



Universiti Malaysia
KELANTAN

**DIVERSITY ASSESSMENT OF NON-MANGROVE
TREE SPECIES IN DELTA TUMPAT, KELANTAN**

by

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DECLARATION

I declare that this thesis entitled “Diversity Assessment of Non-mangrove Tree Species in Delta Tumpat, Kelantan” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Diversity Assessment of Non-mangrove Tree Species in Delta Tumpat, Kelantan

ABSTRACT

Non-mangrove species are valuable but the number and total species available at Tumpat are rarely unknown. The aim of this study is to assess the diversity of non-mangrove tree species in Delta Tumpat, Kelantan and to compare the number of individual of non-mangrove tree species at both disturbed and undisturbed areas. The study was conducted in Delta Tumpat, Kelantan from September to October 2016. Plots of rectangular shape with a dimension of 20m×10m were set up at 10 plots for disturbed and undisturbed area and the location area was randomly selected. The total area for this study was 0.2 ha for each disturbed and undisturbed area. Based on this study, the results showed nine different species of non-mangrove tree species has been found which are *Acanthus ilicifolius*, *Acrostichum aureum*, *Cocos nucifera*, *Derris trifoliata*, *Hibiscus tiliaceus*, *Ipomoea pes-caprae*, *Nypa fruticans*, *Pandanus helicopus* and *Terminalia catappa*. The number of individual of non-mangrove tree species at undisturbed area was higher than in disturbed area with 235 tree for undisturbed and 85 for disturbed area. Besides, the diversity value of non-mangrove tree species in undisturbed area is higher diverse with Shannon-Wiener Index (H') = 0.86 as compared to disturbed area which has a less value with (H') = 0.65. In addition, the value of Simpsons' Diversity Index (D) for undisturbed area also higher than disturbed area with D = 1.52 for undisturbed area and D = 1.49 for disturbed area. The value showed that undisturbed mangrove areas are more diverse compared disturbed mangrove area. Species richness community increase as the value index increase.

Penilaian Kepelbagaian Spesies Pokok Bukan Bakau di Delta Tumpat, Kelantan

ABSTRAK

Spesies bukan bakau adalah bernilai tetapi bilangan dan jumlah spesies didapati di Tumpat jarang diketahui. Tujuan kajian ini adalah untuk menilai kepelbagaian spesies dan untuk membandingkan bilangan individu bukan bakau di kedua-dua kawasan yang terganggu dan tidak terganggu di Delta Tumpat, Kelantan. Kajian ini telah dijalankan di Delta Tumpat, Kelantan pada bulan September hingga Oktober 2016. 10 plot segi empat tepat dengan ukuran 20m×10m telah dibina di kawasan terganggu dan tidak terganggu dan kawasan untuk kajian ini telah dipilih secara rawak. Jumlah kawasan untuk kajian ini adalah 0.2 hektar bagi setiap kawasan yang terganggu dan tidak terganggu. Berdasarkan kajian ini, terdapat sembilan spesis bukan bakau yang berbeza iaitu *Acanthus ilicifolius*, *Acrostichum aureum*, *Cocos nucifera*, *Derris trifoliata*, *Hibiscus tiliaceus*, *Ipomoea pes-caprae*, *Nypa fruticans*, *Pandanus helicopus* and *Terminalia catappa*. Bilangan individu spesis bukan bakau di kawasan tidak terganggu adalah lebih banyak daripada kawasan terganggu, 235 pokok untuk kawasan tidak terganggu dan 85 pokok untuk kawasan terganggu. Disamping itu, nilai kepelbagaian spesis bukan bakau di kawasan bakau tidak terganggu adalah $(H') = 0.86$ berbanding kawasan bakau yang terganggu yang mempunyai nilai lebih rendah $(H') = 0.65$ dan nilai $(D) = 1.52$ untuk kawasan tidak terganggu dan $(D) = 1.49$ untuk kawasan terganggu. Nilai ini menunjukkan bahawa kawasan hutan bakau tidak terganggu adalah lebih pelbagai daripada kawasan bakau terganggu dibandingkan. Spesis bukan bakau meningkat apabila nilai indeks meningkat.

