CHAPTER 3

METHODOLOGY

3.1 RESEARCH LOCATION

Study areas are located at Port Dickson in Negeri Sembilan, Kuala Terengganu in Terengganu and Kota Kinabalu in Sabah. Generally, Malaysia coastal areas comprises into three divisions which are West Coast of Peninsular Malaysia, East Coast of Peninsular Malaysia and East Malaysia (Borneo). Port Dickson is to represent the West Coast of Peninsular Malaysia while Kuala Terengganu to represent East Coast of Peninsular Malaysia and Kota Kinabalu representing the beaches in East Malaysia.

Two sampling sites were selected to represent one recreational beach and one fishing area. Hence, a total of six sampling sites were selected and surveyed. Plastics debris was sampled from January 2010 till March 2010 from all selected beaches. Figure 3.1 shows the map of the sampling sites and Table 3.1 shows the coordinates of the sampling sites. The beaches positions were determined with a portable Global Positioning System (GPS) during the sampling.

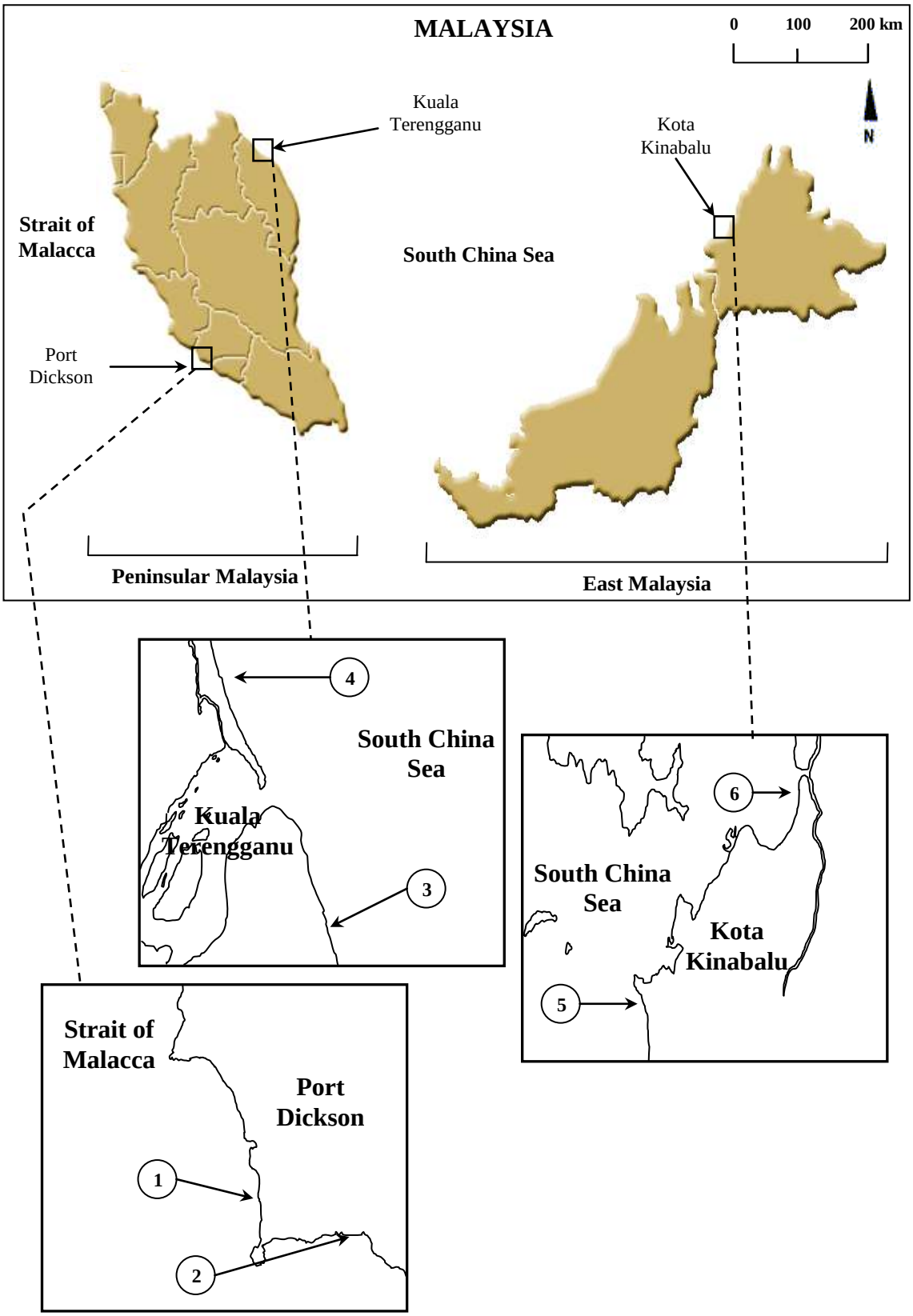

Figure 3.1: Locations of sampling sites on Malaysian beaches. Numbers correspond to location numbers in Table 3.1.

Table 3.1: Sampling Site Coordinates.

SAMPLING SITES	COORDINATES	
	LATITUDE	**LONGITUDE**
Port Dickson, Negeri Sembilan		
1. Teluk Kemang Beach	2º27'19.14'' N	101º51'18.47'' E
2. Pasir Panjang Beach	2º25'21.33'' N	101º55'12.20'' E
Kuala Terengganu, Terengganu		
3. Batu Burok Beach	5º19'21.83'' N	103º09'14.26'' E
4. Seberang Takir Beach	5º21'21.26'' N	103º07'51.20'' E
Kota Kinabalu, Sabah		
5. Tanjung Aru Beach	5º56'18.43'' N	116º02'48.00'' E
6. Teluk Likas Beach	6º00'31.82'' N	116º06'37.04'' E

3.2 SAMPLING OF PLASTIC DEBRIS

3.2.1 Sampling Design

