CHANGES IN SMALL ISLANDS OF TOURIST DESTINATION CASE STUDY: TURTLE ISLANDS PARK, SANDAKAN, SABAH

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ABSTRACT

Tourists are fascinated with small islands trip for many purposes. In addition to their natural beauties the islands may be calm, isolated area and pollution free from mainland. Most of the small islands in Sabah, Malaysia have been promoted to tourists as diving, snorkeling, swimming and sun bathing destination. However, the main tourist attraction for Turtle Islands Park (TIP) is for turtle landings and laying their eggs. It is located 40 km north of Sandakan and are gazzeted as a park in 1977 under the jurisdiction of Sabah Parks. Beach erosion is one of the serious problems in TIP. It is a major threat to Sabah Parks's shore-based facilities and turtle nesting. This study aimed to identify the shoreline changes and the most dynamic part of the two islands in TIP. Aerial photos in 1970 and 1996 were collected from various departments and merged to examine the shape of the islands. Field trips in February and June 2011 were conducted to record the coordinates of the shoreline and vegetation areas by using Global Position System. The aerial photos and field data were analyzed using ArcGIS version 9.3 software. Results show that major changes of the island have occurred since 1970. Most of the original trees seen on aerial photos in 1970 were gone and the coastal vegetation identified during the field trip was new and small in size. Severe erosion occurs within the Selingaan Island while large amount of sediment loss in the southern part of the Gulisaan Island is evidenced that erosion contributes to reduce the area of nesting ground. During the field trip, there was no sign of new beach erosion in Selingaan but southern part of Gulisaan Island. The impact of the monsoons season to the beach erosion is not clear because the eroded area is not concentrated in one direction only. Actions have been taken by Sabah Parks to protect the islands by setting up the reef balls and stone revetment in Selingaan Island. However, it is only effective to one side of the island while erosion continuously occurs on other side of the island. Further actions are needed to maintain the beach that is highly important for the turtles, which is playing an important role as tourist attraction.

Keywords: Tourist, shoreline changes, marine park, small island, Turtle Islands Park.

1.0 INTRODUCTION

Tourism sector has become a major contributor to the Malaysian economy in term of GDP, investment and employment, and it is the third largest source of income from foreign exchange (Mulok, et. al, 2012). Marine resources such as coastal and water-based activity have become the major attraction for the tourism industry. It becomes a great tourism asset and one of the important iconic destination images for Sabah (Rosmalina Abdul Rashid, 2012). However, small islands are quite vulnerable to natural disaster event and anthropogenic impacts.

Turtle Islands consist of 5 islands where 3 islands (Selingaan, Bakkungan Kechil and Gulisaan Islands) belongs to Malaysia and under the jurisdiction of Sabah Parks (UPM, et al. 1996). The rest of the islands belongs to the Philippines. Sabah Parks estimates that the Turtle Islands Park (TIP) covers an area of 17.4 km^2 (Figure 1). The biggest island is Bakkungan Kechil followed by Selingaan and Gulisaan Islands. Major threats of these islands are beach erosions on land elevation less than 3.5 m above mean sea level (Abdullah and Musta, 1999). Shoreline erosion in TIP is affected by many factors such as wind speed, storm frequency, sediment or rock type and its porosity. Therefore, sediment transported along the coastal area is also vulnerable to tidal waves and wind-generated waves. Equatorial climate with warm and

humid conditions exposes this area to heavy rainfall and different wind regimes during seasonal monsoons.

Tourists visit different places for different reasons such as diving, snorkeling, swimming and sun bathing but the key attraction of TIP to tourists is somehow unique. TIP is one of the important tourist destinations in Sandakan, Sabah for the watching activities of turtle landings and laying their eggs. Based on the Sabah Parks records, the number of visitors arrived to the park can be up to 14,000 per year (Lasuin et al, 2011). Therefore the existence of the sandy beaches as part of turtle egg laying area is considered as one of the highest economic value on the island. However the size of the beach is decreasing due to severe beach erosion. Loss of sandy beach may have great impact to turtle conservation activities and tourist revenue to Sabah.

Understanding the potential changes in the sediment sources and supply of the TIP with environmental change is an important key to estimate the present and future of its beach stability. This study was conducted to assess the shoreline dynamic processes and to identify the most dynamic part of the islands for further management plan.