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LIST OF ABBREVIATIONS

e.g	-	example
H'	-	Shannon-Wiener Index
ha	-	hectare
IVI	-	Importance Value Index
km	-	kilometre
m	-	metre
NaCl	-	Sodium Chloride

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CHAPTER 1

INTRODUCTION

1.1 Background of study

In Malaysia, mangrove covered about 565 000 ha where 16% of the area was distributed along the west coast of Peninsular Malaysia (Shamsudin and Nasir, 2005). Mangroves are tropical species restricted by frost and vegetative competition to intertidal regions in tropical and subtropical sheltered water bodies. The species composition and structure of plant in mangrove forest depend on their physiological tolerances and competitive interactions (Alongi, 2008). Mangrove forest provides various ecological functions such as inundation and flood control and protection from soil erosion, storm and wave damages.

Mangrove vegetation has been classified into two categories which are true or exclusive mangrove species and associated mangrove species (Wang *et al.*, 2010). True mangrove species has defined as mangrove tree species such as *Rhizophora mucronata*, *Rhizophora apiculata*, *Bruguiera gymnorhiza* and *Sonneratia caseolaris*. Meanwhile, there are several type of plants that can live at or around the mangrove forest that known as associated mangrove species such as ferns (e.g: *Acrostichum aureum*), herbs (e.g: *Acanthus ilicifolius*), palms such as *Nypa frutican* and shrub (e.g: *Derris trifoliata*).

Even though mangroves are not an ideal growing environment for herbs, but a few are exceptionally resilient. In addition, ferns are delicate plants that only grow in areas where there are suitably moist conditions so ferns can live at mangrove area.

Associated mangrove species or non-mangrove tree species are utilised as roof, food, and some species can be use as medicinal purposes which can act as one of economic sources for our country. Preservation and conservation are needed to maintain the species population and the mangrove area.

A study is to assess the mangrove vegetation at Tumpat based on ground-truth and remote sensing measurements have been conducted by Satyanarayana et al., (2011). Based on the study, combination of ground survey and remote sensing provided valuable information for the assessment of mangrove vegetation types in Tumpat, Kelantan. This current study aimed to assess the diversity of non-mangrove tree species and to compare the number of individual of non-mangrove tree species at both disturbed and undisturbed areas in Delta Tumpat, Kelantan.

1.2 Problem statement

Study diversity of non-mangrove tree species especially in Delta Tumpat is very scarce. Although non-mangrove species are valuable but the number and total species available at Tumpat are rarely unknown. Therefore, this study was carried out to review the diversity of non-mangrove tree species especially on located at disturbed and undisturbed area.

1.3 Objectives

These objectives of this study were:

1. To assess the diversity of non-mangrove tree species in Delta Tumpat, Kelantan.
2. To compare the number of individual of non-mangrove tree species at both disturbed and undisturbed areas.

CHAPTER 2

LITERATURE REVIEW

2.1 Mangrove Forest and Vegetation

Mangrove forest is located along the sea and consists of a unique and variety of flora and fauna (Cannicci *et al.*, 2008, Nagelkerken *et al.*, 2008). In addition, mangrove forest offers many functions such as protection against the disasters like tsunami and flood (Kathiresan and Rajendran, 2005). Plant of mangroves is generally divided into two groups, which are true or exclusive mangrove species and associated mangrove species. True mangrove species is mangrove tree species such as *R. mucronata*, *R. apiculata*, *R. mangle* and *A. alba* while for associated mangrove species are the non-mangrove species such as *Acrostichum aureum*, *Acanthus ilicifolius*, *Nypa fruticans* and *Derris trifoliata* live in mangrove (Satyanarayana *et al.*, 2011). Mangrove trees have been the source of firewood, poles and charcoal (Shukor, 2004). Besides, mangrove trees are also used for house building, furniture and few household items. Associated mangrove species or non-mangrove tree species are functioning as roof, food, and some species can be use as medicinal purposes which can act as one of economic sources for our country.

Mangrove vegetation is exposed to critical environmental conditions. Some of the critical environments are cycles of drought and heavy rain, inundation, water salinity and aeration of the soil. In other words plants in mangrove forest are continuously exposed to stress but plant at mangrove has special characteristics which is the plant can survive in a harsh and stressful environment (Mastaller, 1997).

2.2 Non-mangrove plants

Besides mangrove tree, other vegetation such as ferns, herbs, palms and shrub also can be found at mangrove forest area. All of non-mangrove plants are known as associated mangrove species that can give benefit to human and has many functions such as medicinal purposes, food, functioning as roof and etc.

