



UNIVERSITI PUTRA MALAYSIA

**FLORISTIC COMPOSITION, DIVERSITY AND ECONOMIC VALUATION OF
A COASTAL HILL FOREST IN PULAU PANGKOR, MALAYSIA**

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A COASTAL HILL FOREST IN PULAU PANGKOR, MALAYSIA**

By

SHOLEH GHOLLASIMOOD

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
Fulfillment of the Requirement for the Degree of Doctor of Philosophy

September 2011

Dedicated To:

My father Shir Mohamad Ghollasimood

And

My mother Tooba Habibimood



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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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Chairman: Prof. Faridah Hanum Ibrahim, PhD

Faculty: Forestry

The preservation of biological diversity is considered important for a variety of reasons, including economic value and preservation of natural ecosystem processes. The goal of this work was to describe all vascular plant diversity, structure, species composition along a coastal hill forest in Pulau Pangkor, Perak. The objectives were to (1) obtain trees and non-trees plant species composition and richness, and describe abundant, diverse and climbing modes of the climbers and assess plant diversity (2) calculate economic value, especially stumpage value for the forest stand and (3) estimate the biomass of trees in relation to the carbon content and energy. Five plots of one hectare each were established and each plot were divided into contiguous 100 subplots units each of 10 m×10 m quadrats. Each subplot was systematically surveyed by enumerating and identifying all vascular plants from all strata, and measuring the diameter at breast height (DBH≥5 cm) of all trees and 45 soil samples were collected to analyse soil texture. Differences of species richness and abundance between plots were analyzed by

ANOVA. Diversity analysis was conducted using EstimateS (version 8.2.0) to 95% confidence intervals. A canonical correspondence analysis (CCA) was carried out to analyze the relationships between climber abundance and environmental parameters.

The mean stem density was 7585 stems per ha and in total 36797 vascular plants representing 348 species belonging to 227 genera in 89 families were identified within 5-ha. The most spacious rich families were Rubiaceae having 27 species, followed by Dipterocarpaceae (21 species), Euphorbiaceae (20 species) and Palmae (14 species). Based on growth forms, 60% of all species were trees, 15% shrubs, 10% herbs, 10% lianas, 5% palms, 4% climbers, and 4% ferns. The average stumpage value was MYR 93741 per hectare. Dipterocarpaceae contributed to 86 % of the total stumpage value of the study area and the results confirmed the status of this family as the major timber species.

Diversity index values including non-parametric estimators revealed that the highest level of diversity occurred with increasing number of individuals in a sample. Alpha Fisher and Shannon-Wiener from parametric and Chao 2 from non-parametric estimators were the best estimators in this study area. Species accumulation curve shows how species richness increases until eventually the curve levels off with increasing sample size and it captured a high proportion of the species richness in the third plot.

Regression of elevation and palm, climber, epiphyte and shrub richness showed no significant relationship but linear regression of tree richness against altitude was

significant. Although the number of trees reduced with increasing elevation, the number of trees with dbh ≥ 5 cm in higher altitude were increased.

Climbing mechanisms differ significantly among the five plots ($P < 0.0001$) and 52% of the climbers are adapted to this climbing mechanism. The CCA illustrates the distribution of climbers according different elevations. The CCA results explain 56% of the cumulative variance in species data, indicating that, elevation had the highest correlation with species distribution ($r^2 = -0.4$, $P < 0.0001$; $r^2 = -0.16$, $P < 0.001$), while soil type was not significant and showed no correlation with climber density ($r^2 = 0.009$, $P \geq 0.85$).

The total above and under ground biomass of trees (dbh ≥ 5) was 665 t/ha. As half of the biomass is carbon, the estimated total carbon content is 299.4 t/ha, while the estimated energy content of all the biomass is 2.09×10^{19} KJ.

