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SPECIES DIVERSITY AND STUMPAGE VALUATION OF TIMBER RESOURCES AT PASIR TENGKORAK FOREST RESERVE, LANGKAWI, MALAYSIA

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Chairman: Prof. Awang Noor bin Abd Ghani, PhD
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Tropical forest is highly diverse and provides high economic value. It plays an important role in providing goods and services which contributes to long term social benefits to the community. However, the diversity of coastal forests and its economic value are not well understood because previous studies have been mainly focused on lowland and hill dipterocarp forests. This study was carried out to examine tree composition and estimate its economic value of timber resources in a lowland coastal forest. Four one-hectare plots were set up in Pasir Tengkorak Forest Reserves in Langkawi, Kedah and the subplots measuring 10 m x10 m were established in each subplot. All trees greater than 1 cm dbh and above were identified and the parameters measured include tree height and diameter. The total number of trees recorded above 1 cm in the four hectare plots was 13,543 trees comprises of 50 families, 113 genus and 236 species with the dominant families were Guttiferae, Anacardiaceae and Myristicaceae. *Swintonia floribunda* is the most dominant species with the most high importance value (IV). The species diversity indices obtained for all four plots were relatively high. The Simpson's index of diversity ranged from 0.946 to 0.969 with an average of 0.960. The Shannon-Weiner index (H') ranged from 3.808 to 5.616 with an average value of 5.06. For the species evenness, results showed that the Simpson's measure of evenness (1/D) ranged from 0.239 to 0.563. The results suggest that species evenness in the four hectare plots is low. The average basal area is 28.57 m^2 per hectare while the timber volume is 289.17 m^3 per hectare. Stumpage value of timber in the study area is quite high, ranged from RM23,199.87 to RM37,969.37 per hectare with average value of RM 33,600.46 per hectare. Family Anacardiaceae has the highest stumpage value estimated at RM14,379 per hectare which contributes about 42.79% of the total stumpage value. *Swintonia floribunda* Griff. is the species with the highest stumpage value with RM8373.58 per hectare. The results also indicate that the diameter class that contributes the most to the stumpage value is from diameter class above 60 cm. The regression analysis shows that the relationship between stumpage value and species diversity was significant at the 5% level. Policy implications of the study and recommendations for future research are also highlighted.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

KEPELBAGAIAN SPESIS DAN PENILAIAN STUMPEJ SUMBER KAYU-KAYAN DI HUTAN SIMPAN PASIR TENGKORAK,LANGKAWI,MALAYSIA

Oleh

MUHAMMAD HAFIDZ BIN ABDULLAH

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Pengerusi: Profesor Awang Noor bin Abd Ghani, PhD
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Hutan tropika mempunyai kepelbagaian yang tinggi dan menyumbang kepada nilai ekonomi yang tinggi. Ianya memainkan peranan dalam menyediakan produk dan perkhidmatan yang menyumbang kepada faedah sosial jangkamasa panjang kepada masyarakat. Masalah yang timbul yang menjurus kepada kajian ini ialah kepelbagaian spesis di hutan pantai dan nilai ekonominya tidak banyak difahami kerana kebanyakan kajian lepas fokus kepada hutan dipterokarpa tanah pamah dan bukit. Implikasinya, dikhuatiri kawasan hutan pantai akan semakin hilang kepada kegunaan yang lain. Objektif kajian ini dijalankan adalah untuk memeriksa komposisi pokok dan menentukan nilai ekonomi sumber kayu di satu kawasan hutan tanah rendah pantai. Empat plot kajian (100 m x 100 m) ditetapkan di Hutan Simpan Pasir Tengkorak, Langkawi, Kedah dan subplot berukuran 10 x 10 m ditanda dalam setiap plot. Semua pokok berdiameter 1 cm ke atas dikenalpasti dan parameter yang diambilkira termasuk diameter dan tinggi pokok. Jumlah pokok yang berdiameter 1 cm ke atas direkodkan dalam empat hektar plot ialah 15,543 pokok yang terdiri dari 50 famili, 113 genera dan 236 spesis yang mana didominasi oleh Famili Guttiferae, Anacardiaceae dan Myristicaceae. *Swintonia floribunda* merupakan spesis yang paling dominan dengan nilai kepentingan (IV) yang paling tinggi. Indeks Kepelbagaian Spesis yang didapati dalam keempat-empat plot adalah tinggi. Indeks Kepelbagaian Simpson mencatatkan nilai antara 0.946 to 0.969 dengan nilai purata 0.960. Indeks Shannon-Weiner (H') di kira antara 3.808 hingga 5.616 dengan nilai purata 5.06. Kesamaan spesis di kawasan kajian dikira dengan menggunakan Pengukur Kesamaan Simpson (1/D) yang mendapat hasil 0.239 hingga 0.563. Hasil keputusan itu menunjukkan kesamaan spesis adalah rendah. Purata keluasan pangkal dasar pokok dalam empat hektar plot ialah 28.57 m^2 per hektar manakala jumlah keseluruhan isipadu kayu ialah 289.17 m^3 per hektar. Keputusan menunjukkan nilai stumpej adalah tinggi dari RM23,199.87 hingga RM37,969.37 per hektar dengan nilai purata RM33,600.46 per hektar. Famili Anacardiaceae mencatatkan nilai stumpej tertinggi dianggarkan berjumlah RM14,379 per hektar yang juga 42.79% dari jumlah keseluruhan. *Swintonia floribunda* Griff. ialah spesis yang mempunyai nilai stumpej tertinggi iaitu RM8373.58 per hektar. Kelas diameter yang paling menyumbang kepada nilai stumpej ialah dari kelas diameter 60 cm ke atas. Analisis regresi menunjukkan hubungan antara nilai stumpej dan kepelbagaian spesis adalah signifikan pada tahap 5%. Implikasi dari kajian ini dan cadangan untuk penyelidikan yang akan datang juga ditunjukkan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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FAO	Food and Agriculture Organization
MTC	Malaysia Timber Council
MTIB	Malaysian Timber IndustryBoard
SMS	Selective Management System

