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# THE MALAYSIAN FORESTER

'The Malaysian Forester' adalah jurnal antarabangsa yang diterbitkan setengah tahunan oleh Jabatan Perhutanan Semenanjung Malaysia untuk menggalakkan pengetahuan mengenai semua aspek hutan dan Perhutanan Malaysia sejak 1931 (sebelum ini dikenali sebagai Malayan Forester sehingga tahun 1973). Ia bukan sebuah penerbitan kerajaan, walaupun ia diterbitkan dengan kelulusan Jabatan Perhutanan Semenanjung Malaysia. Artikel oleh penyumbang di negara-negara selain daripada Malaysia adalah dialu-alukan, dengan syarat perkara berkenaan terpakai ke Malaysia atau perhutanan tropika secara umum dan tidak kepentingan semata-mata tempatan. Jurnal tidak bertanggungjawab untuk penyata dan pendapat yang dinyatakan oleh penyumbang.

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**SEXUAL IDENTIFICATION OF BAMBOO BORER  
*DINODERUS MINUTUS* (FABRICIUS)  
(COLEOPTERA: BOSTRYCHIDAE)**

F. ABOOD, A.R. NORHISHAM , M. SHAHMAN AND A. ANDY

**Abstract:** There is no available documented literature on sexual identification of the bamboo borer *Dinoderus minutus* (Fabricius). In this study, adult and pupal stages of *Dinoderus minutus* were examined in an attempt to differentiate the sexes for this particular species. Freshly killed and cleaned adult as well as pupal stages were examined under stereomicroscopy and different characteristics for both stages were compared. Results showed that there were no distinct morphological features in the adult stage that could be used as distinguishing sexual characters. However, differentiating sexual features were observed in the pupal stage. Gonapophyses, comprising of a pair of conical extrusions were present at the terminal abdominal segment in the female pupa whilst a pair of parameres was observed in the male. These morphological characteristics which were identified only in the pupal stage, proved to be the most reliable method to determine the sex of *D. minutus*.

**Key words:** *Dinoderus minutus*, powderpost beetles, bamboo borer, sexual differences

# SEGMENTATION OF NATURE TOURISTS THROUGH MOTIVATION OF TRAVEL TO KUALA GANDAH NATIONAL ELEPHANT CONSERVATION CENTRE

SUZIANA HASSAN, ABDULLAH MOHD, MANOHAR MARIAPAN  
AND MOHAMED ZAKARIA HUSIN

**Abstract:** Segmentation of nature tourists is an important step related to tourism products planning and in formulating comprehensive tourism policy. Studies in the segmentation of nature tourism of people who visited Kuala Gandah were based on their travel motivation to recognize the affiliation among nature tourists groups. A total of 401 samples of respondents were surveyed through purposive sampling design. Multiple Discriminant Analysis (MDA) test was administered to segmentise and predict nature-tourist types. The results showed that 64% of the original cases were correctly classified and 61% of cross-validated grouped cases correctly classified. Ecotourists do not differ from other segments in terms of social-demographics and trip characteristics but had higher contributions to travel motivation attributes. Results suggest that the ecotourists are included in 'hard ecotourism', while nature escapists and comfortable naturalists in 'medium ecotourism' and passive players in 'soft ecotourism'. The results propose several implications for nature product promotion, development, and implementation of a sustainable tourism policy. Such research would help destination marketing organizations more effectively by linking environmental attributes to specific motivations.

**Key words:** Nature tourists, motivations, segmentation, managing implication

**TWO NEW RECORDS OF *VATICA* L.  
(DIPTEROCARPACEAE) FOR PENINSULAR  
MALAYSIA**

H. EL-TAGURI AND A. LATIFF

**Abstract:** Two new records of *Vatica* Sect. *Vatica*, viz. *V. sarawakensis* Heim and *V. pedicellata* Brandis are herein reported for Peninsular Malaysia.

