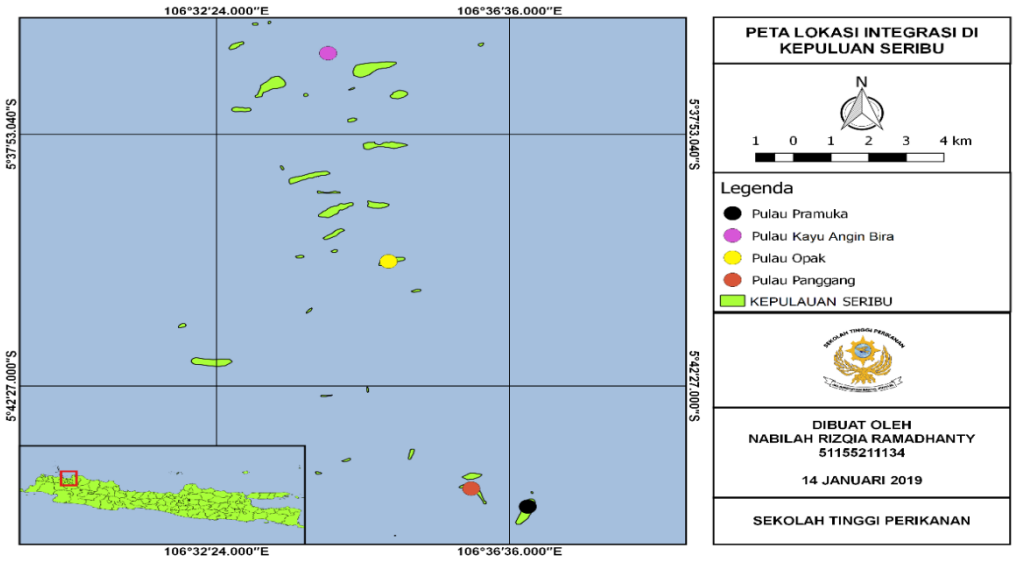

Figure 2: Location of sampling in Thousand Island.

3. Results

3.1 The results of identification of marine debris

The types of marine debris found at each station are plastic and other categories. Meanwhile, bottles, rubber, metal, glass and organic types of waste are found in almost every station. In seven stations, the distribution of marine debris is in almost all stations (Table 1.)

Table 1: Distribution of marine debris.

No.	Types of Trash	Station						
		I	II	III	IV	V	VI	VII
1	Bottle	√	-	√	√	√	√	√
2	Plastic	√	√	√	√	√	√	√
3	Rubber	√	-	√	√	√	√	√
4	Metal	-	-	√	√	√	√	√
5	Glass	√	-	√	√	√	√	√
6	Organic	√	-	-	√	√	√	√
7	Etc. / others	√	√	√	√	√	√	√

Source: Results of Data Collection

The amount of marine debris at each station and the amount of marine debris per type are presented in full in Table 2.

Table 2: Amount of marine debris at each station (A).

No	Types of Trash	Station (A)							Total
		I	II	III	IV	V	VI	VII	
1	Bottle	3	-	9	23	23	63	5	126
2	Plastic	12	9	332	48	58	77	40	576
3	Rubber	5	-	25	15	1	78	45	169
4	Metal	-	-	1	2	2	21	8	34
5	Glass	1	-	3	5	1	25	4	39
6	Organic	15	-	-	126	4	33	11	189
7	Etc. / others	1	12	18	17	2	12	1	63
Total		37	21	388	236	91	309	114	1196

Source: Data Calculation Results

The largest number of marine debris was obtained, namely 388 pieces at station III (Marunda Beach), 309 pieces at station VI (Opak Island), 236 pieces at station IV (Pramuka Island), 114 pieces at station VII (Pulau

Kayu Angin Bira), 91 pieces at station V (Pulau Panggang), 37 units at station I (Pantai Indah Kapuk), and at least at station II (Pantai Ancol), namely 21 units. The most types of waste found at all stations were 576 types of plastic and the smallest was 34 types of metal. While the others, 189 organic types, 169 rubber types, 126 bottle types, 63 other categories of waste, and 39 glass types.