CHAPTER 1

INTRODUCTION

1.1 General Background

Forests in Malaysia are classified as tropical rainforest which is believed to be the oldest and most complex ecosystem in the world. Two of the main characteristics of tropical rainforest are the fast growth of plant species and also unbeatable diversity of the species. Malaysia enjoys the diversity of plant species in a sustainable ecological environment with the large area of forested area and stable climate.

It is estimated that there are about 14,500 of flowering plant species in Malaysia Tropical Rainforest and from that amount, about 9,000 of the species are located across the Malaysian Peninsular. It includes 3,000 of tree species, 1,000 orchid species, 300 species of palms and 500 species of ferns. About 677 of timber species which comprises of 168 genus have commercial value (NRE, 2006).

The mega diversity of flora and fauna species available has made forests one of the important natural resources which provide multi basic needs for mankind. The roles of forest range from the economic, social and environmental benefits to the local and global community.

From the economic perspective, forest contains thousands of timber and non-timber products which provide sources of continually supply materials for domestic industry, for export and for import in the form of wood, fibre, processed products, energy and a wide variety of forest products. Forests also as the source of national development such as provide rural income, shares of national assets and also have become more widely recognized as cultural heritage.

The distribution of forest area also benefits for recreation purpose and encouraged the development of tourism sector which valued to the local communities. The forests may attract the recreational uses from local and abroad which can contribute to the development of nearby area. From environmental aspects, forests supply carbon and biotic potential storage, maintain diversity, unique and rare forms of life. Forests also provide infrastructural services such as stabilizing streamflow and microclimates, protect land and earth structures such as roads and canals, and purify the atmosphere (FAO, 2010).

1.2. The importance of forest biodiversity and its value

In tropical rain forests, tree species act as an important proxy for overall biodiversity as they are the main producers upon which all other organisms depend directly or indirectly for food (Ashton, 2008). It reflects to the structural and functional complexity of ecosystems, the temporal and spatial complexity of their dynamic cycles.

Millennium ecosystem assessment by Robert (2005) which focused on the relation between ecosystem and human being on ecosystem services stated that the services were the benefits that people would obtain from ecosystem. These include provisioning services such as food, water, timber and fiber; regulating services that affect climate, floods and water quality; cultural services such as recreational and aesthetic; and also supporting services such as soil formation, photosynthesis and nutrient cycling.

The public have given more attention and were aware on the importance of forest and its sustainable use of the resources. This due to the wider choices of uses of the resources offered including wood products and the services. Duerr (1966) stated that the economic of forest is concerning in making, distributing and consuming the goods and services of the forest. These goods and services include trees, recreation, wildlife, watershed regulation and the final products from the resources.

Due to its significant effect to the socio economic of the country, numerous studies on biodiversity assessment and evaluation of timber resources have been conducted in various types of forests. A study by The Forestry Administration of Cambodia (2010) was conducted to provide a better understanding of the changing relationships between society and forests policy reviews and reforms in national forest sectors. The objectives of the study were to identify emerging socio-economic changes impacting on forest and forestry and to identify priorities and strategies to address emerging opportunities and challenges.