Ferns can be found at mangrove area. Ferns are delicate plants that can grow in areas where there are suitably moist conditions that make it suitable to live at mangrove area. Adaptation with saline soil is able to adapt the factor that encourages ferns to live at mangrove area. Ferns are different from the other flowering plants because they reproduce with spores and an intermediate plant stage called a gametophyte. One of the fern that were determined at delta Tumpat in the previous study is *Acrostichum aureum* (Satyanarayana *et al.*, 2011).

Plant that has succulent leaves and stems with no persistent woody tissue is known as herbs. Even though mangroves are not an ideal growing environment for herbs, but a few are exceptionally resilient. The found of *Acanthus ilicifolius* at Delta Tumpat as proved that herbs can grow in mangrove area (Satyanarayana *et al.*, 2011). Another non-mangrove species is from Palmae family. Most palms are distinguished by their large, compound, evergreen leaves arranged at the top of an unbranched stem. Based on the previous research, *Nypa fruticans* was found at Delta Tumpat, Kelantan (Satyanarayana *et al.*, 2011).

In addition, shrub also one of the mangroves associates. Shrub has woody plant that has multiple stems and smaller than a tree. Besides, the number of shrub will be depending on the growing conditions. Based on Raghunathan and Thangaraj (2014), *Derris trifoliata* is the shrub that has been found at mangrove area and it has a medicinal purpose. Besides that, according to Setiu Wetland: Tranquility Amidst Plenty written by Nakisah and Fauziah (2003), *Hibiscus tiliaceus* can be found at mangrove area. *Hibiscus tiliaceus* or known as sea hibiscus is a low spreading tree. It is commonly found along sandy seashores and tidal creeks.

2.3 Disturbed Mangrove Area

The disturbed mangrove area is an area that has been influenced by encroachment activities such as deforestation, tree cutting and reclamation of land for agriculture or housing settlement (Wah *et al.*, 2011). The area is near with the encroachment activity is still known as disturbed area. Usually, plants like true mangrove and non-mangrove tree species and animal like snail at or around the disturbed area will decrease or extinct because of the disturbance by human.

2.4 Undisturbed mangrove Area

The undisturbed mangrove area is opposed with disturbed mangrove area. Undisturbed mangrove area is a healthy ecosystem with more regeneration of seedling and all the plant at this area can live without encroachment activity from man (Wah *et al.*, 2011). Undisturbed area has many species or population of plants and animals at or around the area because it was avoided from disruption from man.

2.5 Diversity Index

In calculating diversity of plants, the common indices used are Shannon-Wiener Index (H') and Simpson's Diversity Index. Based on previous study, Shannon-Wiener Index and Simpson's Diversity Index are used to calculate the diversity of shrub and herbs (Bharali *et al.*, 2011) and were used in order to calculate the diversity of mangrove species in each plot (Wah *et al.*, 2011).

CHAPTER 3

MATERIALS AND METHODS

3.1 Study Area

This research study was conducted at the Delta Tumpat, Kelantan as shown in Figure 3.1. The Delta Tumpat, Kelantan is a distinctive unit in the northeast corner of Malaysia consist about 1500 km² in area and flanking the lower course of the broad, meandering of River Kelantan. The mangroves are distributed in several patches consisting of 17 islands with an estimated total area of 1200 ha. It is located at latitude and longitude of 6°11'-6°13' N & 102°9'-102°14'E. The annual temperature of the area and its surrounding environment is 26.8°C (Satyanarayana *et al.*, 2009).

At Delta Tumpat, Kelantan there are mangrove community that have been categories as true or exclusive mangrove species and associated mangrove species. Some example of true or exclusive mangrove species are *Rhizophora* species and *Avicennia* species. Other than true mangrove species, there are associated mangrove species such as *Acrostichum aureum*, *Acanthus ilicifolius*, *Nypa frutican* and *Derris trifoliata* (Satyanarayana *et al.*, 2011).

3.1 Material and Methods

The comparison of individual of non-mangrove species between disturbed and undisturbed area were carried out during this study. Site was selected using random sampling method. More green in the area are considered as undisturbed mangrove area.

The selected sites for disturbed and undisturbed area were randomly selected. Ten sites were selected for both disturbed and undisturbed areas have been chosen. A rectangular sampling plot of 20m×10m was used in this study as shown in Figure 3.2. The plot was set up at both disturbed and undisturbed site.