2.0 METHODOLOGY

Study of shoreline changes and beach erosion for Selingaan and Gulisaan islands in TIP were carried out based on field observation to identify the present condition. Field surveys were conducted on 17-18 February 2011 and 19-20 June 2011 to cover the northeast and southwest monsoons, respectively. Secondary data such as Global Positioning System (GPS) reading and aerial photos from different Government Departments were analysed to give better understanding of the islands changes in the past.

Aerial photos on 26 September 1970 and 2006 collected from Land and Survey Department and Forestry Department, while photos in August 2000 and in 2008 were provided by Sabah Parks. Multispectral Digital globe Satellite Imagery in 2010 was overlaid with the coordinates from GPS (Garmin, model GPS Map 60CSX) for vegetation line and land areas taken during the field trip in 2011. The ground checking and observation based on 2011 site visit were also cooperated in this study. Available data were analysed and overlayed by using ArcGis 9.2 software. The outputs were presented as a map to show and to compare the shoreline changes in Selingaan and Gulisaan Islands.

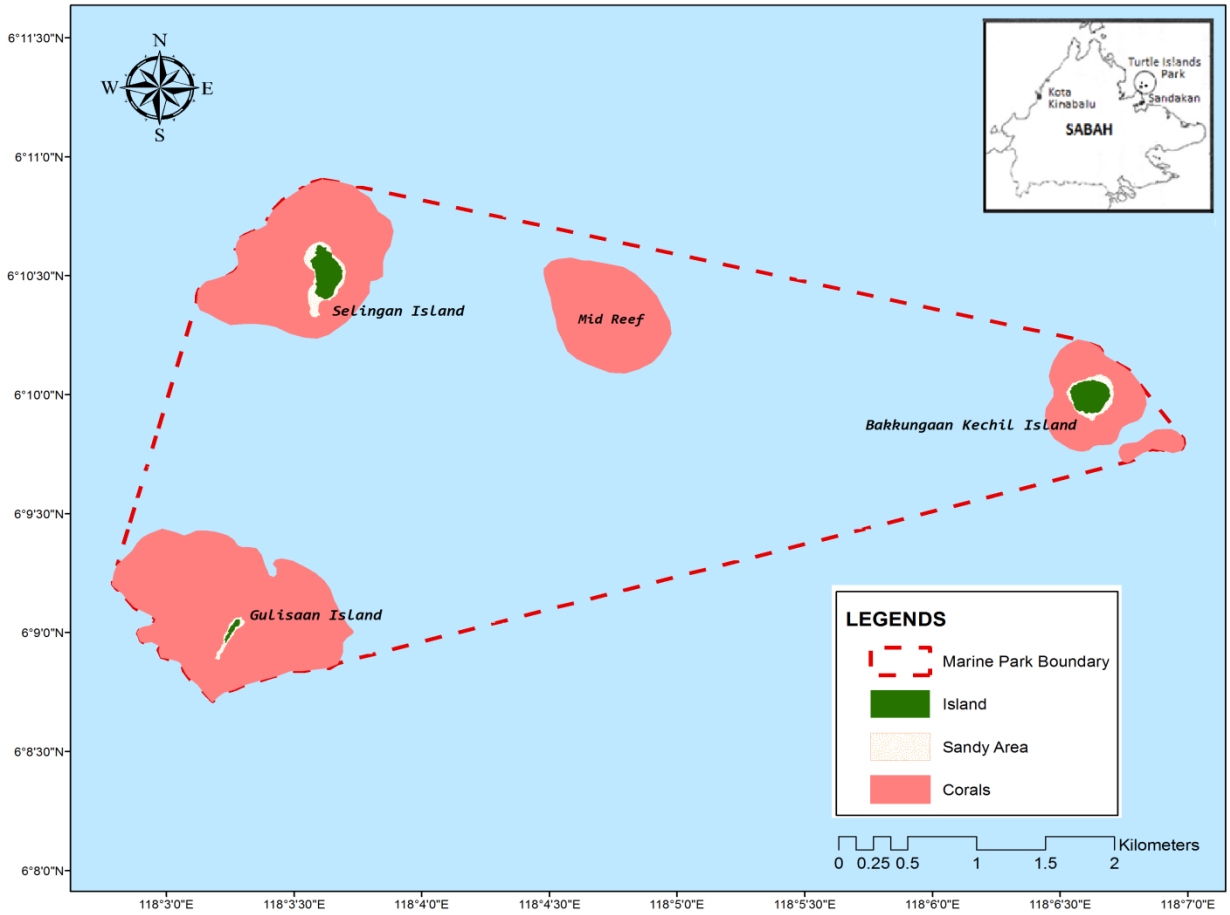

Figure 1: Location of the Turtle Islands Marine Parks

3.0 RESULTS

The onset of the northeast monsoon is in October and the peak is from December to February. Based on the interview with the Sabah Parks officer in charge in TIP, during these months, the Sabah Parks staffs sometimes were unable to travel to Sandakan to replenish their food supply while fishers in small boats were unable to go to sea. Rough sea conditions decreased the tourist arrival in this island. The impact of the southwest monsoon could be seen between July and October. The weather is unpredictable but the sea is not as rough as during the northeast wind. This wind system is believed to contribute significantly to shoreline changes and sand distribution in TIP.

3.1 Selingaan Island