In total the number of endemic species, above and below ground biomass and economy valuation, compare to the other sites of Peninsular Malaysia were high.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**FLORISTIK KOMPOSISI, KEANEKARAGAMAN DAN PENILAIAN
EKONOMI DARI HUTAN BUKIT PESISIR DI PULAU PANGKOR,
MALAYSIA**

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Perlindungan kepelbagaian biologi dianggap penting untuk pelbagai alasan, termasuk nilai ekonomi dan pemuliharaan proses ekosistem alam. Objektif kajian ini adalah untuk menjelaskan semua kepelbagaian tumbuhan vaskular, struktur, komposisi jenis hutan bukit sepanjang pantai di Pulau Pangkor, Perak. Tujuannya adalah untuk (1) mendapatkan komposisi jenis dan kekayaan pohon dan selain pohon, dan menjelaskan mod kelimpahan, kepelbagaian dan mod pemanjat, melihat kepelbagaian tanaman (2) menghitung nilai ekonomi, terutama nilai tegakan nilai bagi dirian hutan dan (3) menganggarkan Biojisim pohon dalam kaitannya dengan kandungan karbon dan tenaga.

Lima plot satu hektar setiap satu didirikan dan setiap petak dibahagikan kepada 100 unit anak petak dengan setiap kuadrat 10 m × 10 m kuadrat. Setiap anak petak di survei secara sistematik melalui pengumpulan data dan mengenalpasti semua tumbuhan

vaskular dari semua strata, dan mengukur diameter paras dada ($DBH \geq 5$ cm) dari semua pohon dan 45 sampel tanah telah dikumpulkan untuk menganalisa tekstur tanah. Perbezaan kekayaan spesies dan kelimpahan antara plot dianalisis dengan ANOVA. Analisis Kepelbagaian dilakukan menggunakan estimates (versi 8.2.0) bagi selang kepercayaan 95%. Analisis korespondensi kanonik (CCA) dilakukan untuk menganalisis hubungan antara kelimpahan pepanjat dan parameter alam sekitar.

Kepadatan purata batang adalah 7585 batang setiap ha dan sejumlah 36797 tumbuhan vaskular yang mewakili 348 spesies yang melibatkan 227 genus dalam 89 keluarga telah dikenalpasti dalam kawasan 5-ha. Keluarga yang paling kaya dan berharga adalah Rubiaceae mempunyai 27 spesies, diikuti oleh Dipterocarpaceae (21 spesies), Euphorbiaceae (20 spesies) dan Palmae (14 spesies). Berdasarkan bentuk pertumbuhan, 60% dari semua spesies adalah pokok, tumbuhan renek berkayu 15%, tumbuhan herba 10%, pohon pepanjat berkayu 10%, palma 5%, pepanjat 4%, dan paku pakis 4%. Purata nilai tegakan adalah RM93.741 per hektar. Dipterocarpaceae menyumbang 86% dari jumlah nilai tegakan kawasan kajian dan keputusan mengesahkan status keluarga ini sebagai jenis kayu utama.

Nilai indeks kepelbagaian termasuk penentu bukan-parametrik menunjukkan tahap kepelbagaian tertinggi berlaku dengan peningkatan jumlah individu dalam sampel. Penganggar parametrik Alpha Fisher dan Shannon-Wiener dan bukan parametrik Chao 2 adalah penentu terbaik di kawasan kajian ini. Graf terkumpul spesis menunjukkan bagaimana meningkatkan kekayaan spesies sampai ke tahap mendatar dengan

peningkatkan saiz sampel dan merangkumi sebahagian besar kekayaan spesies dalam plot ketiga.

Regresi ketinggian dan kekayaan palma, pepanjat, epifit dan tumbuhan renek berkayu tidak menunjukkan hubungan yang signifikan, namun regresi linier kekayaan pohon terhadap ketinggian adalah signifikan. Walaupun jumlah pohon berkurang dengan peningkatan ketinggian, jumlah pohon dengan diameter 5 cm \geq jauh yang lebih tinggi dari yang sepatutnya.