**Key words :** *Vatica sarawakensis*, *Vatica pedicellata*, Dipterocarpaceae, new records

# IMPACT OF RIL SYSTEM ON THE RESIDUAL TREES IN PEAT SWAMP FOREST OF PEKAN FOREST RESERVE

P. ISMAIL<sup>1</sup>, K. ABD RAHMAN<sup>1</sup>, M.S. NIZAM<sup>2</sup>,  
W.A. WAN MOHD SHUKRI<sup>1</sup>, M. SAMSUDIN<sup>1</sup>, T. ISMAIL<sup>3</sup>  
AND A. GRIPPIN<sup>3</sup>

**Abstract:** Since 1999 when harvesting operation started in Pekan Forest Reserve (FR), Rimbaka Timber Harvester or Rimbaka, considered as reduced impact logging (RIL) is the only system used for timber harvesting. The main objective of this study was to determine impacts of the RIL system on the residual trees. Four sets of cutting limits represent low to high cutting limits were tested in four harvesting blocks. Damage assessment was conducted immediately after the harvesting operation completed. Damage on the crown was the major damage that occurred on the residual trees, followed by stem and root damage, respectively. Most of the trees that survived were apparently under light category of damage and they were expected to continue to survive as good residual trees. The total percentage of damaged and dead stands of all species was about 36.5%; heavily damaged and total dead trees contributed 11.4% and 14.3%, respectively. Felling activity contributed to 90.2% of tree damages and 81.5% of tree deaths; however, extraction activity was much less destructive, causing only 9.8% and 18.5% on tree damage and tree death, respectively. As a whole, results of the study showed that the RIL system had successfully produced relatively less damage and low mortality on the residual trees of the peat swamp forests.

**Key words:** South-East Pahang, harvesting, reduced impact logging (RIL), cutting Limit, peat swamps

# **SPATIAL VARIATION OF PHYSICAL ENVIRONMENT AND ENVIRONMENTAL ASPECT OF SELECTIVE LOGGING: A CASE STUDY OF TROPICAL HILL DIPTEROCARP FORESTS OF PENINSULAR MALAYSIA**

**SAIFUL ISLAM<sup>1</sup>, M. N. SHUKOR<sup>2</sup>, I.FARIDAH-HANUM<sup>3</sup>  
AND A. LATIFF<sup>2</sup>**

**Abstract :** A systematic sampling and survey along the gradient directed transect was conducted within study area to investigate the effects of selective logging on tree species diversity, stand structure and physical environment of tropical hill dipterocarp forest of Peninsular Malaysia. In this study baseline information on environmental aspects of selective logging have been generated and compared with that of pre-logging condition by surveying the same samples. Soil physical parameters and microclimatic variables are mainly included for comparing spatial variation as well as species distribution. However, canopy openness is also discussed to find out its relationship to soil moisture and forest microclimate variation following logging. The variation of species composition in relation to habitat types as identified by numerical methods (Cluster and Principal Component Analysis) has been characterized and described in terms of possible environmental data. The results have been compared with the available studies from Malaysia and overseas. However, for the lack of pre-logging data as well as limited information particularly on microclimate, comparison was compounded. This study shows that the study site, Ulu Muda Forest Reserve, Kedah seems to be largely controlled by local micro-topography and associated microenvironment.

**Key words :** Spatial variation, physical environment, selective logging, tropical hill dipterocarp forest

# ESTIMATING THE ECONOMIC VALUE OF NATURAL BAMBOO STANDS: A CASE STUDY IN PAHANG, MALAYSIA

SHUKRI MOHAMED<sup>1</sup>, AWANG NOOR ABD. GHANI<sup>1</sup>  
AND MOHD HAKIMI MOHD HANAPI<sup>2</sup>

