CHAPTER 1: INTRODUCTION

1.1 Marine Pollution

Since the disaster from Exxon Valdez tanker in 1989, oil spill events continue to occur throughout the globe. Recently, news on oil spill from exploded offshore drilling rig in the Gulf of Mexico had shocked the world. It is the worst marine pollution event in history due to oil spill with the release of more than 5000 barrels of oil per day (Robertson & Kaufman, 2010, para. 2). Unlike other oil spill occurrences, this event is harder to control since it is from underwater oil well that could pump out more oil indefinitely until the leak is plugged (The Associated Press, 2010, para.15). As one of world's richest seafood grounds, it will affect fishermen's livelihoods, hundreds species of fish, birds and other wildlife including human health (The Associated Press, 2010, para. 4).

Oil spill is listed as one of marine pollutants besides heavy metals, radioactive compounds, nutrients and other organic matter (Boaden & Seed, 1996; National Academy of Sciences, 1975). However, Boaden & Seed (1996) thought that oil pollution in the marine ecosystem are given more attention compared to the damages it brings probably due to the spectacular nature of the event and the involvement of huge oil-based companies. While oil spill is given the attention, other sources of marine pollution continue to disrupt the ecosystem more than that of oil spill event. One of the examples of such pollutant is solid waste disposal into marine ecosystem.

Many people may not know that the largest landfill on earth is in the middle of an ocean. Garbage mostly plastics, formed an island two times the size of Texas, known as The Great Pacific Garbage Patch. It occurs due to the naturally slow moving and the clock wise spiral of current at the area. Both flows collect trash from all over the world and the size is increasing every year. Without doubt, the garbage patches brings numerous harm to marine wildlife and ecosystem. It is known to cost damage to 19 islands of Hawaiian Archipelago that receives huge mass of shot out trash from the patch (Silverman, n.d., para. 1).

Solid waste found in ocean or beaches has damaging impact yet often neglected as the general public will not be affected directly or immediately. Therefore, in depth studies are needed to look at marine pollution in general and review solid waste disposal or marine littering.

The impacts from marine pollution have become important environmental issues. The pollution had disrupted the marine ecosystems and their functions. This is particularly true along the coastline area where large population relies heavily on coastal waters for food and recreation (Mann, 2000). To make it worst, the intensity and geographic scope of human activities towards the coastal environment had been increased especially among developing countries (Bowen & Depledge, 2006).

Marine pollution in Malaysia is also a serious concern especially along the Malaysian West Coast. States such as Penang, Perak, Selangor and Johor are the most industrialized states in the country with the highest population density. Besides, the west coast of Malaysia is within the Straits of Malacca which is one of the world's important shipping lane (Chua et al., 2000). The coastal area receives impacts from both anthropogenic sea-based and landbased activities. Previous studies suggested that major land-based sources of pollution in Malaysia are from agricultural, industrial activities and urbanization while sea-based sources of pollution are mainly from operational and accidental discharges of oily pollutants from shipping vessels (Abdul Rani et al., 1999).

Few years ago, it was reported that Malaysian cockles were contaminated with lead and other hazardous metals (Junos & Mohamad, 2005, para. 8). The presence of lead in the ocean can be caused from several sources including solid waste thrown directly or carried through contaminated river. This event affected the fishery industry at Sungai Juru in Penang. The farmers lost half of the yield and their profit (Junos & Mohamad, 2005, para. 8).

Other economic sector that is facing the impact of marine pollution is tourism. Port Dickson as one of the most visited beach in Malaysia is polluted with brownish water and solid wastes on the beach (Ziauddin, 2000, p.17). It was reported that the drain from the nearby area had also contributed to the pollution in Port Dickson (Ziauddin, 2000, p.17). The reports proved that pollution in the marine ecosystem deteriorates the esthetics value of a place, damage the biodiversity of flora and fauna thus have major effects economically and environmentally.

On the other hand, activities in the east coast of Malaysia are mainly fishing and recreational. East coast beaches are mostly sandy beaches compared to muddy beaches in the west coast. The larger area contributes to lesser density of locals and tourists. It receives influence from the South China Sea that pollution intensity may be less significant as compared to that of the narrow and busy Straits of Malacca. The location within the large South China Sea also contributes to a more intensive fishing industry in the area.

Although west and east coastlines of Malaysia are important for various reasons, the beaches of East Malaysia are recognized internationally for their beauty and uniqueness. Many areas along this coast are well known for their rich coral reefs ecosystem. Although it is a popular destination for divers, the area is well managed with the authority often restrict the number of individual for each visit (Department of Marine Park Malaysia, 2010). Besides tourism, the beaches in East Malaysia receive the least intervention from human activities due to lower population density and comparatively less development. Although the sea is rich with flora and fauna, the fishing activities generally are in a small scale. As a result, the pollution in the area appears to be insignificant due to the dilution effects (Thurman & Trujillo, 2004).

There are various types of pollutants which have been reported to pollute the marine ecosystem. Shahidul Islam and Tanaka (2004) in their study had categorized major marine pollutants into ten categories which are fertilizers, pesticides and agrochemicals, domestic and municipal waste and sewage sludge, oils, heavy metals and trace elements, organic compounds, plastics, sediments, eutrophication and algal bloom, aquaculture activities and biological pollution.

1.2 Marine Debris Pollution

Among other pollutants, marine debris is the most visible element that affects the aesthetical value of a marine ecosystem (Claereboudt, 2004). Although the most damaging pollutants are usually invisible, presence of marine debris on beaches is no doubt gave impression on the health of the ecosystem.