Mekanisma pepanjat berbeza secara signifikan antara lima ($P < 0.0001$) dan 52% dari pepanjat dapat menyesuaikan dengan mekanisme tersebut. CCA menggambarkan pengedaran pendaki mengikut pelbagai ketinggian. Paksi kedua dan ketiga CCA menjelaskan 56% varians terkumpul dalam data spesies, menunjukkan bahawa, ketinggian mempunyai korelasi tertinggi pada paksi 2 dan 3 ($r^2 = -0.4$, $P < 0.0001$, $r^2 = -0.16$, $P < 0.001$) dan sangat mempengaruhi pola taburan pepanjat, sedangkan jenis tanah tidak signifikan dan tidak berkorelasi dengan kepadatan pepanjat ($r^2 = 0.009$, $P \geq 0.85$).

Jumlah biojisim tanah atas dan bawah tanah bagi pokok ($dbh \geq 5$) adalah 665 t / ha. Separuh dari biojisim adalah karbon, anggaran jumlah kandungan karbon adalah 299.4 t / ha, manakala anggaran kandungan tenaga bagi semua biojisim adalah 2.09×10^{19} KJ.

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APPROVAL

I certify that a Thesis Examination Committee has met on 28 September 2011 to conduct the final examination of Sholeh Ghollasimood on her thesis entitled " Floristic Composition, Diversity and Economic Valuation of a Coastal Hill Forest in Pulau Pangkor, Perak, Malaysia" in accordance with the Universities and University College Act 1971 and the Constitution of the Universiti putra Malaysia [P.U. (A) 106]. The Committee recommends that the candidate be awarded the Doctor of philosophy. Members of the Examination Committee were as follows:

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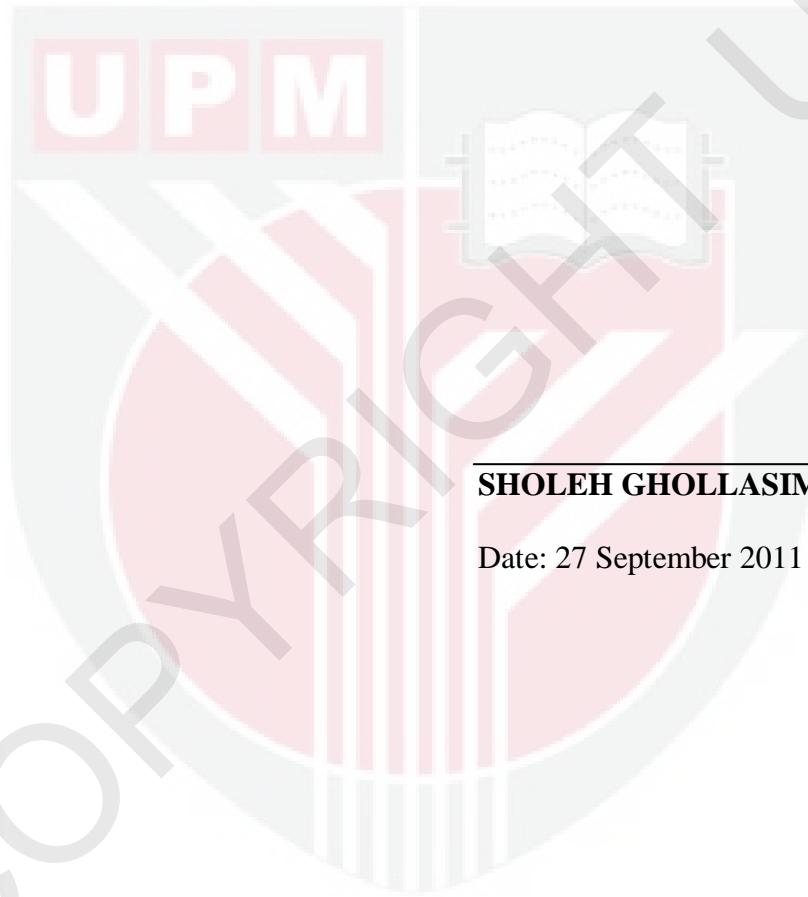
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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not submitted for any other degree at Universiti Putra Malaysia or other institutions.



SHOLEH GHOLLASIMOOD

Date: 27 September 2011

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