In this practice, the characteristics of the measured waste size are limited to the meso size only, the micro and nano sizes are not used because the measurement uses a metal ruler whose scale is only up to meso (> 5mm - 2.5 cm). The total size of marine debris per station and per size is presented in full in Table 3.

Table 3: Total size of marine debris.

Size Marine Debris	Station							Total
	I	II	III	IV	V	VI	VII	
Mega (1 m)	3	-	5	1	-	-	-	**9**
Macro (2.5 cm – 1 m)	26	18	360	220	89	298	109	**1120**
Meso (>5 mm – 2.5 cm)	8	3	23	15	2	11	5	**67**
Total	**37**	**21**	**388**	**236**	**91**	**309**	**114**	**1196**

Source: Data Calculation Results

The size of the most waste found at the practice location at each station is the type of macro-debris size (2.5 cm - 1 m) with a total of 1120 pieces and the least amount of waste found is the size of mega-debris (> 1 m) 9 pieces. While the size of the meso (> 5mm - 2.5 cm), the results were 67 pieces. The results of calculating the size of marine debris at each station are different, the following is the size of marine debris per station (Figure 3.).

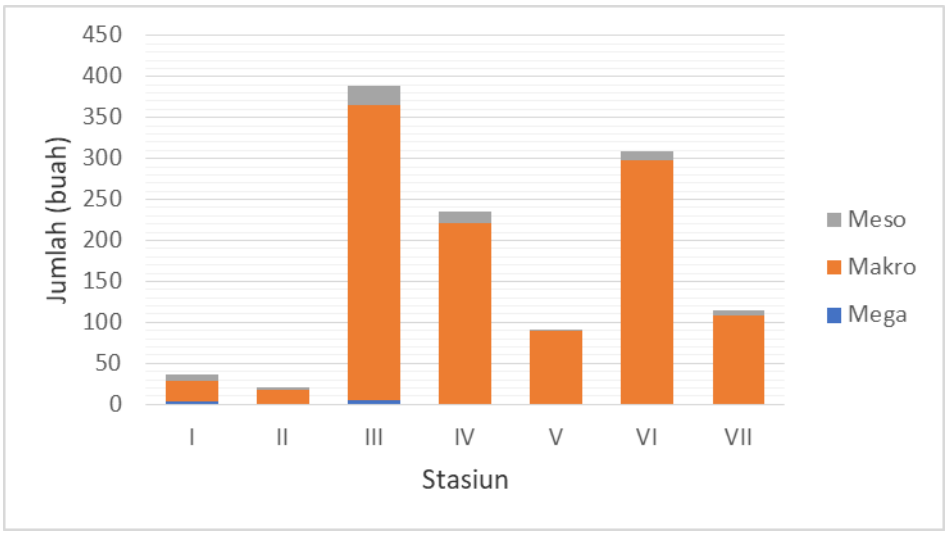

Figure 3: Total size of waste at each station.

The most amount of waste sizes found was at Station III (Marunda Beach), which was 388 pieces and the least was found at Station II (Ancol Beach), which was 21 pieces. Then followed by Station VI with 309 units, Station IV with 236 units, Station VII with 114 units, Station V with 91 units, and Station I with 37 units.

3.3 Marine Debris Mass

The mass of marine debris that has been calculated from each station, namely station II (Ancol Beach), station III (Marunda Beach), station IV (Pramuka Island), station V (Panggang Island), and station VI (Opak Island) is presented in full in Table 16. Except for station I (Pantai Indah Kapuk) because the observations made were only visual observations (without taking and weighing) and station VII (Pulau Kayu Angin Bira) because it used secondary data obtained from the Thousand Islands Marine National Park. And secondary data is the total of all garbage found.

Table 4: Total mass of marine debris.

