CLASSIFICATION AND QUANTIFICATION OF MARINE DEBRIS AT TELUK LIKAS, SABAH

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ABSTRACT.*Marine debris is a well-known issue faced by the public today and the problem is becoming serious day by day. In this study, quantification and classification of marine debris for plastic, fabric, paper, metal, glass and rubber was conducted to evaluate the marine littering of contamination level at Likas Bay. This study also aims to identify the sources of the marine debris whether it was from the land or was brought in from the sea. By selecting 10m x 10m transects randomly, the marine litters that were collected along the bay were rinsed, dried, weighted and classified according to categories. Total of 3396 items/100m^{2}of marine debris with the weight of 14499.36g/100m^2 were collected throughout the study. From the result, it shows that plastic dominated the overall numbers and weight percentage of marine debris with 94.38% in numbers and 65.29% in weight. The study also indicates that the occurrence of marine debris at Likas Bay was not mainly caused from recreational activities at the area, but was brought in from the sea. This may due to the physical condition and the bay position which has the tendency to trap the marine debris from the sea. Therefore, further investigation should be undergoing to overcome and reduce the impact to the marine debris.*

KEYWORDS: Marine debris, Littering, Transects, Bay

INTRODUCTION

Beaches throughout the world are facing serious problems due to litter accumulation (Derraik 2002; Hidalgo-Ruz & Thiel 2013; Topçu *et al.* 2013). One of the problems is the pollution of oceanic and coastal habitats with plastic debris. Number of plastics waste increases in marine ecosystems mirrors the increased prevalence of plastics in society, and reflects the high durability and persistence of plastics in the environment (Hidalgo-Ruz & Thiel 2013). This is also can be said as marine debris. Marine debris are solid materials of human origin that are discarded at sea or reach the sea through waterways or domestic and industrial outfalls (Rees & Pond 1995; Van Cauwenberghe *et al*. 2013). Many recreational activities both on land and in the ocean such as picnicking, boating, swimming, fishing and surfing can generate marine debris (Van Cauwenberghe *et al***.** 2013) such as plastic bottles, containers, food wrappers, cups, fishing nets and others (Moore & Allen 2000; Abu-Hilal & Al-Najjar 2004). The main types of marine debris are plastics, polystyrene, rubber, wood, metals, sanitary or sewage-related items, paper and cardboard, cloth, glass and ceramic (McIlgorm *et al*. 2011; Bravo *et al*. 2009; Zhou *et al.* 2011; Rosevelt e*t al*. 2013)

The environment faces many detrimental consequences due to the variability in type of marine debris. Secretariat of the Convention on Biological Diversity (2012) revealed that all known species of sea turtles, about half of all species of marine mammals, and one-fifth of all species of sea birds were affected by entanglement or ingestion of marine debris. The frequency of impacts varied according to the type of debris; over 80 % of the impacts were associated with plastic debris while paper, glass and metal accounted for less than 2 %. Not only marine debris is aesthetically displeasing, it also poses a health and safety hazard to coastal residents and tourists (Abu-Hilal & Al-Najjar 2004; Claereboudt 2004). Injuries can occur to people particularly foot laceration as a result of stepping on broken glass, bottle caps, medical waste and even syringe (Dixon & Dixon 1981; Abu-Hilal & Al-Najjar 2004). Boaters and the shipping industries are also affected by marine debris as it may lead to damage to vessels and equipment (McIlgorm *et al*. 2011). Many studies on marine debris have reported deleterious effects on marine organisms. For example, Derraik (2002) was reported that plastic affect the marine organism. Marine organisms usually confuse plastics and polystyrene as food and ingestion of these marine litters may cause obstructions in throats or digestive tracts. Another study by Gudger and Hoffman (1931) reported a shark, caught in a rubber automobile tyre in 1931 which is one of the first entanglement records of marine debris. Marine organisms can be entangled in nets, fishing line, ropes and other debris, which can inflict cuts and wounds or cause suffocation or drowning (Moore *et al*. 2009; Van Cauwenberghe *et al.* 2013).

While most marine debris recorded was of anthropogenic origin, some were brought in to the beaches through the ocean. Litter can accumulate temporarily or permanently on beaches and on the sea bed due to transportation by wind, tide and current (Somerville *et al.* 2003). At high tide, debris moved by waves is commonly stranded along the beach bays (Beach *et al.* 1998). The debris will continue to accumulate unless stronger current occur and relocate the debris to another place. Swirled by currents, plastic litter accumulates over time at the center of major ocean vortices forming “garbage patches” that is the larges masses of ever-accumulating floating debris fields across the seas. Therefore, beach clean ups involving many volunteered participants should be conducted on beaches throughout the world for a sign of increasing awareness towards marine debris pollution (Rees & Pond 1995; Bravo *et al*. 2009). The increase of marine debris accumulation especially on recreational beaches has caused local authorities to take further action by hiring private companies to carry out clean up works.