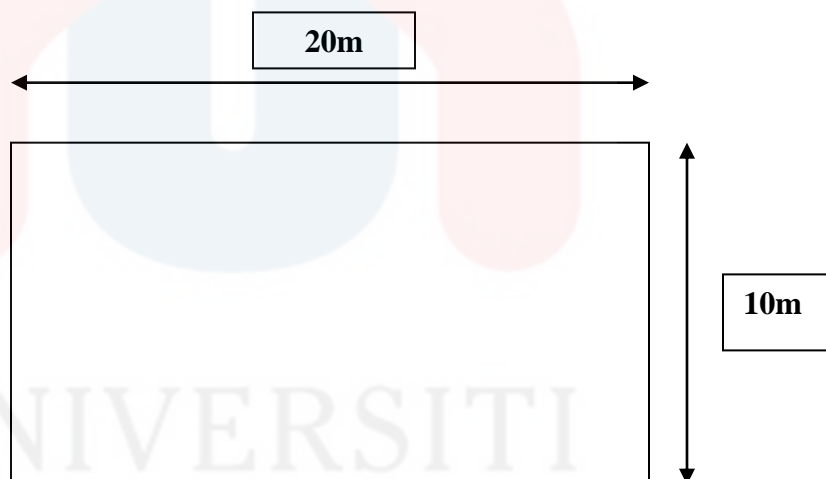


Figure 3.2: Rectangular shape plot (20mX10m)

All the non-mangrove tree species that have been founded within the plot was identified, counted and recorded. The diversity of plants for both disturbed and undisturbed areas was calculated using Shannon-Wiener Index (H') and Simpson's Diversity Index.