The shape of the Selingaan Island (photos are not in the same scale) had changed through time (Figure 2a-c). In 1970s, Selingaan Island was mainly covered by coconut trees and formed by large area of sandy beach (Figure 2a). This island was also surrounded by coral reef which was important as source of beach sediment. Through time, the beach around the island was slowly eroded. Based on the aerial photo in 2000, most of the surrounding beach a eroded to form triangle island shape (Figure 2b). Within 30 years, sandy beach area in the north was gone to form a large area of rocky shore. The land areas where most of the old coconuts tree

stood that could be seen in Figure 2a had disappeared. Only the middle part of the island observed in 1970 was left in 2000. Most of the vegetation in the island was considered young based on the size and height of the trees. Basic infrastructures such as office and accommodation of Sabah Parks' staff were built in the south eastern part of the island. Dense vegetation could be seen at the surrounding area.

According to the Sabah Parks' ranger who worked in this island for many years, the sediment at the island would shift according to the seasonal monsoon. During the northeast monsoon, the beach in the east side was basically eroded and the sediment loss would accumulate in the southern part of the island. Most of the sediment would be back to the original location when wind direction changed to the southwest monsoon.

Recently, unexpected change of weather pattern had affected the dynamic shifting of sediment around island where the amount of sediment accumulated in certain area of the island was reduced and affected the sea turtle nesting area. Severe erosion at the south eastern beach had damaged the vegetation areas and Sabah Parks' basic facilities on the island. Shoreline protection has been setup to protect the beach from erosion especially at the developed area but the shape of the island had been still significantly changing (Figure 2c).

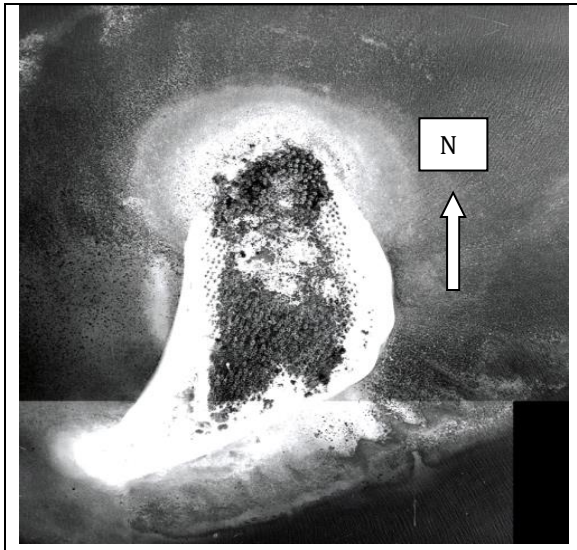	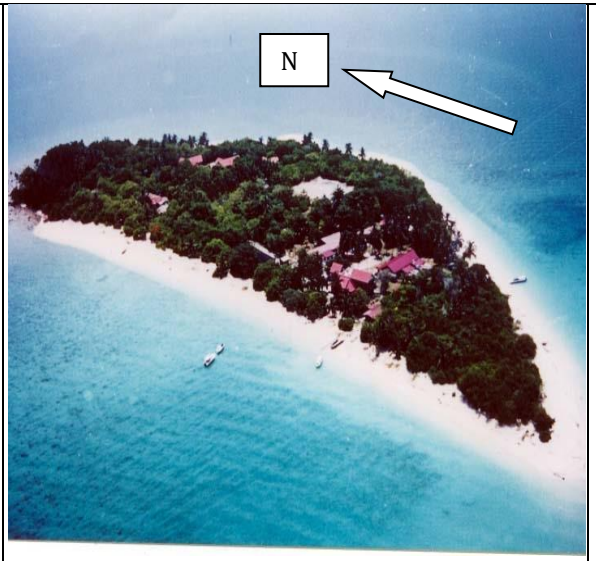	
Figure 2a: Aerial photo of Selingaan Island on 26 September 1970, (Lands and Surveys Department, 2011). Arrow indicating North.	Figure 2b: Aerial photo of Selingaan Island on 08 August 2000 (Sabah Parks, 2011). Arrow indicating North.	Figure 2c: Aerial photo of Selingaan Island in 2008 (Sabah Parks, 2011). Reef ball and stone revetment are built at the south of the island. Arrow indicating North.