**Abstract:** This paper presents results of a study on appraising the economic value of natural bamboo stands in Pahang, Malaysia. Data were gathered by interviewing active and registered bamboo collectors and manufacturers of bamboo products in the state, as well as some secondary information from the Fourth National Forestry Inventory. A rapid field inventory was also conducted to estimate the number of culms and potentially harvestable culms in a clump of bamboo. The economic value of the natural bamboo stands is estimated using the residual value approach. *Gigantochloa scortechinii* was harvested in Raub for making joss/incense sticks, while *Dendrocalamus pendulus* and *Schizostachyum zollingeri* were harvested in Rompin for the production of vegetable/fruit baskets. It is estimated that about 6.47 million harvestable culms of *G. scortechinii* would be available in the forests of Pahang with an economic value of about RM1.747 million. As for *S. zollingeri* (and others), the potentially harvestable culms amounted to about 3.84 million culms with an economic value of RM882,329 (end product is vegetable/fruit basket) or RM1.611 million (end product is bamboo sticks). Assuming only these three species are harvested and used, there would be at least RM2.629 million worth of bamboo resource in the natural forests in Pahang.

**Key words:** bamboo, natural forests, economic valuation

# PREPONDERANCE OF TAPANG TREES, *KOOMPASSIA EXCELSA* (BECC.) TAUBERT AND THE DISTRIBUTION OF ITS SEEDLINGS

I.B. IPOR, C.S. TAWAN, F. OTHMAN, K. MEEKIONG  
AND S. MOGORET

**Abstract:** A study on the population patterns of Tapang, *Koompassia excelsa* (Becc.) Taubert was conducted at Gunung Gayu, Padawan, Sarawak. Twenty three plots of 30m x 30m were established to determine the floristic structure and composition of the forested areas with the occurrence of mature Tapang trees, survival of seedlings and distribution pattern of the saplings and seedlings of *K. excelsa*. A total of 545 individual trees with diameter breast height (DBH)  $\geq 5.0$  cm belonging to 162 species were recorded. The sites were dominated by *Durio zibethinus* (Iv = 12.87), *K. excelsa* (Iv = 10.99), *Octomeles sumatrana* (Iv = 8.15), *Pangium edule* (Iv = 7.16) and *Ficus aurata* (Iv = 6.22) with the estimated biomass of 1350.62 t/ha and leaf area index (LAI) of 5.31 ha/ha. Young saplings mostly thrived between 1 m to 15 m from the mother trees. In terms of sapling size, majority of the sapling populations ranged between 0.5 cm to 2.5 cm diameter and height between 3.0 cm to 10.00 cm. Relationship between stem diameter and height of saplings had strong relationship with  $r^2 = 0.90$ .

**Key words:** *Koompassia excelsa*, floristic structure, sapling and seedling.

# DEMOGRAPHY OF THE BAGWORM, *PTEROMA PENDULA* JOANNIS ON AN EXOTIC TREE, *ACACIA MANGIUM* WILLD IN MALAYSIA

CHEONG YEW LOONG<sup>1</sup>, AHMAD SAID SAJAP<sup>1</sup>, HAFIDZI MOHD NOOR<sup>2</sup>, DZOLKIFLI OMAR<sup>2</sup> AND FAIZAH ABOOD<sup>1</sup>.

**Abstract:** Demography of *Pteroma pendula* (Lepidoptera: Psychidae) feeding on *Acacia mangium* was examined in the laboratory. The species undergoes six instars. The mean total lifespan of *P. pendula* was  $44.8 \pm 1.5$  days, with males at  $47.7 \pm 1.4$  days and females at  $41.8 \pm 1.6$  days. The length of cases was significantly correlated with the larval head capsules width with  $R^2= 0.97$  for male and  $R^2= 0.92$  for female. Its short life cycle allows this species to have a minimum of eight generations yearly. Generally, its growth and developmental performances on *A. mangium* are relatively similar to those developing on oil palm. Thus *A. mangium* is a good alternate host for the pest population to build up its numbers. In addition to its invasiveness, *A. mangium* serves not only as a refugium for the pest but also a source of infestation to agricultural crops within the vicinity.