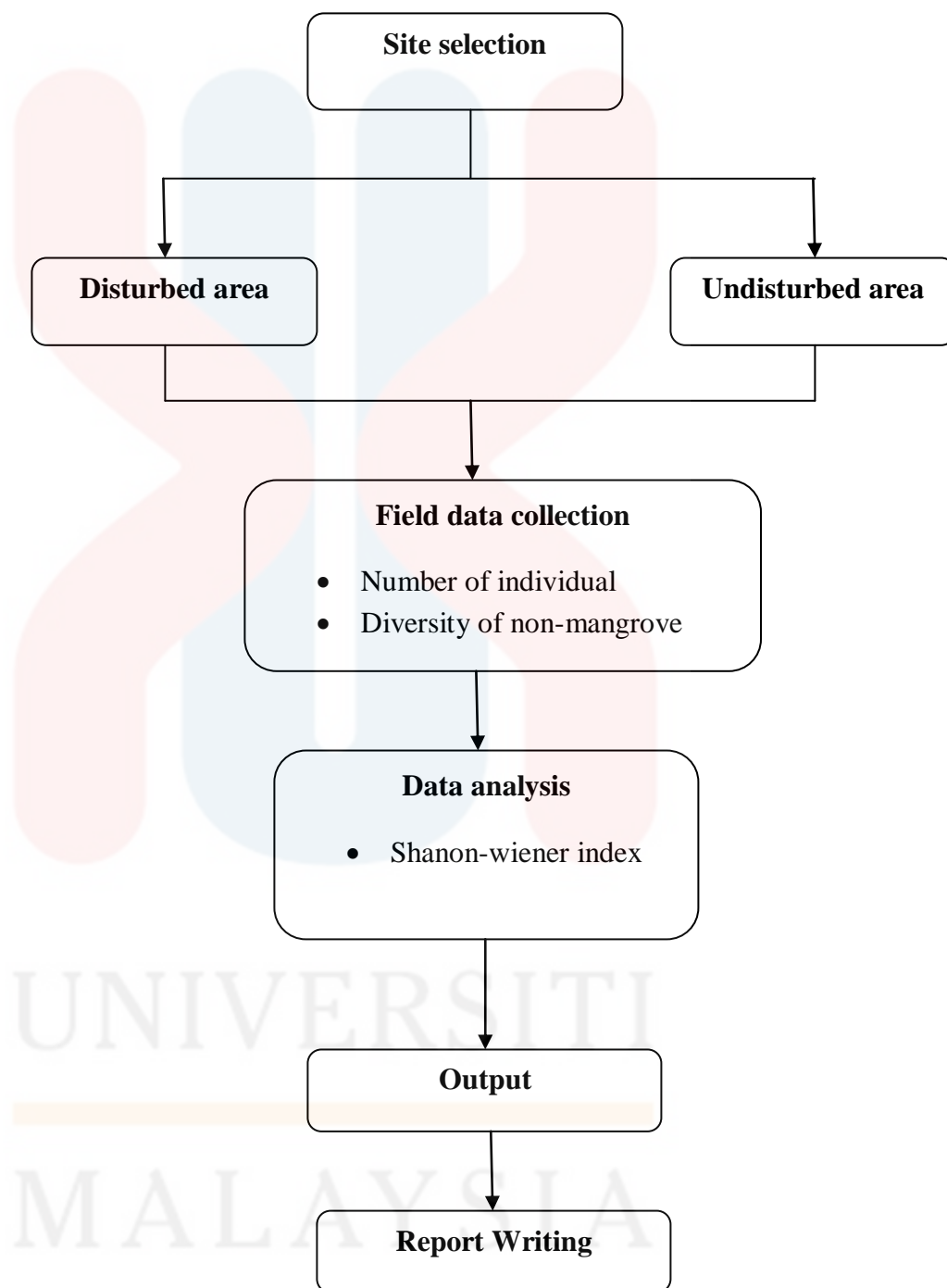


Figure 3.3: Research flow chart

3.2 Data Analysis

The Shannon-Wiener Index (H') and Simpson's Diversity Index (D) was been used to calculate the diversity of non-mangrove tree species in both disturbed and undisturbed areas using Equation 1 and Equation 2. The results of species diversity in disturbed and undisturbed area then compared.

Shannon-Wiener Index:

$$H' = - \sum_{i=1}^R (p_i \cdot \ln p_i) \quad \text{(Equation 1)}$$

Where;

H' = The Shanon-Wiener Index of Diversity

R = The unique species

P_i = The proportional abundance of species i

$\ln p_i$ = The logarithm of the proportional abundance of species i

$P_i = \frac{n_i}{N}$, where

n_i = the number of individuals of species i collected

N = the total number of individuals of all species collected

Simpson's Diversity Index:

$$D = \frac{N(N-1)}{\sum n(n-1)} \quad \text{(Equation 2)}$$

Where;

D = The Simpson's Diversity Index

N = the total number of individuals of all species collected

n = the number of individuals of species collected

CHAPTER 4

RESULTS AND DISCUSSION

The total area of each plot at disturbed and undisturbed area was 0.2 ha each. Four location for undisturbed were located at Pulau Layang-layang, Pulau Bedal, Pulau Nelayan and Pulau Tanjung Duff. Whereas, location for disturbed area were located at Pulau Tujuh and Pulau Kambing.

The total number of trees that has been founded at undisturbed area is 235 and 85 at disturbed area. There were nine species of non-mangrove tree species that has been found at undisturbed area within all plots which are *Acanthus ilicifolius*, *Acrostichum aureum*, *Cocos nucifera*, *Derris trifoliata*, *Hibiscus tiliaceus*, *Ipomoea pes-caprae*, *Nypa fruticans*, *Pandanus helicopus* and *Terminalia catappa*. In the other hand, only four species was found at disturbed area which are *Acanthus ilicifolius*, *Derris trifoliata*, *Hibiscus tiliaceus* and *Nypa frutican* as shows in Table 4.1.

Table 4.1: Overall Data Collection

No.	Content	Undisturbed area	Disturbed area
1.	Area of plots (ha)	0.2	0.2
2.	Number of species	9	4
3.	Number of plants	235	85

Table 4.2: The family group and diversity value index for non-mangrove tree species

No.	Species Name		Family	Frequency	
	Scientific Name	Common Name		Disturbed Area	Undisturbed Area
1.	<i>Acanthus ilicifolius</i>	Jeruju Putih, Sea Holly	Acanthaceae	4	4
2.	<i>Acrostichum aureum</i>	Piai Raya	Pteridaceae	0	5
3.	<i>Cocos nucifera</i>	Kelapa	Palmae	0	4
4.	<i>Derris trifoliata</i>	Tuba Laut	Leguminosae	2	9
5.	<i>Hibiscus tiliaceus</i>	Baru Baru, Kali Bang Bang, Sea Hibiscus	Malvaceae	10	10
6.	<i>Ipomoea pes-caprae</i>	Tapak Kuda	Convolvulaceae	0	4
7.	<i>Nypa fruticans</i>	Nipah	Palmae	69	190
8.	<i>Pandanus helicopus</i>	Pandan	Pandanaceae	0	1
9.	<i>Terminalia catappa</i>	Ketapang	Combretaceae	0	8
Shannon-Wiener Index				0.65	0.86
Simpson's Diversity Index				1.49	1.52