The plastic debris sampling was conducted once a month for three consecutive months (January, February and March) on each beach site. A survey frequency of one month (i.e. 28 days) was used based on Lettenmaier (1978) that recommended monthly surveys as the best frequency for obtaining information. Table 3.2 shows the date of samplings on each beach site. Then, the quantity and density of plastic debris is compared between beaches with different function.

Table 3.2: Date of samplings on each beach site.

SAMPLING SITES	MONTHS		
	JANUARY	**FEBRUARY**	**MARCH**
Port Dickson, Negeri Sembilan			
1. Teluk Kemang Beach	14/01/2010	12/02/2010	10/03/2010
2. Pasir Panjang Beach	16/01/2010	14/02/2010	12/03/2010
Kuala Terengganu, Terengganu			
3. Batu Burok Beach	03/01/2010	02/02/2010	01/03/2010
4. Seberang Takir Beach	05/01/2010	04/02/2010	03/03/2010
Kota Kinabalu, Sabah			
5. Tanjung Aru Beach	26/01/2010	25/02/2010	24/03/2010
6. Teluk Likas Beach	28/01/2010	27/02/2010	26/03/2010

The area of sampling beach site was from the low tide shoreline and high tide shoreline which are within the foreshore zone to the berm which is within the backshore zone. The berm is the upper part of the beach that receives wave action during extreme storms condition and high surf. The best practice for beach surveys is the debris should be sampled from the entire beach profile (from the most recent strandline to the back of the shore) with a depth of 50 mm (Ryan *et al.*, 2009).

Samples of plastics debris in beach sediment were collected monthly during the low tide, within three belts transects signifying sample replicates that extend from the berm scarp to the low tide terrace (base of the foreshore). Moreover, datums located on the crest of the berm were used in order to re-establish the sampling areas each month using measuring tapes and stakes.