**Key words:** Bagworms, *Pteroma pendula*, life history, *Acacia mangium*

# **TOURISM IMAGES FOR THREE HIGHLAND DESTINATIONS IN MALAYSIA AS PERCEIVED BY TOURISTS**

AZLIZAM AZIZ AND NURUL AMIRAH ZAINOL

**Abstract:** This paper focuses on comparing the destination image among the three highlands in Malaysia (Cameron Highlands, Fraser's Hill and Genting Highlands) as perceived by the tourists. A self-administered survey was used to collect data from 1200 respondents intercepted by using stratified sampling technique. Forty-one image attributes were factor analysed and compared among the three highlands using Multivariate Analysis of Variance (MANOVA). This study managed to identify 6 images for the three destinations and subsequently labelled as "accessibility and services", "local attractions and facilities", "general mood and vacation atmosphere", "leisure and recreational activities", "natural surroundings", and "nature heritage and ambience". Results also indicated several images which are unique to each individual destination. Genting Highlands was perceived to be synonymous with "leisure and recreational activities", Fraser's Hill with "general mood and vacation atmosphere" and Cameron Highlands with "local attractions and facilities". The findings of the study provided theoretical and practical implications for the tourism authorities of Malaysia in order to manage and promote their destinations in a meaningful way.

**Key words:** destination image, highland, Malaysia, tourism

# AGROFORESTRY TYPOLOGY AND ITS IMPLICATIONS ON SURROUNDING SOUTH REGION OF GUNUNG MERAPI NATIONAL PARK, JAVA, INDONESIA

PRIYONO SURYANTO<sup>1,2\*</sup>, H. MOHD ZAKI<sup>2</sup>,  
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**Abstract:** The surrounding characteristics land use for the new national park of Mount Merapi in the southern region are dominated by agroforestry practice. Based on the situation, a review of its agroforestry status is very important in an early step in a perspective collaboration approach between the local community and the national park. The objectives of this study were to determine the typology of agroforestry and its implications on Gunung Merapi National Park (GMNP). The study used a survey approach with a population unit community which practises agroforestry in Kaliadem and Jambu Village. Purposive random sampling was employed where the respondents were randomly chosen based on the social status data retrieved from the local authorities. Meanwhile, measurement of stand structure was done by census technique on all land types by the selected respondents. Social economic aspect was assessed using a thorough interview with each chosen respondent. In particular, clustering agroforestry practice, with a K-mean cluster and a similar pattern of interaction among land types with GMNP, was identified using an ordination with Multidimensional Scaling (MDS). The results showed that agroforestry has been practised in home garden, dry field and village lands, as proven by the domination of agroforestry based on grass (AFG). Based on the AFG in private lands and the level of emphasis given on the GMNP, the typology of agroforestry and its implications on the GMNP could be grouped into three different clusters labelled as *intensive agroforestry*, *semi-intensive agroforestry* and *conventional agroforestry*. Therefore, an initiation buffer zone management on the areas surrounding the GMNP could be done through private land optimisation with a focus on intensive agroforestry.

**Key words:** agroforestry, home garden, dry field, land village, national park

# **THE EFFECTS OF REDUCED IMPACT LOGGING (RIL) ON FOREST REGENERATION IN ULU BARAM, SARAWAK, MALAYSIA**

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**Abstract:** There has been an increasing interest in reduced impact logging (RIL) practice, particularly in tropical forests. Studies have shown that RIL promotes enhanced regeneration, allowing for earlier re-entry and more sustainable forest harvest of higher-quality commercial wood. The objective of this study was to assess regeneration of potential tree species in the logging corridors under reduced impact RIL in Block 13, Sela'an-Linau Forest Management Unit (FMU), Ulu Baram, Sarawak, Malaysia. The study assessed commercial species regeneration potential in the form of number of species and composition, effect of different felling intensities and effect of slope condition on regeneration. The sampling method was modified based on the Section 3: Treatment Design in "Silviculture Treatment of Logged-over Forest in the FOMISS Sampling Pilot Area (FSPA)" report, focusing only along harvesting corridors. Regenerations of a 1.5 meter height to 10 cm diameter at breast height (dbh) were selected for evaluation. Results indicated that commercial species, mainly from dipterocarps families, regenerated well. A moderate number of felling intensities (2 trees per section) promoted a better number of regenerations. The results related to the light availability for regenerations after felling. Different number of regenerations according to the different sloping conditions were obvious, where steeper slopes have smaller number of regenerations. RIL provides an alternative way to determine regeneration condition and its effect were presented from a case study in Sela'an-Linau FMU at Ulu Baram, Sarawak, Malaysia.