Table 4.2 shows all species collected from different family which are Acanthaceae, Pteridaceae, Palmae, Leguminosae, Malvaceae, Convolvulaceae, Pandanaceae and Combretaceae. Shannon-wiener Index for undisturbed area is higher than disturbed area with the value of 0.86 and 0.65 respectively. In addition, the value of

Simpson's Diversity Index for undisturbed area is 1.52 which is higher than disturbed area with the value of 1.49. From the diversity index value, it showed that undisturbed mangrove areas are more diverse compared disturbed mangrove area. *Nypa fruticans* is the dominant species that has been found with the frequency of 950/ha for undisturbed area and 345/ha for disturbed area. The total number of *Acanthus ilicifolius* for both areas that has been found is same with the frequency of 4. Besides that, the frequency of *Hibiscus tiliaceus* for both area also same which is 10 tree for each area. This is because both of this species can survive and adapt in undisturbed and disturbed area.

There were nine species found in undisturbed area, which are *Acanthus ilicifolius*, *Acrostichum aureum*, *Cocos nucifera*, *Derris trifoliata*, *Hibiscus tiliaceus*, *Ipomoea pes caprae*, *Nypa fruticans*, *Pandanus helicopus* and *Terminalia catappa*. These species found at coastal area and intertidal area. Only four species was found at disturbed areas which are *Acanthus ilicifolius*, *Derris trifoliata*, *Hibiscus tiliaceus* and *Nypa frutican*. Disturbed area is not a suitable place to other plant to grow especially plants that do not have a hard stem.



Figure 4.1: *Nypa fruticans*

Figure 4.1 show the image of *Nypa fruticans* found at Delta Tumpat. *Nypa fruticans* is the frequent species that has been found at both disturbed and undisturbed area. In general, mangrove forests are composed of salt-tolerant plant species that have special adaptations to NaCl stress, including salt-filtering roots and salt-excreting glands on leaves and *Nypa fruticans* is a best species that can adapt to grow in mangrove coastal area with moderate salt load. Besides that, the suitable soils for nipa palms swamp are muddy and clay. This type of soils has a high content of various inorganic salts, calcium and sulphides of iron and manganese and contributing to the typical odour and dark colour. In addition, *Nypa fruticans* is easy to spread at mangrove area because it has prolific powers of reproduction and aggressive growth and expansion (Udoidiong and Ekwu, 2011).

The diversity and the total number of individual of non-mangrove tree species at undisturbed area are higher than disturbed area. Factor that influenced the number of plant species is sand dredging activity at Pulau Tujuh as shown in Figure 4.2. These activities actually disturb the growth of vegetation in the area as they suck the sand from the bottom of the water and threw it to the land that has vegetation. Non-mangrove species such as *Acrostichum aureum* and *Acanthus ilicifolius* as shows in Figure 4.3 and Figure 4.4 are the plant that does not have big stem will easy to die in this situation. Besides that, land reclamation activity is the other activity that influenced the total number and the diversity of non-mangrove tree species at disturbed area as shown in Figure 4.5.



Figure 4.2: Sand dredging activity at Pulau Tujuh

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Figure 4.3: *Acrostichum aureum*



Figure 4.4: *Acanthus ilicifolius*



Figure 4.5: Land reclamation activity at Pulau Kambing

Even though *Nypa fruticans* is frequent species but the number of individual at undisturbed area is higher than disturbed area. Based on the picture, the *Nypa fruticans* had been cut to make the land reclamation activity easier. This activity was occurred at Pulau Kambing and the purpose of this land reclamation activity is to make the river become deeper. This activity happen when some boats cannot through the area because of the land level in the river is thick. When the land reclamation occurred, the land from the bottom river were dredging and the land was been throw at Pulau Kambing and it makes the level of land at this island become increase and water cannot reach at the land surface. When water cannot reach at the surface of land, it makes the land become dry and vegetation such as *Nypa fruticans* cannot live in dry land condition. Besides, it also disturbed other vegetation species such as herbs and shrub.