This study was conducted on Likas Bay beach, Sabah aimed to assess the amount of marine debris collected and to categorize their type and origin.

MATERIALS & METHODS

Study Area

Figure 1 show Likas Bay which is located about 4km from Kota Kinabalu city centre. It is one of the highly visited recreational beaches in Kota Kinabalu by both local and international tourists. Likas Bay comprises mainly of sandy beach and is a mere semi- circular in shape. There are water inputs to the bay from several rivers nearby such as

Inanam and Likas rivers. There are also some food stalls, playground and toilets here. Protected from strong waves, Likas Bay provides a convenient location for swimming and bathing activities. The beach is influenced by the semidiurnal tide action. Traditional fishing and cockles collecting by local community are also practiced at Likas Bay.

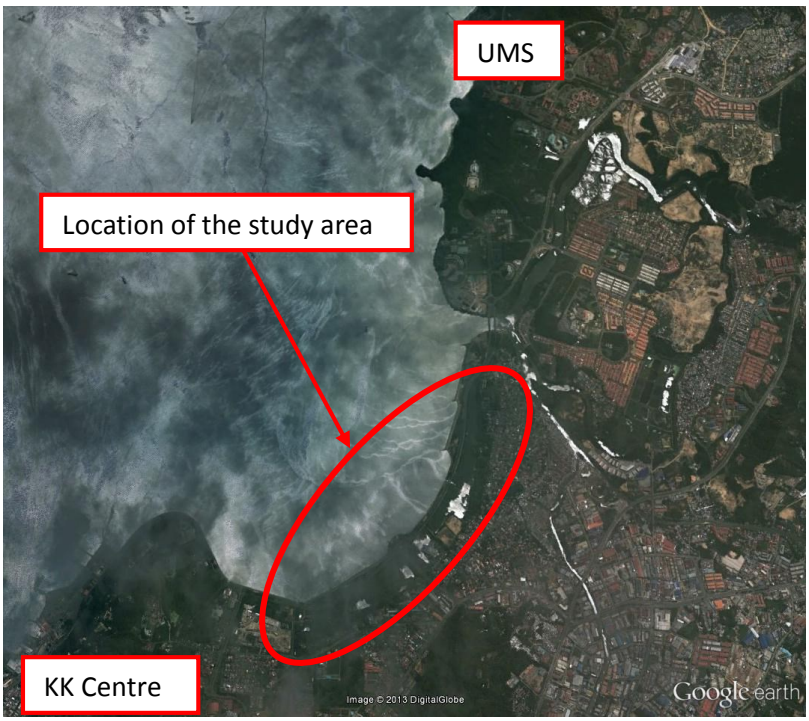

Figure 1: Study area at Likas Bay, Kota Kinabalu, Sabah.

Method

Six transects which measured 10m x 10m were randomly selected along the stretch of Likas Bay beach. These transects were marked with coloured plastic ropes tied to sticks that were planted on the beach. After these transects were determined, all visible debris in it were removed. Debris that was too heavy or too large to be removed were marked and left at its original location and considered as permanent debris. The debris collected was disposed and were not included in the research.

Debris collection was conducted 24 hours after the transect cleaning. This is to ensure that the debris collected truly represented the actual amount of marine debris that had accumulated at the beach within one day's duration. All pieces of debris found in each transect equal to or larger than 2 cm were collected in separate bin bags and later were counted, classified and recorded in the lab. All debris collected was brought back to the lab and rinsed with pipe water in a large bucket to clean off dirt and sand that may cause inaccuracy during the weighing process. The debris was air dried in the lab before being weighed individually. The debris was classified to six main debris categories which were plastic, fabric, metal, paper, glass and rubber. Collection of marine debris at Likas Bay beach was conducted for a week for each month of November and December 2011.

RESULT AND DISCUSSION

This study provides important information about the composition and variability of marine debris on Likas Bay beach. A total of 3396 items/100m^{2}of marine debris with the weight of 14499.36g/100m^2 was recovered from the six transects at Likas Bay beach for the duration of 14 sampling days. From the data analysed, in average, Likas Bay beach accumulates about 40 items/100m^2 weighing 172.62g/100m^2 per day. The data can be deriving using this formula;

$$\text{Composition Average}\left(\frac{\text{Kg}}{100\text{m}2}\text{per day}\right): \frac{\left(\frac{Weight\ of waste\ (Kg)}{10m\ X\ 10M}\right)}{Day\ of\ Sampling}$$

In terms of numbers of debris, plastic debris dominated the samples with 94.3% (Figure 2). The next most abundant group was fabric (4.39%), whilst other debris groups each contributed less than 1% for the overall debris collected. In terms of weight, the debris were again dominated by plastic (65.29%) followed by fabric materials (23.92%), rubber (8.33%) and metal (1.46%) (Figure 3).