**Key words:** reduced impact logging, forest regeneration, logging damage, timber harvesting system

# ISSUES AND CHALLENGES IN MANAGING SECOND ROTATION FOREST, PARTICULARLY FOR TIMBER PRODUCTION IN THE DRY INLAND FOREST OF JOHOR

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**Abstract:** Johor is very fortunate to be endowed with timber species-rich tropical lowland rain forests dominated by three major forest types, *vis-à-vis* the Dry Inland Forest, Peat Swamp Forest and Coastal Forest (mainly the Mangroves). A total of 391,499.02 ha of forest areas had been successfully earmarked as Permanent Forest Reserve (PFR) to be managed sustainably. Timber harvesting from the PFR is regulated through the Selective Management System (SMS) and mainly taken place in the Dry Inland Forest and the Mangroves. At the moment, however, timber harvesting is not economically viable in the Peat Swamp Forest. In the Dry Inland Forest, a substantial volume of timbers was harvested in the past many years from the first rotation forests. Many of these virgin forests have been completely harvested for timber. The bulk of future timbers production, however, will be from the second rotation of these forests. As stipulated by the current SMS practice, an advance growth of 30-45 cm diameter at breast height (dbh) is very crucial as residual stand to form the bulk of future timber trees for the next harvest. This paper, therefore, highlights several key issues and challenges with regard to the current State Forestry Department of Johor's (SFDJ) experiences in the management of the second rotation forests, particularly in ensuring the existing residual stands are adequately stocked in terms of quantity and of specific quality of timber trees for future yield. The paper concludes by addressing the regeneration status and growth potential of these logged-over forests in terms of timber trees per hectare, basal area ( $m^2/ha$ ), volume ( $m^3/ha$ ), diameter increment, species composition, mortality and in-growth using available data derived from a total of eleven (11) growth plots established in the PFR of Johor State.

**Key Words :** second rotation forest, selective management system (sms).

# STOCKING OF SECOND GROWTH FOREST BASED ON THE FOURTH NATIONAL FORESTS INVENTORY (NFI 4)

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**Abstract:** Stocking assessment of the second growth forests based on the Fourth National Forest Inventory (NFI 4) was carried out by the Forestry Department Peninsular Malaysia (JPSM) between 2002 and 2004. NFI 4 results showed that the percentage of species composition of dipterocarp in the second growth forests is considerably lower than virgin forest. However, the composition of dipterocarp group (meranti and non-meranti) is similar to virgin forest. The distribution of diameter for second growth forests showed an inverse-J curve, indicating a continuous recruitment over time in self-perpetuating or human induced ecosystem through silviculture treatments. The second growth forests in Peninsular Malaysia are capable to yield a total of  $103.6 \text{ m}^3.\text{ha}^{-1}$  from potentially extracted merchantable size trees ( $\geq 45 \text{ cm dbh}$ ), which is higher than the threshold volume ( $85 \text{ m}^3.\text{ha}^{-1}$ ) to be harvested from of virgin forests, as agreed upon by the National Forestry Council. This paper discusses the second growth forest, which is defined as the forest areas logged more than 30 years ago (before 1970) under the Selective Management System (SMS) that prescribes a 30-year cutting cycle.