At each site, triplicates of 12.5 L sediment consisting of sand or small gravel was scooped using a small shovel within a 50 x 50 cm^2 quadrate (Plate 3.1) to a depth of approximately 5 cm taken from the low tide (X) and the high tide (Y) water level, as well as, from the berm area (Z) of the beach within three belts transects. Hence, there were nine points of sample per beach site, as shows in Figure 3.2 below. Before scooping the sample, any visible stranded litter on the sand was removed and then filled into a bucket (Plate 3.2).

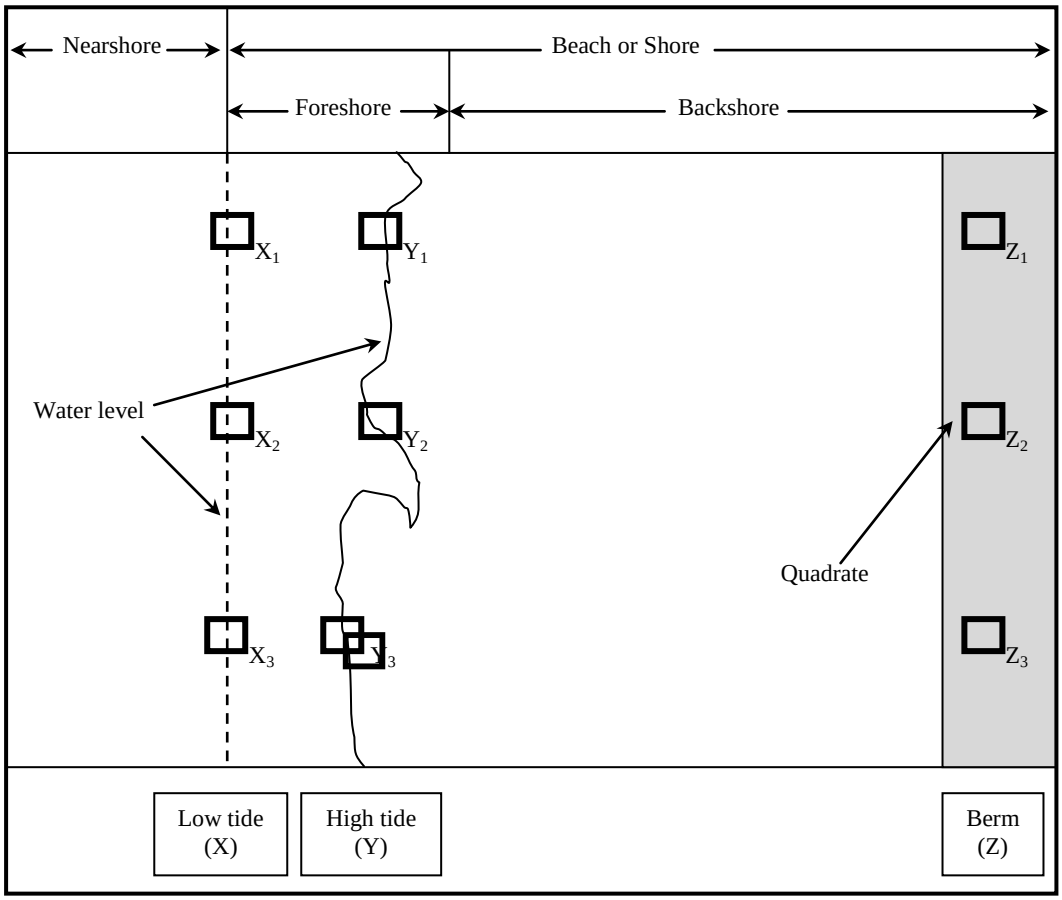

Figure 3.2: Nine points of sample per beach site (three replicates were determined within each water level and berm area).

