THE MALAYSIAN FORESTER

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FOREST CERTIFICATION IN MALAYSIA: CURRENT STATUS AND CHALLENGES

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Abstract: Forest certification has two purposes, firstly to certify standards of forest management (forest management certification), and secondly, to certify that timber products are made from wood sourced from the certified forests (chain-of-custody (CoC) certification). Forest certification in Malaysia started with the implementation of the Malaysian Timber Certification Scheme (MTCS) in 2001. This paper highlights the current status of the Malaysian forest industry's participation in forest certification and trade of certified timber products. To date, about 5.39 million ha of forests in Malaysia are certified. The largest area is Pahang FMU (1,524,827 ha), followed by Perak FMU (991,436 ha) and Sabah (557,452 ha). As of 2015, slightly more than 500 firms are CoC certificate holders, thus participation in CoC certification is considered low as this number is much lower than the number of forest product manufacturers and traders in the country. The European market has been the major export destination for MTCS-certified timber products, and more recently other markets including the Middle East, USA, Australia, New Zealand, India and South Africa have accepted these timber products. Even though export of these timber products is increasing, their share in Malaysia's timber products export is not significant. The greatest challenge is to increase market acceptance of MTCC's certification scheme and thus expanding the market for MTCS-certified timber products.

Key words: Environmental certification, forest management, chain-of-custody, trade, timber products

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IMPACT OF SELECTIVE MANAGEMENT SYSTEM ON THE DIVERSITY OF LIANAS IN LOWLAND DIPTEROCARP FOREST, NEGERI SEMBILAN, MALAYSIA

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Abstract: The study was carried out to determine the impact of Selective Management System on the diversity of lianas in lowland dipterocarp forest at Berembun Forest Reserve, Negeri Sembilan, Malaysia. Sample plots of 0.25 ha were established in an altitude approximately of about 100 – 350 m in forest areas of once cut lianas, twice cut lianas, and in adjacent virgin jungle reserve (uncut lianas) as the control plot. Four sample plots were selected at in each forest area. The diameter of lianas $\geq$ 1 cm dbh were measured according to the standard protocol for lianas census. Lianas diversity of three different forest management regimes under Selective Management System showed that the number of family, genus and individual were not significantly different within $\geq$ 15 years($p < 0.05$). However, liana species diversity between the three forest management regimes was significantly different ($p < 0.05$). The impact of different forest management systems on the diversity of lianas was discussed with reference to data of other tropical forests.

Key words: Selective Management System, liana diversity, , liana cutting, silvicultural treatment

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DEVELOPMENT OF VOLUME FUNCTIONS FOR YELLOW MERANTI SPECIES IN MALAYSIA

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Abstract: Volume is important in updating and projecting inventories, determining harvest level or allowable cut, scheduling the harvest unit for logging, analysing potential alternatives stand treatment and determining site productivity. Inherent in the preparation of a forest management plan and a forest harvesting plan is the availability of a volume table, usually derived from a functional relationship using diameter and / or log length or tree height. Fifteen volume equations (eight unweighted and seven weighted) were fitted by the method of least square to volume of Yellow Meranti species obtained from mixed tropical forests using the STATGRAPHICS Statistical Package. Furnival's Index (FI) was used as the criterion for selecting the best fit regression equation of Yellow Meranti species. The selected volume equation for Yellow Meranti species are as follows:

Local volume equation: $V = -1.2752 + 0.00151549D^2$
(FI = 0.0207621)

Standard volume equation: $V = (1.00098).e^{(-4.05686 + 2.05011\text{Log}_e D + 0.796486\text{Log}_e H)}$
(FI = 0.405376),

Where: V is the commercial tree volume (m^3 overbark), D is the reference diameter or dbh (cm), H is the total commercial log length (m) up to the first large branch below the crown base or to the 30cm end diameter, and e is the exponential function.

Key words: Volume Function, Yellow Meranti, Furnival's Index, Local Volume Equation, Standard Volume Equation.

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SUSTAINABLE ECOTOURISM DEVELOPMENT IN SEKAYU RECREATIONAL FOREST AND LAKE KENYIR IN TERENGGANU, MALAYSIA

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Abstract: Sustainable ecotourism emphasizes on the natural and cultural integrity, sustainability, educational activity, contributes to local community and preserving the conservation and environment. Sekayu Recreational Forest and Lake Kenyir in Terengganu have been identified as potential ecotourism sites for their natural beauties, recreational facilities and tourism activities. The present study analyses the potentials of ecotourism development in Sekayu and Kenyir from the perception of local communities. Non-probability convenience sampling design with purposive techniques was used to collect the survey data from the respondents through structured questionnaire. The number of tourists arrival increase year by year in the study areas. The respondents felt that ecotourism ensure sustainable development in terms of social, economic and environmentally in the study areas. There was also positive attitude of local communities towards ecotourism development for the dimensions of preservation of cultural tradition, sustainable community development and ecotourism planning and management.