Location	Plot	Marine debris mass (kg)						
		B	P	L	Kc	Kr	O	Dll
Ancol Beach	1		0.001					0.005
	2		0.008					0.010
	3		0.002					
Marunda Beach	1	0.045	3.115			0.530		12.53
	2	0.010	3.125	0.010	0.025	1.340		4.960
	3	0.005	1.545		0.395	0.145		6.170
Pramuka Beach	1	0.120	0,035	0,035	0,1	0,0005	0,03	
	2	0.095	0,30	0	0.06	0,075	0,12	0,16
	3	0.06	0,075	0,005	0,155	0,19	0,125	0,155
Panggang Island	1	0.045	0.100	0.040	0,35	0.095	0.085	0.085
	2	0.024	0.321					
	3	0.062	0.413	0.065			0.62	
Opak Island	1	0.135	0.135	0.005	0.385	0.635	0.76	
	2	0.435	0.905	0.045	0.675	0.43	0.455	
	3	0.15	0.135	0.03	0.305	0.89	0.76	
Total Mass (kg)		1.186	9.805	0.195	1.845	4.065	2.68	23.76

Source: Data Calculation Results

The results of the mass of waste from the five stations with the highest to lowest amount were 23.76 kg of type and others, 9,805 kg of plastic waste, 4,065 kg of rubber type, 2.68 kg of organic waste, 1,186 kg of bottle type, 1,845 of glass type waste. kg, metal waste with the amount of 0.195 kg.

3.4 Spread of Marine Debris

Spread is something that is spread or spread. Spatial data is a real picture of an area found on the earth's surface. The distribution of marine waste from the results of the integrated practice that has been implemented, namely plastic waste and other categories of waste is garbage found at each station (Table 4.)

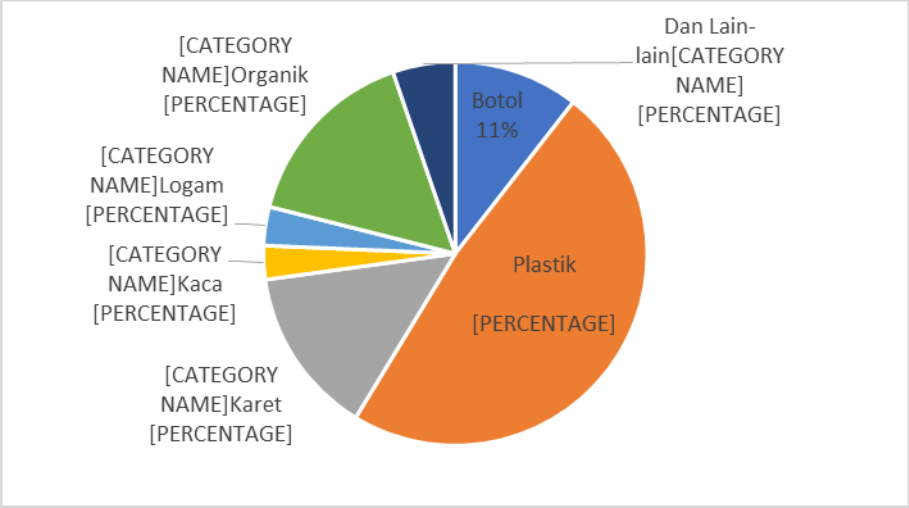

Figure 4: Percentage of marine debris distribution.

Based on the percentage of marine waste distribution above, it can be said that marine plastic waste is the most common type of waste found in Jakarta Bay and the Thousand Islands. The pattern of distribution of marine debris that occurs is random (random).

3.5 Impact of Marine Debris on Ecosystems

Based on a survey of ecosystems affected by waste in the practice locations, namely Jakarta Bay and Seribu Islands, mangroves and seagrasses. The biota in the mangrove ecosystem are mangrove crabs and fish, while the biota in the seagrass ecosystem are fish and starfish. Marine debris that is associated in mangrove and seagrass ecosystems will affect environmental parameters of the ecosystem, such as inhibiting the growth of mangroves and seagrass, reducing nutrients needed by flora and fauna contained therein, pollution of the surrounding environment, and closing sediment in the mangrove ecosystem. If the load received by the waters has exceeded its carrying capacity, then the water quality will decrease. The aquatic environment is no longer in accordance with the established quality standard limits, the waters have been polluted physically, chemically and microbiologically [20]. For example, the Pantai Indah Kapuk mangrove ecosystem receives environmental pressures in the form of macro and microplastic from three rivers, especially the Angke River. Marine debris is distributed to the mangrove ecosystem so that it accumulates in sediments and mangrove roots [21].