During the site visit on 17 February and 19 June 2011, it can be seen that the north-eastern part of the Selingaan Island had a steep slope and short beach. Coral rubble and rocky beaches formed in the northern part of the island. Fine sand sediment was clearly seen and accumulated at the southern part and formed an important role as a nesting area for turtles. Human activities such as sun bathing, swimming and snorkelling were also conducted in this area.

The aerial photos showed that most of Selingaan Island beach was affected by erosion and eroded sand seems to be deposited in the southern part. No clear change of vegetation area between 2010 and 2011 but the positions of sediment were slightly changed due to change of seasonal monsoon (Figure 3). Based on shoreline overlayed results showed that the southern part of the Selingaan Island was the most dynamic part and it needed urgent attention from Sabah Parks although reef balls and stone revetment were built to stablise and shelter the island from beach erosion (Figure 2c).

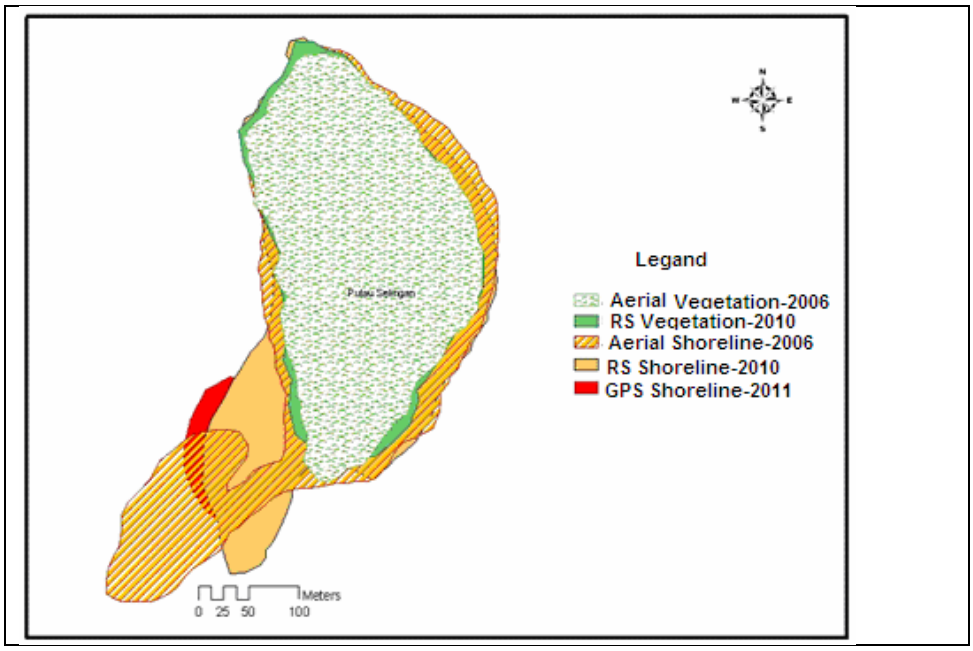

Figure 3: Shoreline changes in Selingaan Island

Based on the aerial photo in 2006 (aerial vegetation-2006), the vegetation area was shrinking due to beach erosion. But the widen of the beach was also observed in some areas probably due to increase of sediment from the sea bed (Figure 3). Sediment accumulated in the south spreaded further southwest with small connecting area to the island (aerial shoreline-2006). According to the park rangers, strong wind in 2007 had eroded most of the fringing trees of island. The eroded area was replaced by creeping vegetation and increase of vegetation cover was detected in remote sensing data in 2010 (RS vegetation-2010). Sediment had accumulated at the west side of the southern part of the island (RS shoreline-2010). During the site visit in 2011, the creeping vegetation was covering as same area as shown in 2010 but accumulated sediment at the south had slightly shifted to the left (GPS shoreline-2011) compared to the remote sensing photos in 2010.

3.2 Gulisaan Island