Key words*:* Ecotourism, Lake Kenyir, Malaysia, Sekayu Recreational Forest, Terengganu

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METARHIZIUM ANISOPLIAE OF PENINSULAR MALAYSIA ORIGIN POSES HIGH PATHOGENICITY TOWARD *COPTOTERMES CURVIGNATHUS*, A MAJOR WOOD AND TREE PEST

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Abstract: The termite *Coptotermes curvignathus* has been reported in Malaysia and is responsible for the destruction of various timber-based products and orchard trees. Controlling this pest population using the biopesticide agent, *Metarhizium anisopliae*, is highly desirable when compared to chemical pesticides because the latter often leads to many environmental concerns. In this study, we isolated *M. anisopliae* from four different locations in Peninsular Malaysia and tested their pathogenicity on *C. curvignathus*. Another six isolates from a previous work were also included. Conidia in the form of suspension at $1x10^7$conidia/mL were applied on workers termites and observed for mortality within a 12-day observation period. In addition, fungal progression rate was calculated based on the number of days it took for the mycelia to emerge and the conidia to form on infected termites. Among the ten fungal isolates tested, PR1 yielded the highest mortality (97%) and the shortest median lethal time (LT50= 1.5 days). While TFFH3 and PKLG isolates had the highest rate in mycelia formation (88%) and conidia sporulation (80%), respectively, they both recorded mortality at 93% and LT50 above 2 days. PR1 ' s performance in infecting *C. curvignathus* appeared to augment its potential use as a biopesticide agent.

Key words: Biopesticide, entomopathogenic fungi, pathogenecity test, subterranean termite, wood

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BIOMASS AND CARBON STOCK ESTIMATION OF HILL DIPTEROCARP FORESTS IN THREE PERMANENT RESERVED FORESTS IN KELANTAN, MALAYSIA

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Abstract : This study was conducted in three different permanent reserved forests in Kelantan, namely Bukit Bakar, Gunung Basor and Gunung Stong Tengah. The aim of the study was to estimate the biomass and carbon stocks of logged-over hill dipterocarp forests. Trees with diameter at breast height of 10 cm and above were enumerated, measured and identified. The study revealed that Bukit Bakar Forest Reserve possessed the highest accumulation of biomass (338.72 t/ha) and carbon stock (169.36 t/ha) followed by Gunung Basor (biomass = 312.85 t/ha; carbon stock = 156.43 t/ha) and Gunung Stong Tengah (biomass = 294.25 t/ha; carbon stock = 147.13 t/ha). The total biomass and carbon stock of logged-over hill dipterocarp forests when compared to the primary forests revealed the rapid regeneration of the standing tree biomass and carbon accumulation within these study sites. This indicates a healthy sign of logged-over hill dipterocarp forests as a potential means in carbon sequestration.

Key words: Hill dipterocarp forest, logged-over forests, above ground biomass; below ground biomass; carbon stock

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DETERMINANTS OF THE CONTRIBUTION OF FORESTRY SECTOR TO PENINSULAR MALAYSIA ' S ECONOMY

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Abstract: Malaysia is a country rich in forest resources where sustainability, conservation and growth in the forestry industry are important at the state, country and regional levels. This study will focus on investigating the upstream level of the forestry sector in Peninsular Malaysia to determine the main factors that contribute to its growth. The primary objective is to measure the short-run and long-run relationship of the determinants. The Autoregressive-Distributed Lag (ARDL) bounds test approach was employed on the Peninsular Malaysia time series data, covering the period of 1980 to 2012. The determinants for the long-run coefficient relationship indicate that consumption, investment, the value of the harvested area and revenue are significant variables; expenditures and net exports were not significant. The coefficient for the short-run relationship illustrates that expenditures, net exports and revenue are not significant for the growth of the upstream level of the forestry sector. The findings reveal that the determinants which influence the contribution of forestry sector to Peninsular Malaysia ' s economy are consumption, investment, the value of the harvested area and revenue.