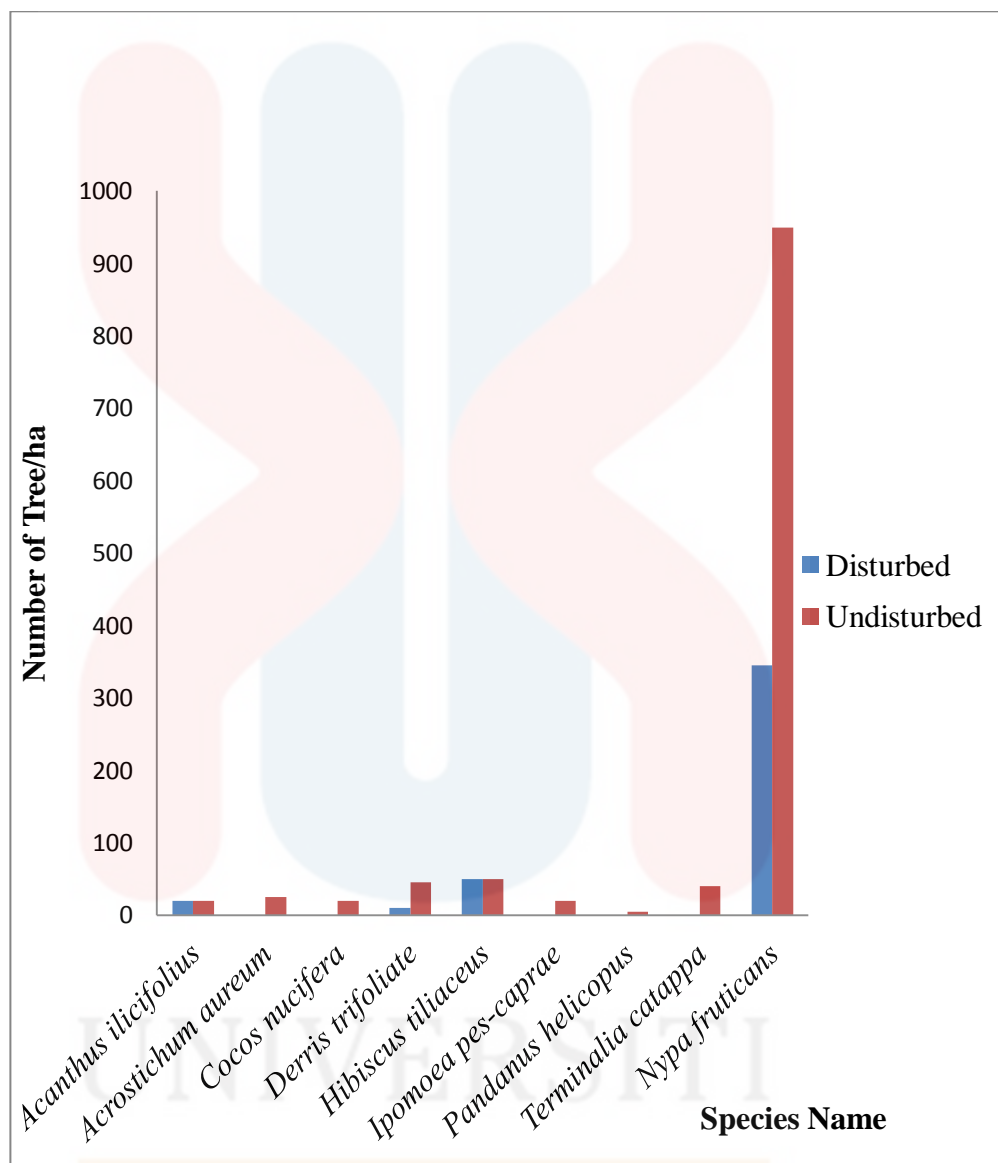


Figure 4.6: Graph of non-mangrove diversity per hectare in disturbed and undisturbed area

Based on the graph, it showed that the estimated number of plant that should be found in 1ha of area. This total number was calculated based on the data of nine species that has been recorded in this study. This result will help to other studies or involved in economic aspect. Nipa is also a useful source of biofuel because it produces