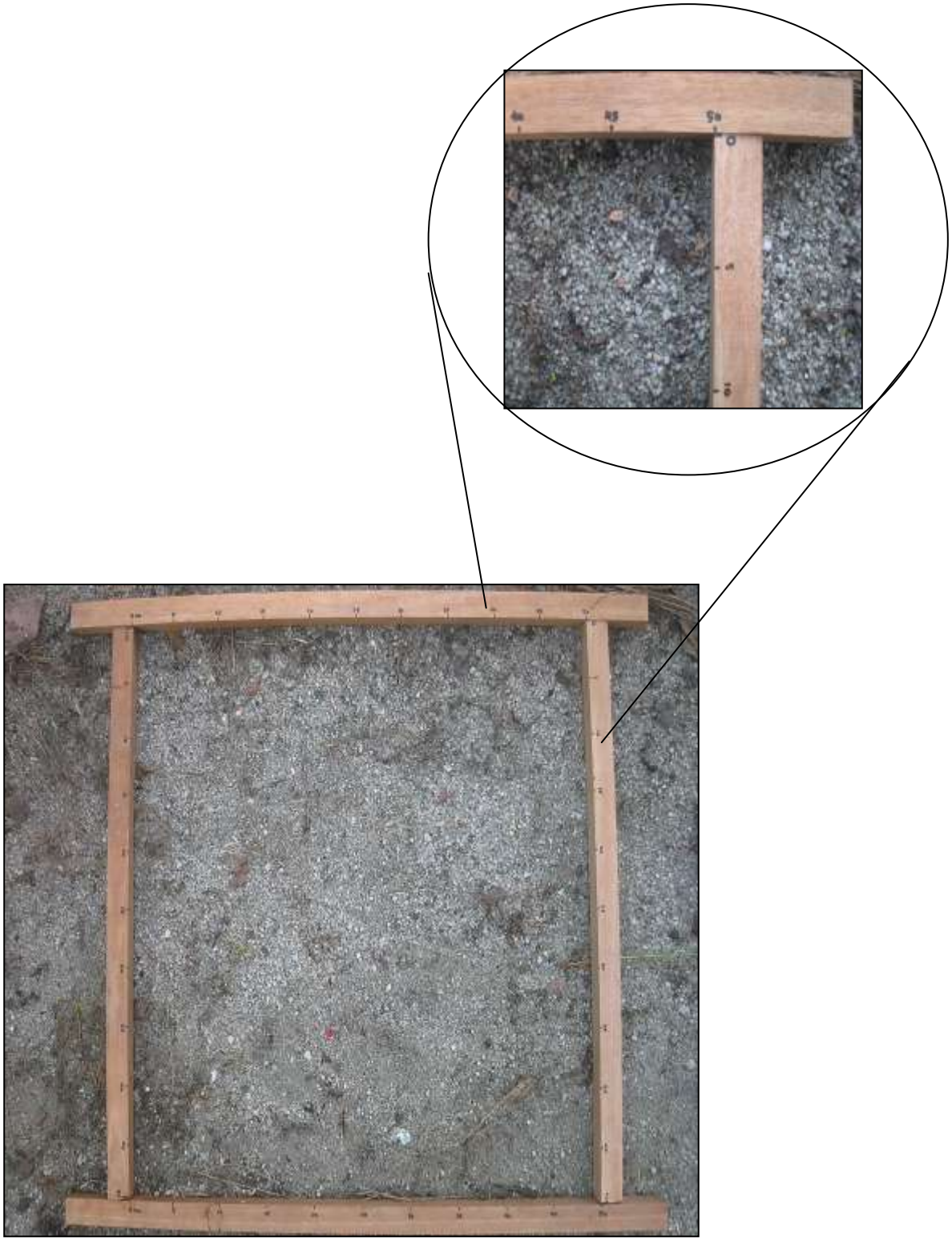

Plate 3.1: Sampling quadrat.

Plate 3.2: Replicate 12.5 L samples of sediment filled into the bucket.

3.2.2 Sieving of Samples

The sand in the bucket was mixed with seawater and stirred. After that, these residues were sieved through a set of nested sieves (Plate 3.3). The sieve aperture size employed were 4.75 mm, 2.80 mm and 1.00 mm with 200 mm of diameter, which arranged in an order of a decreasing sequence of size from top to bottom (Plate 3.4). Particles 1 – 30 mm in size which retained from each sieve tray were placed in separate labelled plastic bags and brought to Chemo Laboratory at Institute of Postgraduate Studies (IPS), University of Malaya for the sorting purpose.