Key words: ARDL bounds test approach, forestry sector

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CANOPY DENSITY CLASSIFICATION OF MATANG MANGROVE FOREST RESERVE USING MACHINE LEARNING APPROACH IN REMOTE SENSING FOR TRANSECT ESTABLISHMENT

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Abstract: Mangrove forests provide different goods and services. The unique environmental factors affecting the growth of mangroves are distance from the sea or the estuary bank, frequency and duration of tidal inundation, salinity, and composition of soil. These crucial factors may under certain circumstances be sources of obstacles in accessing and managing the mangroves. The application of remotely sensed imagery data can bring about a more accurate way of monitoring mangroves. In this study, a set of Landsat 8 satellite imagery covering Matang Mangrove Forest Reserve was classified by using an extension of ArcGIS application, namely Feature AnalystTM. Canopy densities of four different classes were identified according to spatial association, size, shape, texture, pattern and shadow of features in the image; they are dense canopy, moderately dense canopy, low dense canopy, and open areas. Ultimately, three classes of disturbance were created based on the factors believed to have effects on the quality of mangroves which are as follows: least disturbed area, moderately disturbed area, and most disturbed area. The accuracy of the classes identified was validated through ground surveys by observing the abundance of vegetation. Subplots of ground validation were created by using random systematic line plot method. Most of the over-logged areas were replanted with *Rhizophora* species.

Key words: mangroves, geospatial technology, forest canopy, Malaysia

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DEVELOPMENT OF *PTEROMA PENDULA* JOANNIS (LEPIDOPTERA: PSYCHIDAE) FEEDING ON SELECTED LANDSCAPE TREES IN PENINSULAR MALAYSIA

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Abstract: Development time, survival rate and fecundity of *Pteroma pendula* fed on three different host trees, *Acacia mangium*, *Callerya atropurpurea* and *Cassia fistula*, were determined in the laboratory. A cohort of 100 eggs (n = 100) were used for each host trees. Mortality and development time from eggs to adult were recorded and the fecundity was obtained from dissected fertilized females. The results revealed that higher survival rate was observed on the bagworms fed on *A. mangium* (38%) compared to those fed on *C. atropurpurea* (33%) and *C. fistula* (25%). Development time of the larvae fed on *A. mangium* was shorter than the larvae fed on the other two species. Higher survival rate and shorter development indicated that *A. mangium* is the most suitable host plant and provides better food quality to *P. pendula*. Generally, males have longer longevity than the females. Fecundity of the females that reared on *A. mangium* (76.33 ± 1.77) is significantly higher than those who reared on *C. atropurpurea* (69.8 ± 1.85) and *C. fistula* (69.2 ± 1.07). Low numbers of fertilized females were obtained due to the failure in the mating process, resulted by the non-synchronize development time of both females and males. As a conclusion, *P. pendula* showed a different extent of adaptation on different host trees and host-related factors is the most influential factors that affected their development.

Key words: Bagworms, leaf-eating pest, landscape tree, lepidoptera, life table

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DIVERSITY OF FAUNA SPECIES IN AYER HITAM FOREST RESERVE, SELANGOR, MALAYSIA

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Abstract: Ayer Hitam Forest Reserve (AHFR) is one of the remaining lowland forest in the Klang Valley. A research was undertaken to study the fauna species in this forest. They were divided into four species groups namely; bird (nocturnal and insectivorous), bat, small mammal (non-volant) and primate. Each group used different capturing methods. Birds were trapped using Mist-netting method while bats were captured using both mist-net and harp-trap. Small mammal (non-volant) species were captured using live-trap. Distance Sampling Method for line transects and opportunistic surveys were used to observe primate species. A total of 7 species with 43 individuals of nocturnal bird and a total of 20 species of insectivorous bird with 146 individuals were captured. For bat, 10 species with 64 individuals were captured. Nine species with a total 62 individuals were recorded for small mammals. Only 4 species of primates were found in the AHFR out of a total 10 species present in Peninsular Malaysia.

Key words: Species composition, fauna diversity, Ayer Hitam Forest

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WOOD DENSITY AND CARBON ESTIMATES OF MANGROVE SPECIES IN KUALA SEPETANG, PERAK, MALAYSIA

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Abstract: Mangrove forests provide a broad array of ecosystem services including fisheries production, sediment regulation, wood production and protection from storms and waves. Mangroves also may have an important role as a pool in global carbon budgets and in mitigating climate change. Here we investigated the wood density and carbon content of the mangrove species in Kuala Sepetang, Perak. Using data from 13 mangrove species, the value for wood density and carbon were estimated. Wood density ranged from 0.33 gcm^{-3} to 0.64 gcm^{-3}, where the lowest and highest values were given by *Sonneratia caseolaris* and *Ceriops tagal*, respectively. The carbon content was 42.48% on average, where *Bruguiera cylindrica* gave the lowest value at 45.13 % while *Lumnitzera racemosa* was the highest at 45%. These values suggest that Kuala Sepetang mangrove forest has the potential to sequester and store substantial amounts of atmospheric carbon.