a high amount of sap that can be converted to alcohol (Tsuji *et al.*, 2011) and nipa is able to produce higher yields alcohol compared with other crops (Hamilton and Murphy, 1988) and has two factories produced alcohol from nipa in Sarawak, Malaysia up to 1980's (Chai and Lai 1984). Since the *Nypa fruticans* is a frequent species that been found in Tumpat mangrove area, nipa can be utilized for various traditional purposes and economic aspects by local people. As example, roof can be made from nipa leaves and always called it as "atap nipah". Roof from nipa leaves are still used nowadays and it's become an attractive thing to the younger generation who are familiar with the zinc roof. In addition, the leaves are also used in the art of basket weaving, mats, bags and hats and it can be as a souvenir. Besides that, nipa sap can be use in manufacture of sugar that called as "gula apong". "Gula apong" that made by the local people is used as a flavouring for added flavour of a food or cooking. In addition, this sugar can avoid and reduce diabetes and high blood pressure. Besides to be used in their daily life, all the stuff that is made from nipa species can be sold and it will generate their income. Besides that, other species of non-mangrove tree species are can be utilised as roof, food, and some species can be use as medicinal purposes. All these species are valuable and need to be preserved and conserve for future generation.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This research compared the diversity and number of individual of non-mangrove tree species at both disturbed and undisturbed area at Delta Tumpat, Kelantan. The diversity of non-mangrove tree species were analyse by using Shannon-Wiener Index and Simpson's Diversity Index. The value showed that undisturbed mangrove areas are more diverse compared disturbed mangrove area. As the value index increase, it shows that the place has higher species richness. The number of individual of non-mangrove tree species at undisturbed area is higher than disturbed area.

5.2 Recommendation

In order to obtain more accurate results, more plots must be added. Based on Wah *et al.*, (2011) the total number of plots that has been set up was 30 plots in rectangular shape with a dimension of 20X10m for each plot. Collection of data species must be counted correctly and must analyse the correct of species name. Besides that, self safety is needed during the sampling data session because the lands in the mangrove areas are muddy and slippery. Wear the suitable attire such as boots are recommended to prevent our foot step on sharp thorns or roots and to prevent our foot to step on the some animal such as mollusca. Mangrove area in Delta Tumpat must be conserve and preserve

to avoid extinction of the vegetation. All the vegetation has their own function to stable the ecosystem. In addition, preservation and conservation is needed to make sure that our future generation not loss this biodiversity and can enjoy the nature. Anthropogenic activity such as land reclamation and sand dredging must be reduced to make sure the vegetation at this area can growth well.



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APPENDIXES

Appendix a) Data collection at undisturbed and disturbed area

Undisturbed areas

Plot	Species Name	Frequency
1	<i>Nypa fruticans</i>	28
2	<i>Derris trifoliata</i>	4
	<i>Nypa fruticans</i>	38
3	<i>Nypa fruticans</i>	13
4	<i>Acrostichum aureum</i>	5
	<i>Nypa fruticans</i>	25
5	<i>Nypa fruticans</i>	26
6	<i>Acanthus ilicifolius</i>	4
	<i>Nypa fruticans</i>	30
7	<i>Derris trifoliata</i>	5
	<i>Hibiscus tiliaceus</i>	3
	<i>Nypa fruticans</i>	21
8	<i>Nypa fruticans</i>	9
9	<i>Cocos nucifera</i>	4
	<i>Hibiscus tiliaceus</i>	4
	<i>Ipomoea pes-caprae</i>	1
	<i>Terminalia catappa</i>	5
10	<i>Hibiscus tiliaceus</i>	3
	<i>Ipomoea pes-caprae</i>	3
	<i>Terminalia catappa</i>	3
	<i>Pandanus helicopus</i>	1

Disturbed areas

Plot	Species Name	Frequency
1	<i>Nypa fruticans</i>	15
2	<i>Nypa fruticans</i>	13
3	<i>Nypa fruticans</i>	8
4	<i>Nypa fruticans</i>	9
5	<i>Nypa fruticans</i>	3
6	<i>Acanthus ilicifolius</i>	1
	<i>Nypa fruticans</i>	7
7	<i>Acanthus ilicifolius</i>	3
	<i>Derris trifoliata</i>	1
	<i>Hibiscus tiliaceus</i>	3
	<i>Nypa fruticans</i>	2
8	<i>Hibiscus tiliaceus</i>	2
	<i>Nypa fruticans</i>	4
9	<i>Derris trifoliata</i>	1
	<i>Hibiscus tiliaceus</i>	3
	<i>Nypa fruticans</i>	4
10	<i>Hibiscus tiliaceus</i>	2
	<i>Nypa fruticans</i>	4

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Appendix b) All species that has been found at disturbed and undisturbed area of mangrove forest at Delta Tumpat, Kelantan.



Nypa fruticans



Hibiscus tiliaceus



Cocos nucifera



Acanthus ilicifolius



Terminalia catappa



Pandanus helicopus



Derris trifoliata



Acrostichum aureum



Ipomoea pes-caprae