**Key words:** National Forest Inventory, Selective Management System (SMS), Silviculture, dipterocarp

# **SILVICULTURAL PRESCRIPTIONS FOR SECOND GROWTH FORESTS: A CASE STUDY IN TEKAM F.R.**

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**Abstract:** Introduction of mechanized harvesting to inland dipterocarp forest can alter the size, structure, species composition, spatial distribution, stocking level of the pristine rainforest towards a more heterogeneous residual stands. The assessment of second growth forest at landscape level using satellite imagery allows us to examine the variation of stand condition over a large area, and development of a strategic planning to support sustainable management. In developing the silvicultural prescriptions, we looked into three key components of forest stand and used them as the basis to decide on the appropriate silvicultural option. Our assessment approach began with classifying the forest stands into eight commercial species groups. Using a stand projection model we simulated the stand stocking, structure and composition up to 120 years. More than thirty (30) cutting options with minimum dbh limit of 45 cm and 50 cm for non-dipterocarp and dipterocarps, respectively were applied on the simulated stand at each 5 years time step. A growing stock assessment was carried out using minimum stocking standards such as residual stand density, net commercial volume, and proportion of dipterocarps. The silvicultural decision made is not only taking into account the current status of the growing stock but also the projected future stand condition. The paper presents the outcome of the growing stock assessment and recommends silvicultural options to enhance the growing stock of second growth production forest.

**Key words:** second growth forest, harvesting, silviculture, projection

# DEVELOPMENT OF LOCAL VOLUME TABLE FOR SECOND GROWTH FORESTS USING STANDING TREE MEASUREMENTS

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**Abstract:** The need to have an accurate measure of tree volume is fundamental in forest management and administration as tree volume is widely used for estimating the productivity of a forest stand, as well as for the assessment of taxes and fines. In moist tropical forest, volume table has been recognized as the best approach to estimate volume especially due to some difficulties in tree measurements. Various researches on tree volume estimation have been conducted in Peninsular Malaysia with the purpose of improving planning in the management of forests. In order to construct reliable volume tables, enumeration of a relatively large number of sample trees of various size classes and species or species groups are required. The enumeration of each sample tree requires accurate diameter measurements of several sections of the stem. To obtain such measurements, traditionally the sample trees have been measured either using felled or standing trees and therefore costly and time consuming. Currently, the same level of accurate measurements can be obtained without the need to undertake destructive sampling or direct measurements, such as by climbing trees. This paper highlights the use of digital measurement tool for the measurement of standing trees for the development of volume tables. The benefits and limitations of this digital approach over traditional data collection technique are discussed.

**Key words:** local volume table, second growth forest

# SECOND GROWTH FORESTS: ARE THEY GROWING AND HAVE THEY RECOVERED?

H. ISMAIL, Z.S. NURHAJAR, W.A. WAN SHUKRI,  
M. SAMSUDIN AND O. HARFENDY

**Abstract:** To achieve sustainable forest management in production forests, accurate estimates of forest growth and recovery are critical to determine appropriate cutting cycles, growing stock and allowable harvest. Under the current forest management system, Selective Management System (SMS), a cutting cycle of 25-30 years is being applied based on the projected volume growth rate of 2.0-2.75 m<sup>3</sup> ha<sup>-1</sup> year<sup>-1</sup>, mortality at 0.9% year<sup>-1</sup> and ingrowth at 0.6% year<sup>-1</sup>. In terms of growing stock, the management requires at least 32 sound residual trees ha<sup>-1</sup> (30-45 cm dbh) of commercial species to be left behind during harvesting to form the next harvest volume. This paper reviews results of some growth and yield studies conducted in Peninsular Malaysia. It also reports the initiative undertaken by FRIM to uniformly analyze 10 growth and yield study areas in Peninsular Malaysia. Results indicate that mean diameter growth was recorded at 0.4-0.7 cm year<sup>-1</sup> and volume increment was at the rate of 1.0 -1.5 m<sup>3</sup> ha<sup>-1</sup> year<sup>-1</sup>. Results also indicate that mortality rate of more than 5% at 1-3 years after logging was higher than anticipated due to damage during harvesting operations. Rate of mortality stabilized at about 2% in plots logged more than 15 years. Results also indicate that higher ingrowth rate of about 4% in almost all of the plots. However, this was insufficient to offset the lost of stand volume due to mortality. A computer growth and yield prediction model namely Growth and Yield Models for Mixed Tropical Forests (GYMMTF) has been successfully developed by FRIM whereby non-linear volume functions (Chapman-Richard, Gompertz, and Logistic) were incorporated into the model. The logistic volume function was found to be the best fitted function for forest in Peninsular Malaysia. The function for all species (15cm +) is  $Volume = 304.288 / (1 + \exp^{(0.8359 - 0.0289 * Year)})$ . A mathematical function that relates Stand Volume (Q) at Year t and initial growing stock (g) was developed and expressed as  $Q(t,g) - g = 0.05496838t^{1.370805} g^{0.9203555} \exp^{(-0.0107871t - 0.01765623g + 0.00003009421tg)}$ . Using these volume expressions, optimization study was carried to determine the optimum cutting cycle for second growth forests in Peninsular Malaysia. Overall results indicate that second growth forests are not growing to the projected level as expected under the current forest management practices. The current cutting cycle of 25 to 30 years has to be prolonged to at least 40-50 years. The optimum initial growing stock should be at least 90 m<sup>3</sup> ha<sup>-1</sup> for all trees above 15cm. Another option is to maintain the current cutting cycle, but the number of residual trees has to increase from 32 tree ha<sup>-1</sup> to 45-50 tree ha<sup>-1</sup>. Results of growth and yield studies are very important in refining and adjusting the current management system to ensure that the management of productive forests in the country is biologically sound.