3.6 Waste Management

There is waste management at station IV (Pramuka Island) by the Samo-samo SPKP (Rural Conservation Counseling Center) Organization and Business Group in the form of recycling houses and community based conservation information huts or commonly known as “Garbage Banks”, with the aim of being able to reduce the volume of waste systematically and productively in many forms, namely chopping machines, compost, biogas with a simple technological approach commonly used by the community. In addition, there is a recycled art and craft shop. PPSU (Public Infrastructure and Facilities Handling) officers from the Thousand Islands Cleanliness Sub-Department at stations IV and V apart from cleaning and carrying trash to TPS (Temporary

Disposal Sites), during spare time or rest, officers make ecobricks. According to Asih & Fitriani [22], Ecobrick is a way of handling plastic waste by packaging clean and dry plastic into plastic bottles to the specified density. Currently ecobrick products are formed into something useful such as chairs, tables, and so on.

3.7 Oceanographic Parameters

The direction and velocity of the flow that occurs during practice are secondary data, which is obtained from related agencies, presented in Figure 5.

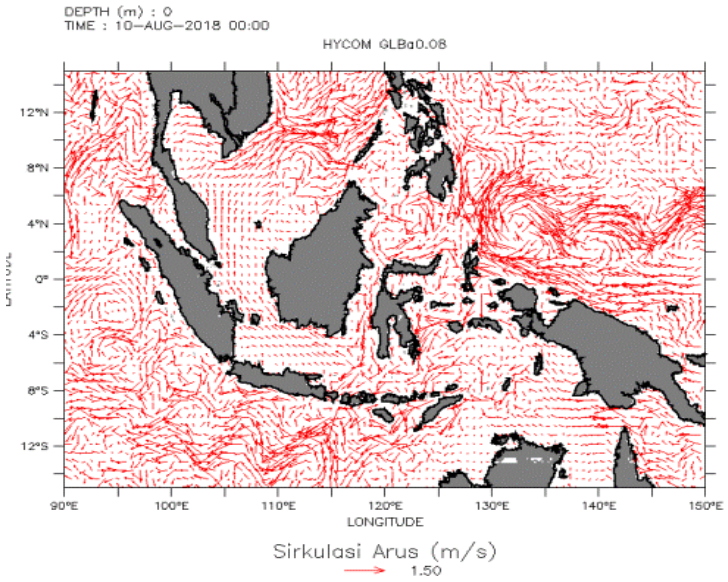

Figure 5: Flow Direction and Speed (Center for Marine Research, 2018).

Based on the current pattern in August, the current velocity of 1.50 m / s that leads to the northeast (South China Sea) comes from the southeast (Flores Sea) through the Java Sea. Wind is one of the factors that causes waves in a waters. The wind observed at 2 months when data collection was the east monsoon. According to Sahwan [23], this condition should have a relatively large amount of garbage stranded. However, the conditions in the field are relatively smaller. Basically, the east monsoon is dry season, so it doesn't really affect the waves to carry marine debris. Supposedly in September, there has been a transition season to the west monsoon. However, as long as the integration practice was carried out, the east monsoon still occurred. Tides in Jakarta Bay (Tanjung Priok) In general, the tidal conditions that occur in the practice area at the time of practice are based on the picture, namely high tides occur twice a month and the lowest tides occur twice a month (Figure 6.)