Key words: Allometric equation, carbon content, wood density, mangrove species

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UPSTREAM HOUSEHOLDS' WILLINGNESS TO PAY (WTP) FOR FORESTED WATERSHED PROTECTION IN LANGAT BASIN, SELANGOR, MALAYSIA

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Abstract: Forested watershed provides sufficient ecosystem services to water consumers including watershed protection, biodiversity conservation, landscape beauty, carbon sequestration, nutrient cycling, soil formation and flood regulation. Nevertheless, watershed ecosystem services are not fully captured in current market price and policy decision. The payment for ecosystem services (PES) have attracted increasing awareness as a new market mechanism that convert non-market values of the environment into real financial inducement for sellers to provide watershed management service to buyers. Langat Basin is an important water catchment area providing raw water source and other amenities to approximately 1.2 million people within the basin area. Langat basin is experiencing rapid growth and classified as moderately contaminated. The basin is more likely to be polluted in the future. Upstream households of Langat basin were asked to state their willingness to pay (WTP) for conserving watershed protection service. The willingness to pay by 180 upstream households was RM30 per year and total WTP from the double bounded dichotomies choice was computed at RM5401 per year. Result showed households chose the special fund to channel payment for watershed management.

Key words: Household, economic valuation, willingness to pay, watershed protection, Langat Basin

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GROWTH AND PHYSIOLOGICAL RESPONSES OF *SHOREA MATERIALIS* RIDL. SEEDLINGS TO VARIOUS LIGHT REGIMES AND FERTILIZER LEVELS UNDER NURSERY CONDITION

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Abstract: Relative light intensity (RLI) is one of the most significant factors that affect plant growth by controlling physiological traits of plants in terms of photosynthesis, respiration, stomatal conductance, and chlorophyll synthesis, among others. An experiment was conducted in the shade house and open area to determine the effect of three light intensities, viz. 30%, 50% and 100% RLI, and three levels of NPK fertilizer, viz. 0,1 and 2 g. plant^{-1} month^{-1} on the growth and physiological traits of *Shorea materialis* seedlings. During the six-months study period, survival percentage, growth performance and chlorophyll content of the species were monitored every three months, while other physiological parameters, such as photosynthetic rate, stomatal conductance, and stomatal density were recorded at the end of the experiment. The results showed that survival percentage of the seedlings was not significantly affected by different light conditions and fertilizer levels, and it was 100% for all treatment combinations. On the other hand, growth and physiological properties except stomatal density were significantly affected by both the above factors. The seedlings growing under 30% to 50% RLI were significantly better than those under full sunlight, in terms of height increment, diameter increment, leaf number increment, chlorophyll content, photosynthetic rate and stomatal conductance. In addition, the seedlings treated with 1 g NPK were significantly better than the control for photosynthetic rate and stomatal conductance. However, the seedlings fertilized with 2 g NPK were significantly greater than the control, in the matter of height increment, leaf number increment, chlorophyll content. Generally, the species should be planted under 30 to 50% RLI with 1 to 2 g of NPK (monthly) to produce a healthy and high growth of the species.

Key words: *Shorea materialis*, shade-tolerant, light intensity, fertilizer, growth, physiology

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FORESTRY EDUCATION IN MALAYSIA: TRENDS AND CHALLENGES

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Abstract: The expansion of the forestry sector in Malaysia and the importance of forest for its biodiversity conservation and ecosystem services requires the development of human capital at both technical and professional levels. The relevance of forestry education in the country, its trends and challenges are herein discussed.

Key words: Malaysia, forestry sector, education, tends, challenges

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INTEGRATED FRAMEWORK IN SOCIAL BEHAVIOUR RELATED TO WILDLIFE MANAGEMENT

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Abstract: Social research provides tools and techniques for understanding the feasibility of conservation actions. The Theory of Planned Behaviour (TPB) is one of the most widely used models for social behaviour. Applied studies have examined whether the TPB is a true general social behaviour model through, for example, the selection of samples from diverse populations or the use of this model to develop effective strategies for behaviour change. Several interfering factors can affect control intended behaviour. In this paper, the motivational and cognitive factors are considered in the final integrated model which can be applied in the field of conservation and wildlife management.

Key words: Theory of Planned Behaviour (TPB), integrated frame work, cognitive hierarchy, Self-Determination Theory (SDT), motivation model, Pro- Environmental behaviour model