**Key words:** second growth forests, growth and recovery, cutting cycle

# CLASSIFICATION OF SECOND GROWTH FORESTS AT TEKAM FOREST RESERVE, PAHANG AND CHERUL FOREST RESERVE, TERENGGANU

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**Abstract:** Currently, the management of forests in Malaysia is facing new challenges as harvesting of production forests experiences a shift from the generally rich and productive undisturbed forests to logged-over forests. In the very near future, all forest harvesting is expected take place only in logged-over forests. One of the main challenges involves the classification of the forests by stocking classes. This problem does not exist in the management of undisturbed forest as the forests are generally homogenous in terms of size class distribution, and as such the implementation of pre-felling inventory throughout the whole compartment to assess the growing stock is adequate. However, second growth forests logged more than 20 years ago are more heterogeneous in nature with high variations in size class distribution due to the previous harvesting operations. This characteristic is expected to be more profound in forest types with high clumping features or where harvesting was unevenly implemented, thus creating a patchy nature. To understand this, a study was conducted to assess and classify the second growth forests located in Tekam Forest Reserve in Pahang and Cherul Forest Reserve in Terengganu. A look at the stocking of second growth forests of various ages on both sites indicated that there was no particular trends of forest recovery. Classifying such forests based on years after logging was found to be unveiling. Since the study areas are large and heterogeneous, classification was made based on forest canopy densities. The approach was based on Forest Canopy Density (FCD) Model developed by the International Tropical Timber Organisation (ITTO) and was successfully tested in several tropical forest areas. Landsat 7 ETM+ imageries of the year 2003 were used for the classification. The classification yielded 4 FCD classes, namely Low (1-30%), Medium (31-50%), High (51-70%) and Very High (>70%). It was found that this approach gave a better reflection of the forest stocking classes and was more pragmatic to be implemented in large forest areas. The FCD classes could be used for forest classification although further refinement may be required to enhance forest management at the operational scale.