Gulisaan Island is located at southern part of the TIP (Figure 1). Field observation indicated that Gulisaan Island has the most dynamic beach in the TIP where the Sabah Parks office has shifted 4 times due to beach erosion while the turtle hatchery has been moved into middle of the islands. The size and vegetation cover shrunk through time (Figure 4a-c, photos are not in the same scale). Personal communication with Sabah Parks' rangers in Selingaan and Gulisaan islands, the beach in the southern part of Gulisaan Island was mainly eroded by strong waves especially during the peak of the south west monsoon. In 1970s, the Gulisaan Island was surrounded by wide sandy beach and dense vegetation (Figure 4a). Coconut trees were abundant in the northern part of the island.

Current structures around the island formed a long narrow sandy bank (a spit) in 2000 and 2008 (Figure 4b and 4c). The location and shape of the sandy bank had gradually changed depending on the energy induced by surrounding waves and currents. The north-south sandy banks could be clearly seen during the low tide. The sand bars were formed by sediment from the eroded beach or deposit of marine plants and animals skeletal remains. The coral reef and other marine life surrounding the island played an important role as sediment source and formation of the island.

During the site visit on 18 February 2011 and 20 June 2011, huge trees had fallen over along the west side of the island. Severe coastal erosion occured in this area compared to the eastern part of the island. Most of the surviving vegetation was small in size and affected by beach erosion. Creeping vegetation (e.g *Ipomoea*sp) dominated the island vegetation. Deposition of sediment and drifted logs from elsewhere were seen stranded in the southeast areas.

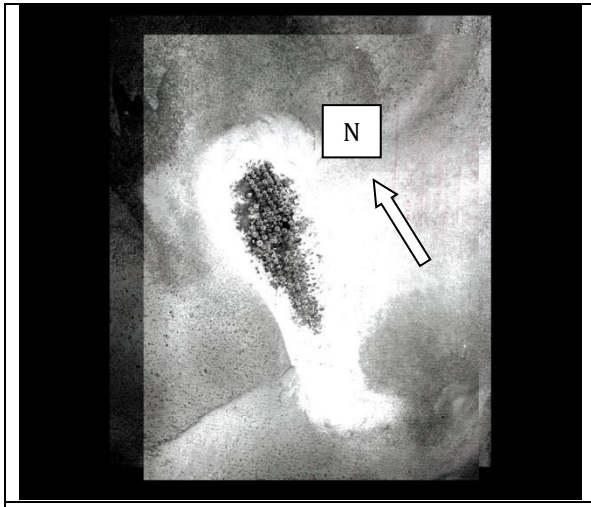	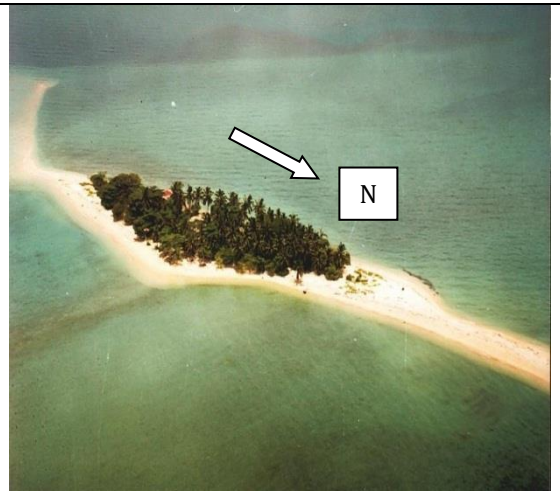	
Figure 4a: Shape of the Gulisaan Island on 26 September 1970, (Lands and Surveys Department, 2011). Arrow indicating North.	Figure 4b: Shape of Gulisaan Island on 08 August 2000(Sabah Parks, 2011). Arrow indicating North.	Figure 4c: Shape of Gulisaan Island in 2008 (Lands and Surveys Department, 2011). Arrow indicating North.