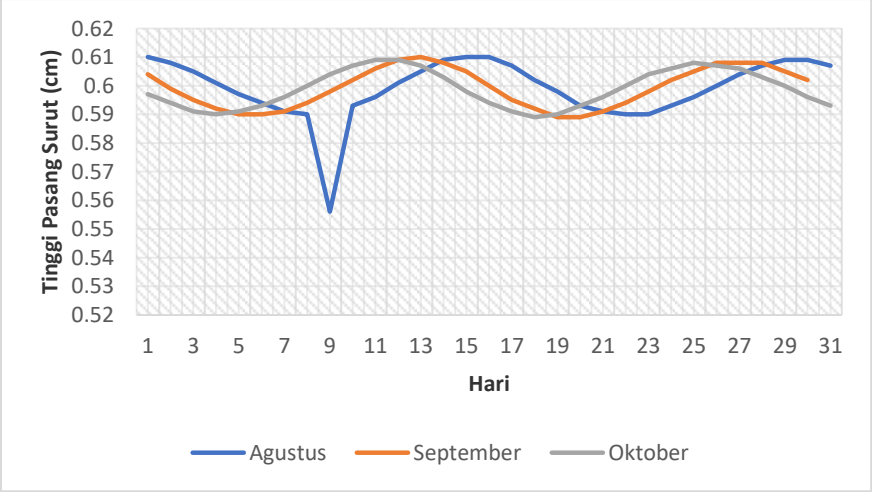

Figure 6: Average tidal heights in Jakarta Bay (Pushidros TNI AL, 2017).

Based on the average tide height in Jakarta Bay, it experienced anomalies in August on the 8th day, due to large tides, reaching its lowest point of 0.56 cm. And the highest tide is in August on the 16th day, namely 0.61 cm. Tides in the Thousand Islands (Pramuka Island) and Tidal conditions obtained from related agencies (Figure 7.)

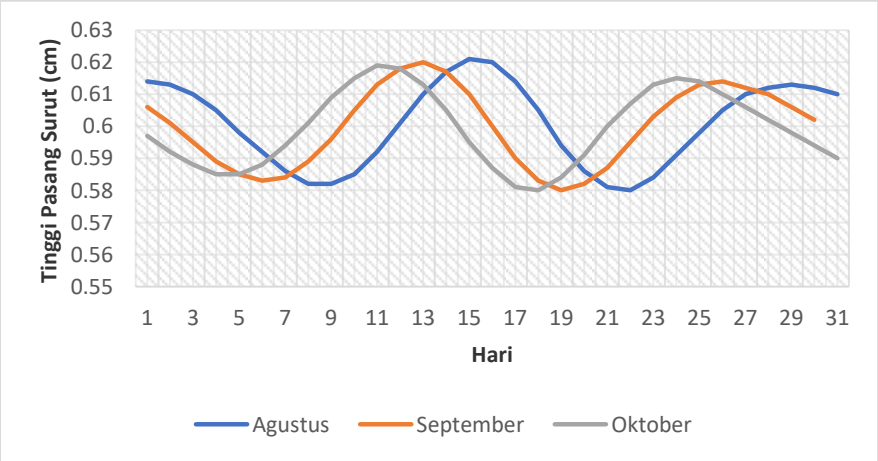

Figure 7: Average tidal heights in the Seribu Islands.

Based on the average tidal height in the Seribu Islands, the secondary data has an average cycle in the three months. The highest tide and lowest low tide occurred in August on the 14th day, namely 0.62 cm and the 22nd day, namely 0.58 cm. The tidal type in the Thousand Islands is a single daily tide type (Diurnal Tide). According to Zurma and his colleagues [24], a single daily ebb means that in one day there will be one tide and one ebb.

4. Conclusion

The types of marine debris found at each data collection station were 576 pieces of plastic and 63 other categories of waste. Based on the size, the most common is macro-debris (2.5 cm - 1 m), which is 1120 pieces.

The highest mass of marine debris found in Jakarta Bay and the Thousand Islands with a weight of 23.76 kg is miscellaneous waste, plastic waste 9,805 kg, rubber type 4,065 kg, organic type 2,68 kg, bottle type 1,186 kg, glass type waste. 1,845 kg, metal type waste weighing 0.195 kg. The dominant distribution of marine debris in the waters of Jakarta Bay and the Thousand Islands is plastic waste with a percentage of 48%. 16% organic, 14% rubber, 11% bottle, 5% miscellaneous categories, 3% glass and 3% metal. With a wind pattern from the east and a current pattern leading to the northeast (South China Sea) from the southeast (Flores Sea) through the Java Sea. It is necessary to hold a further socialization program on waste, public awareness of the use of plastic waste and government intervention in affirming regulations on waste, both in management and use. One of the uses of household plastic waste into materials that can be used is the ecobrick.

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