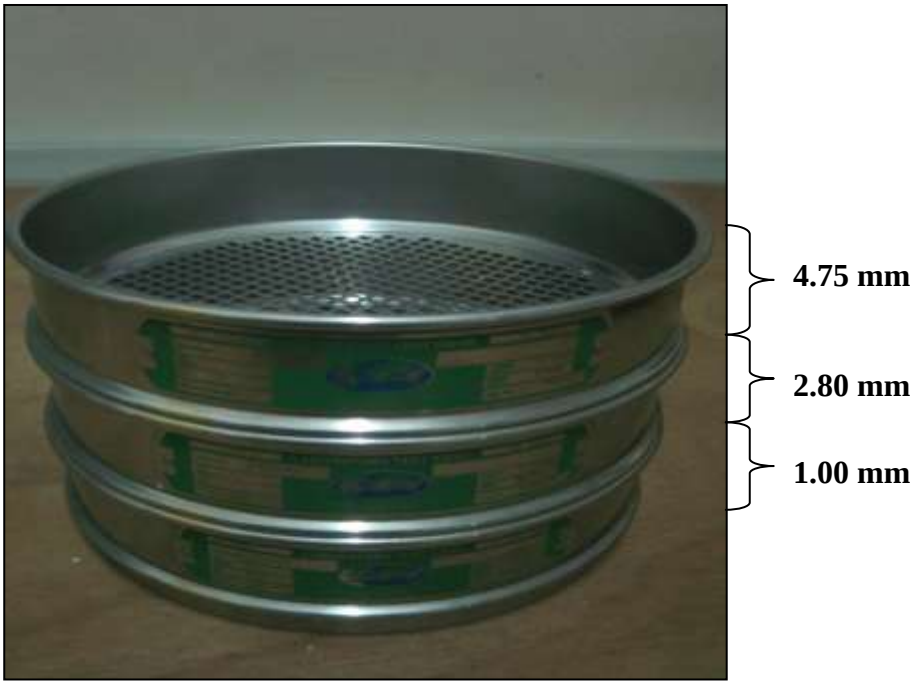

Plate 3.3: A set of nested sieve.