Beach erosion occurred around the island (Figure 5). Generally large amount of sediment would accumulate in the southern part of the island. From the field observation in 2011, the sand in this island was generally dryer than Selingaan islands due to less vegetation cover. Shallow root systems of some vegetation undermine roots holding capacity to the soil and allowed faster beach erosion. The staff of Sabah Park observed that turtles searching for suitable nesting areas ended up on the other side of the island due to limited beach area for nesting. Previous turtle nesting was also affected by the beach erosion. Fallen trees by beach erosion and stranded logs from mainland also prevented the turtle beach for nesting.

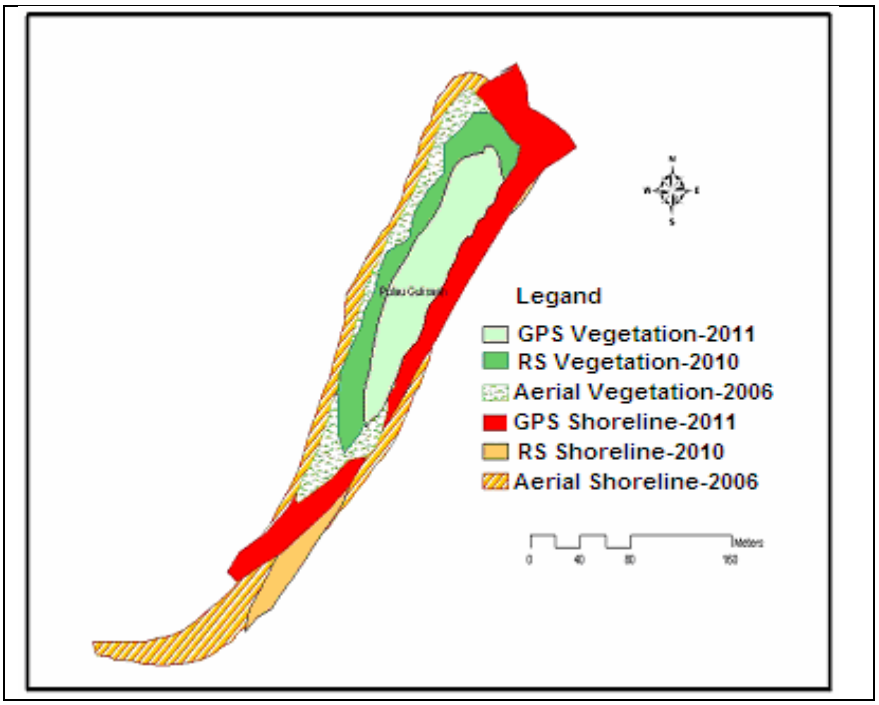

Figure 5: Shoreline changes of Gulisaan Island

Based on the aerial photo in 2006 (Aerial vegetation-2006), the vegetation covered the south and northern part of Gulisaan Island (Figure 5). The vegetation coves were likely eroded from west side of the island where large vegetated area detected in 2010 (RS vegetation-2010) but during site visit in 2011, (GPS vegetation-2011) only the middle of the island was covered by patches of trees and grasses. Large area of sediment accumulated around this island and exposed sediment is starching to the south of the island and could be seen from the aerial photos in 2000 (Figure 4b). Shoreline in 2010 (RS shoreline-2010) showed that the sediment in the south of the island decreased and shifted to the right compared to in 2006 (Aerial shoreline-2006). In the following year (GPS shoreline-2011) the tip of the sediment accumulated in this area shifted further to the left.

4.0 DISCUSSION

All the islands in TIP are under the protection of the Sabah Parks, therefore human activities are limited and erosion due to land use change is minimised. Based on current facilities available in Selingaan Island, only 50 tourists are allowed to stay per day (Lasuin, et al, 2011). Tourists are using the beach at eastern side of this island for swimming, snorkelling and sunbathing while waiting for the sunset to watch turtles laying eggs.