While a study by Ashton (2008) about the challenge of biodiversity and and its sustainable management in Malaysian Forests with objective to find the method of management which can optimize both sustainable timber production. These studies have provided information on the trade- off between forest conservation and other land use options. In most tropical countries, forest revenue systems are implemented by charging timber fees, usually in two manners which either based on timber volume or by stumpage fees such as royalty and tax or the concession area or license fees such as premium and area tax. The timber is evaluated so that the allocation for state and government can be determined.

1.3. Background of Langkawi

Langkawi is an archipelago which contains 104 of islands in Andaman Sea and Langkawi Island is the largest island which measuring about 478 sq kilometres. It is situated in the northern west coast of Peninsular Malaysia under Kedah State administration. Langkawi Island is a developed land and has the most people living than other islands in Langkawi Archipelago.

It is stated that Langkawi have been existed about 500 million years ago as a foetus land at the edge of a continent known as Gondwanaland. The proof can be seen at the under of granite of Gunung Machincang. The Machincang is believed to be the base of the shaping of the other in Peninsular Malaysia. The change of sea level with the erosion and climate change has stimulate the geological reaction which formed cave, mountains and land colony until as seen today.

The development of Langkawi Island is very fast moving as it is chosen as one of the duty free zone where the merchandise imports are not been taxed to promote the local economies and encouraged the tourism sector. The infrastructure development in Langkawi Island is converged in the flat land of west coast while the other parts of Langkawi Island is still covered with large tropical rainforest areas which are the important natural resources for environment stability and conservation of flora and fauna heritage. Due to the existence of valuable resoucers, Langkawi Island has been a paradise for the researchers from all over the world to do research associated with geology, biodiversity and also marine sea. The beauty of Langkawi Island with the beautiful beaches, waterfalls and forests have attracted millions tourists each year and has been as one of the popular destination for them in Malaysia.

On 29th of March until 2 April 2007, three examiners from UNESCO have visited Langkawi as an effort by Government and state Government to recognise Langkawi as Langkawi Geopark. Result from the visit is Langkawi has been recognised as Langkawi Geopark and listed as 52^{nd} of all Geopark under the Global UNESCO Network of Geopark. Langkawi Geopark Malaysia is the first ever in South East Asia and second one in Asia continent after China.

The study area in Pasir Tengkorak Forest Reserve was chosen because of the geographical factor which is unique and has diversity of species. The status of Langkawi itself as Langkawi Geopark has also encouraged this study to be conducted in the area.

1.4. Problem Statement

The data of flora in coastal forest is important to provide information about the type of vegetation and the distribution of species available. Besides, the floristic composition of coastal forest can be compared with different types of forest in Malaysia due to different altitudes, types of soil and climate. The output of the study can provide information in the differences of total individuals in the area, specific species distribution and also the species growth pattern from the other type of forests.

The threats to stability of ecosystem in coastal forests are coming from unplanned development of tourism industry, disturbances from human that illegally collect the forest products and land use for agricultural purposes. The impacts of these threats which have brought major changes in coastal system bring to the loss of biodiversity and geological features vegetation. The incomprehensive of coastal zone management in Malaysia had been an issue that encourages the conflicts in the coastal forest.

The importance of conservation of the coastal forest could be demonstrated from the ecological and economic reason. Thus, the information of species composition in a coastal forest and its timber value could provide the opportunity cost between the conservation of the area and the extraction of timber resources for the state's income. Furthermore, the ecological and economic study in coastal forests could provide the tradeoff between the conservation with the other land use options which the ultimate mission to enhance the greater attention from the authorities to protect the area.

The assumption of high diversity of species in a forest area leads to high stumpage value is commonly accepted. A research is needed to relate between the two variables instead of the factors of log price, log cost and profit. The research performed would determine whether the species diversity in a coastal forest positively related to the value of timber available.

1.5 Objectives of the Study

The main objective of the study was to determine the species diversity and its stumpage value of a costal forest. The specific objectives of the study were:

1. To examine the floristic composition and species diversity in the study area,
2. To determine the stumpage value of timber resources in this area, and
3. To examine the relationship between the stumpage value of timber and its species diversity.

1.6 Organization of the Study

The research is divided into five chapters. Second chapter highlights the general background of forestry in Malaysia and studies on biodiversity and valuation of timber resources. The methods used in this study are explained in Chapter 3. Chapter 4 presents the results from the study and the discussion of the results obtained. Chapter 5 concludes the findings of the study and presents some recommendations for future research.

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