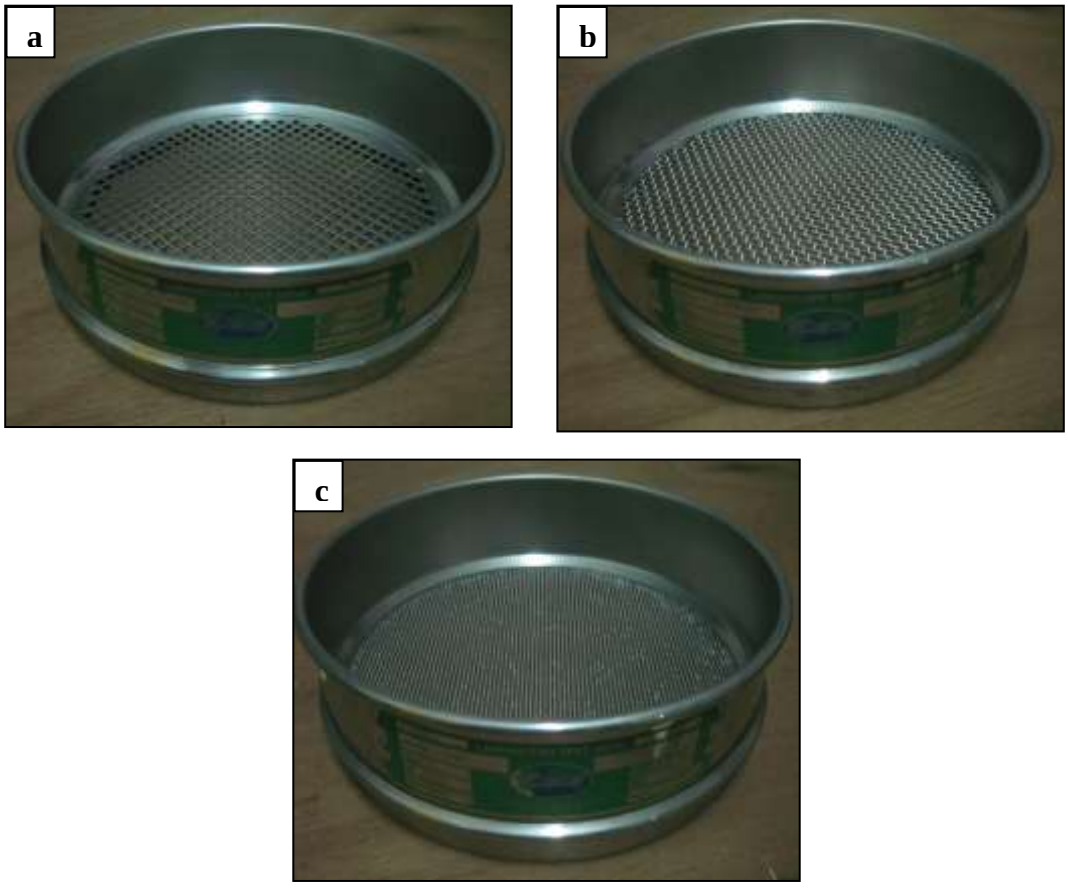

Plate 3.4: Separated sieve according to size. (a) 4.75 mm aperture size of sieve; (b) 2.80 mm aperture size of sieve; (c) 1.00 mm aperture size of sieve.

3.3 LABORATORY ANALYSIS

3.3.1 Sorting of Samples

After samples had been collected from the sampling sites, the samples were sorted based on two procedures as recommended by Ogi and Fukumoto (2000) and Moore *et al.* (2001a). First procedure is dry sorting (McDermid and McMullen, 2004). Each sample was placed on a sheet of white paper where materials were sorted into major categories; plastic, plant and shell. The materials were placed in separate containers and labelled with sieve size, location and type.

Second procedure is wet sorting (McDermid and McMullen, 2004). Each sub-sample of plastic was rinsed to remove sand and soil and also to pick out non-floatable objects that might be mistaken for plastics (i.e. glass, paper and ceramic matters). Small amounts of sample were poured into a container of freshwater. The container was swirled for one minute and floating particle (mostly plastic) then was sieved out. Some sub-samples required rinsing several times to remove all of the clinging sand and soil. The samples were then oven dried for one hour at 65°C (McDermid and McMullen, 2004).

3.3.2 Classification and Quantification of Samples

After drying, the plastic samples in each size class of sieve were separated, identified and classified into five types of plastic; namely film, foam, fragment, line and pellet. These different types of plastic were counted, weighed and placed in separate containers. Each size class was weighed to 0.01 g on an Ohaus top-loading balance. Meanwhile, non-plastic materials which were plant and shell from each sample was sorted, counted and weighed.

3.4 STATISTICAL ANALYSIS

All data obtained from the plastic, plant and shell samples were statistically calculated, analyzed, evaluated and compared using Microsoft Excel software. In this study, two units of comparison applied which were number of items/area (items/m^2) and weight/area (g/m^2) or also known as a density. The density measurement for the sample was calculated using the formulae as follows:

$$\text{Density } (g/m^2) = \left[\frac{\text{Weight of sample (g)}}{\text{Area of quadrate (0.5 m x 0.5 m)}} \right] \times 4$$

Source: McDermid and McMullen (2004).

Other than that, Microsoft Excel software was also used as a statistical tool to generate a One – Way Analysis of Variance (ANOVA) of the samples, as well as, correlation between the quantity of plastic samples with monthly rainfall amount recorded in the sampling sites.