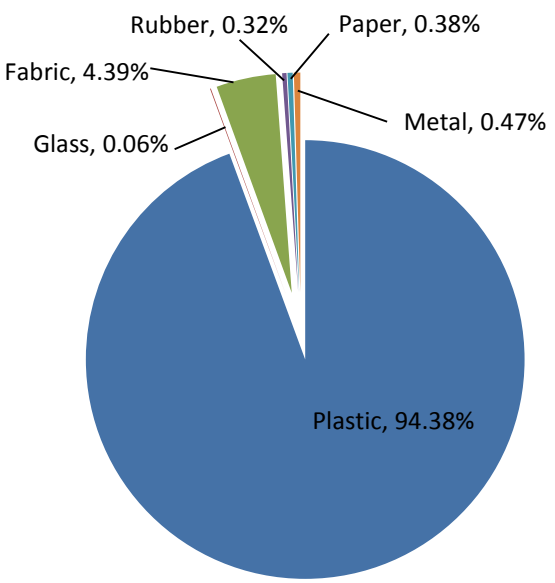

Figure 2: The percentage of total number for quantified debris along the Likas Bay, Kota Kinabalu, Sabah.

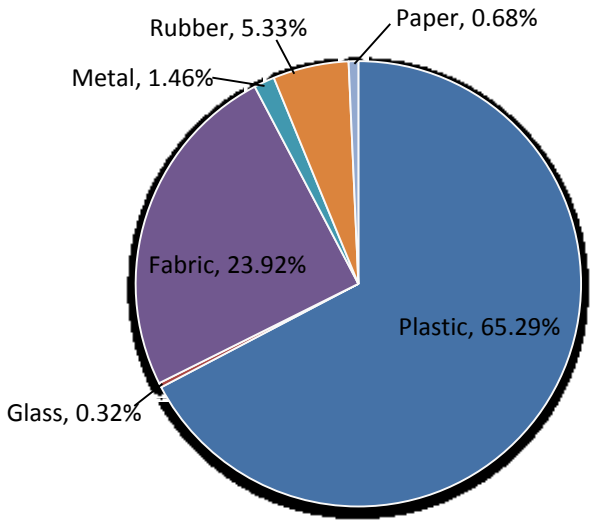

Figure 3: The percentage of total weight for quantified debris along the Likas Bay, Kota Kinabalu, Sabah.

The most abundant items in numbers, as well as in weight were plastic items mostly consisted of plastic drinking bottles, food wrappers, containers and plastic bags. This situation of plastic-dominated debris is very common (Moore *et al.* 2001; Claereboudt 2004; Slavin *et al.* 2012) because of its characteristics which are highly persistence making it durable in the environment and has low density allowing it to float on sea water and thus easily accumulate on beaches. Plastic items are also common be found due to its usage where they are lightweight, strong and cheaply available, which makes them suitable for any manufacturer products as well as waste products (Derraik 2002; Jayasiri *et al*. 2013). Many plastic drinking bottles were collected from the study area and this show the bottled drinking waters are mostly used amongst beach goers in Sabah particularly in Kota Kinabalu. Sampling on weekdays noted that there were fewer beach goers compared to weekends. However, the amount of plastic debris collected within the transects were almost consistent every day and this showed that recreational activities at Likas Bay beach itself was not the main focus on marine waste accumulation. The accumulation of plastic debris at Likas Bay although was mainly from land-based source and transported to the beach from other areas by sea. As reported by Slavin *et al*. (2012), land-based sourced litter on beaches could be transported from other areas via rivers, water outfalls and the ocean.

Fabric debris collected at Likas Bay beach was the second most dominant litter both in number and weight and consisted mostly of fragments of cloth materials. Smaller pieces of cloths are lighter, hence easier to be transported by water to the beach as well. Rubber debris, although contributes less than 1% in number of debris collected, it was the third most dominant debris in terms of weight. Rubber fragments of slippers, tyres and condoms were collected from Likas Bay beach. Other category of debris collected such as metal, paper and glass were very low in number and this corresponded to their low weightage as well. Sharp fragments of glass (drinking bottles) and metal (mostly drinking cans) although low in abundance can cause serious hazard to beach goers (Abu-Hilal & Al-Najjar 2004).

CONCLUSION

This study reached to its conclusion where plastic has highest percentage on number and weight of marine debris with 94.38% in numbers and 65.29% in weight followed by Fabric with 23.29% in number and 4.39% in weight. Meanwhile the lowest percentage of marine debris in number and weight is glass with 0.32% in numbers and 0.06% in weight. Besides that, marine debris is mainly brought from land and transported to the beach from other areas by sea. Controlling and reducing debris in the marine environment is crucial not only for the wellbeing of the beach users but for the protection of marine biodiversity. Regular debris collection on beaches and in waterways such as storm drains should be carried out regularly to avoid debris accumulation on beaches and in the ocean. Effective collaboration of education and legislation should be carried out to reduce the input of marine debris and protect our beaches.

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