Almost all shoreline areas formed by sandy beach was dominated by coral rubbles and broken shell. Steep sloping eastern part of Selingaan Island need contributed to a higher rate of its shoreline erosion. Turtles laying eggs and coastal vegetation cover were among biological factors that could contribute to sediment dynamics on the beach. High frequency of turtle landing on the island and the present of tourists could potentially change the composition of the beach. Tracing of turtle trek could mix up the composition of the sand while almost all tourists staying on the island spent most of their time on the beach. According to Abdullah and Musta, (1999) the size of the Selingaan Island was 8 hectares but no further explanation on the size referring to shoreline or the vegetation line of the island was given.

Currently the Gulisaan Island is not open for tourists. Gulisaan has a long spilt consisting of coral rubble and biogenic remains (corals) materials supplied by the surrounding coral reef area. During the field visit on 18 February 2011 and 20 June 2011, coastal trees at backshore had clearly eroded and the fallen trees stop the turtles from going further inland for nesting. Unconsolidated sediment by turtles nesting activities exposed the inland trees to erosion. Creeping vegetation (e.g *Ipomoea* sp.) that were normally found on the sheltered beach also disappeared by the erosion. There are 3 categories of shoreline problems in Malaysia (Irrigation and Drainage Sabah, 2011). Based on the field observation, the beach erosion in those islands fell into category 1 which was considered as critical where greatly affecting the turtle nesting and infrastructures on the island. The size of the island got smaller and narrower while the shape changed according to the monsoon winds. Turtles came inshore to lay eggs but from observation, they ended up to the other side of the island.

Chiew (2008) reported that Sabah experienced annual rainfall more than 10% higher during 2000-2007 as compared 1990-1999. High rainfall sometimes tied with rough sea and strong wave to the shoreline. Limitation of sediment source could lead to shore erosion. Chiew, (2008) also reported that Malaysia experienced positive annual mean temperature trends from 1968 to 2002 with estimated air temperature increased from 0.7^{o}C to 1.3^{o}C per half century. Creeping vegetation covering the sandy areas would dry easily with high air temperature. High creeping vegetation cover could be seen during rainy season. Beach erosion highly affected the exposed area of the islands. Change of meteorological conditions could also vary the current pattern and wave characteristics around the islands which contributed indirectly to the distribution of the beach sediment.

Based on tide gauge record data, National Hydraulic Research Institute of Malaysia (2010) reported that the general trends in sea level rise along Malaysia's

coastlines in the last 5 years was significantly higher than the general trend corresponding to the previous 20 years where Sandakan, the closest tide gauge station to Turtle Island had an average of sea rise rate of 4.1 mm/year which was more than twice of global average value which was 1-2 mm/year (IPPC, 2007). The sea level rise and other meteorological events contributed to faster sediment lost than expected.

5.0 CONCLUSIONS

TIP is one of the high potential areas for recreational and leisure activities of sand-sun-sea (3s) in the East Coast of Sabah.The beach dynamics around the islands is clearly affected by the many factors including the change of seasonal monsoons. The dynamics of erosional and deposition areas in each island are due to combination of individual exposed areas to the monsoonal wind direction, wind speeds and current patterns. Loss of beach can be clearly seen in the eastern parts of Selingaan Island and severe beach erosion observed on the west side of Gulisaan Island. The sediment is accumulating in the southern part of both islands. Formation of a submerged offshore sandbank may change the bathymetry and directions of the current around the island. Unexpected extreme event such as strong wind due to typhoon in the Philippines has high potential to change the dynamics of sandy beach in Turtle Islands.

Beach erosion is the main challenge in TIP. It affects the turtle nesting ground which is supporting more the 1000 turtles landing yearly (Isnain, 2008). Immediate action is desirable on severe erosion in TIP particularly in the Gulisaan Island. Long term and cost effective shoreline protection needs to be implemented to maintain the presence of beach that is highly important for the turtle nesting and as tourist's attraction to the islands. However, detailed studies on its surrounding environment, coastal processes including beach profiling and current dynamics need to be considered before the implementation of any hard structures protection in the island.

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