Marine debris is the unnatural or unwanted solid material found in the marine ecosystem whether it is disposed or left intentionally or unintentionally ("Marine debris", 2010). Currently, many studies on beach debris are taking place all over the world (Bravo et al., 2009; Ariza et al., 2008; Ivar do Sul., 2007; Morishige et al., 2007). This is because it is a global problem that damages marine ecosystem and living organisms that depend on the ecosystems. It is acknowledged as one of the most critical pollutants in marine environment (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1977, p.17).

From a satellite data, it was reported that there were 2000 items of marine debris including 100 items identified as fishing nets in the subtropical convergence zone of Pacific ocean (National Oceanic and Atmospheric Administration [NOAA], 2011). An astounding 6.8 metric tons of trash were collected from 100 countries which participated in a one day International Coastal Cleanup (ICC) in 2008 (ICC, 2009). The number increased to 7.4 metric tons in another beach cleaning event in 2010 (ICC, 2010). National Academy of Science estimated that 635,029 metric tons of trash enters the ocean every year (NOAA, 2010). United Nations Environment Programme [UNEP] (2005) stated that approximately

5

13,000 pieces of plastic litter is floating in every square kilometer of the world ocean. Most collected item were persistent synthetic materials that last for years. Thus, it is highly essential to study marine debris issues in depth so that impacts from anthropogenic activities can be clearly defined.

The existence of solid waste in marine ecosystem is caused by several activities. Previous studies showed that different activities affect the composition and amount of marine debris differently (Berkun et al., 2005; Claereboudt, 2004). The sources may be ocean-borne or from land activities. However, 60-80% of marine debris was estimated to starts on land (ICC, 2010). These include fishing, recreational activities, shipping and manufacturing industries. Each activity may produce different type and composition of waste thus may generate various environmental impacts.

Seasonal and climatic factors may also affect the debris composition and disposal trend (Frost & Cullen, 1997). Other factors reported to influence the composition and distribution of waste are the physical factors such as type of beach (dune/ vegetated/ back beach or foreshore), wind and waves (Thornton & Jackson, 1998).

Many types of marine debris had been studied including floating debris, submerged debris and inland/ beach debris (Thiel et al., 2003; Moore et al., 2001; Nagelkernen et al., 2001). Regardless of beach type or debris category, most of the studies on marine debris recorded similar results where plastic is the most abundant type of waste (Claereboudt, 2004; Araújo & Costa, 2007; Mallory et al., 2006; Berkun et al., 2005; Moore et al., 2001). The presence of plastic in the marine ecosystem is a serious environmental issue because of the minimal or almost absent of the breakdown by chemical weathering and mechanical erosion at sea as compared to other ecosystem on earth. Thus, it can be considered as persistent pollutants in the ecosystem (Corcoran et al., 2008). The characteristics of plastic that is durable, buoyant and non biodegradable make it an unavoidable threat to marine wildlife (Derraik, 2002).

Lot of studies has been conducted on the impacts of marine debris to wildlife. Debris is often mistaken as food and some of them entangled living organism and poses death threats. Derelict fishing gear had always been the cause of entanglement to marine fauna (Donohue et al., 2001; Hanni & Pyle, 2000). Entanglement is a serious threat to wildlife because the animal may drown or be wounded besides their ability to move, catch food or avoid predators is decreased (Jones, 1995). Other impact of marine debris to wildlife is caused by ingestion of this hazard. This is a serious threat to the survival of wildlife because the ingestion of plastic may obstruct their gastrointestinal tract and reduce the feeding stimulus (Tourinho et al., 2010). Besides entanglement and ingestion of plastics, it may also be used by the 'invader' species that stick on the item. This may then introduce polychlorinated biphenyls in the new food web (Derraik, 2002).

1.3 Marine Debris Pollution in Malaysia

Many marine pollution studies had been done in Malaysia but very few of these studies involved pollution by marine debris. A study in Terengganu reported that plastics were the most abundant type of marine debris, similar to many other regions in the world (Chan et al., 1996). Similar result was recorded in The International Coastal Cleanup for Malaysia where 48% of the debris came from land-based activities (ICC, 2007). Fishing gear had been documented as one of the additional factor that contributes to the extinction of marine turtles in Malaysia (Chan, 2006). However, literature on impacts of marine debris to other wildlife in Malaysia is almost unavailable.

Although published papers on marine debris in Malaysia are very much scarce than other country, it does not indicate the non-existent of the problem. For the locals, they are familiar with beaches that cannot be used because of the presence of litter on beaches and near shore area. Although scientific papers usually did not reach the general public, they are often alerted on marine pollution via news from local newspaper or brochure from campaigns. Additionally, the number of studies conducted to analyze the seriousness of the marine debris issues is very lacking. Therefore, it is crucial that appropriate studies are conducted to investigate this arising problem while generating data and collecting information on the scenario of Malaysian beaches.

1.4 Objectives of the study

This study focused on the solid waste management on beaches along Malaysian shores. The data from this study is needed since very few studies were done on this subject in Malaysia. Solid waste disposal on beaches need some attention since it is often neglected despite the negative impacts it may create. Disposed and abandoned in large quantity and in a continuous manner, crucial attention is needed to manage this waste. Therefore, this study aims:

- i. To compare the abundance, composition, and rate of accumulation of solid waste between selected recreational and fishing beaches in Malaysia.
- ii. To identify possible sources of solid waste on selected beaches.
- iii. To study current management of Malaysian beaches.
- iv. To propose an index addressing solid waste debris on Malaysian beaches for evaluation purposes.
- v. To assess public opinion and attitude on marine issues.