**Key words:** logged-over forest, forest classification, forest canopy density

# VARIATION ANALYSIS ON BUFFER ZONE, CUTTING-LIMIT AND SLOPE ANGLES IN TIMBER HARVESTING PLANNING

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**Abstract:** Managing a very complex ecosystem such as in maintaining sustainability of a tropical forest is very challenging. The challenge has increased in the recent years in timber producing countries like Malaysia due to increased demands and environmental pressures that need forest managers to make crucial and quick decisions. At present, forest management not only deals with harvesting but also conservation and rehabilitation. These normally involve large volumes of data and analysis, which have been mostly carried out manually in most tropical countries. As a result, the efficiencies and effectiveness of the decisions implemented are limited. To overcome this difficulty, this study proposes the development of a GIS-based tool for timber harvesting planning for a tropical forest in Malaysia. Timber harvesting is chosen in this study because it is one of the most sensitive environmental activities in tropical forests. This study presents an analysis of the rule-set, as specified in the Selective Management System (SMS), which is used during forest harvesting in Malaysia. The rules are implemented in a Geographic Information System (GIS), using the ArcGIS 9<sup>TM</sup> software, and these are applied to a small test area, part of the Bubu Forest Reserve (FR) in Taiping, Perak, Malaysia. Although most of the rules specified in the SMS are based on fixed threshold values, this study also presents an analysis in which the threshold values are modified, such that the effect of variation in the threshold is explored. Thus, the study evaluates the sensitivity of the forest management system to the specific threshold values employed in the SMS.

**Key words:** Geographic Information System (GIS), tropical forest, harvesting, and Selective Management System (SMS)

# STOCKING AND SPECIES COMPOSITION OF SECOND GROWTH FORESTS IN PENINSULAR MALAYSIA

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**Abstract:** Management of the production forests in Malaysia is currently undergoing a major change as the total extent of undisturbed forest being harvested is diminishing. Currently most of the harvesting operations are being conducted in second growth (rotation) forests and in the near future all production forest will solely consist of only logged forests. This is expected to result in a significant reduction of the supply of raw materials to the industry because second growth forest stands are generally poorer and not so well-stocked with quality timber species. According to the forest management systems applied to these forests, namely the Selective Management System (SMS) and the Malayan Uniform System (MUS), the residual forests should be able to recover in the specified rotation cycle and there should be sufficient quality crop for the second and subsequent harvests. To understand the situation, a study was carried to assess the stocking and species composition of second rotation forests in two production forests located in Tekam Forests Reserve, Pahang and Cherul Forest Reserve, Terengganu. The study results indicated that the second rotation forests are not as productive as predicted but still able to produce an economic harvest in terms of total timber yield within the specified rotation cycle. However, based on inventory projections of existing stocks, it was found that in general the forests have not fully recovered in terms of stocking of commercial species. Species composition has been altered favouring higher dominance of non-dipterocarp species. Some of the major factors that could have contributed to this phenomenon are slower recovery of the forest after the first cut, higher mortality due to logging damage, and implementation of cutting limit prescriptions that favour high removal of dipterocarps as they are dominant in the upper diameter classes. It must be noted that the second growth forest assessed were those that were more than 20 years old. Currently, forest management practices have improved significantly and thus the recent second growth forests are expected to be in a much better condition. The information generated from this project on the status of the stocking and species composition of second growth forest will be essential for improving planning and management of the resource with the aim of enhancing future productivity.

**KEY WORDS :** second growth forests, stocking, species composition and forest management

# **MANAGING SECOND ROTATION NATURAL TROPICAL RAIN FORESTS UNDER THE SELECTIVE MANAGEMENT SYSTEM: THE CASE OF DUNGUN TIMBER COMPLEX, TERENGGANU, MALAYSIA**

**WAN MOHD SUHAIMI WAN AZIZ AND BORHAN MOHD**

**Abstract:** Dungun Timber Complex (DTC) Forest Management Unit (FMU) has been under the continuous management of the Kumpulan Pengurusan Kayu Kayan Terengganu (KPKKT) since 1983, and is now in its second rotation under the Selective Management System (SMS). The first rotation of the 25-year harvesting cycle was completed in 2007 involving all the productive virgin forest stands within DTC. The second rotation of 30 years is implemented from 2008 whereby the management of timber and non-timber forest produce within the FMU must now take place within the second growth stands. KPKKT takes cognizance of the fact that the timber stock under the second cycle may, or may not, be as good both quantitatively and qualitatively, and that appropriate strategy must therefore be formulated and implemented in earnest to handle and adapt to the new situation. The paper recommends the strategies and describes the findings from surveys conducted in the logged-over stands of the managed forests together with actual experience gleaned from two compartments. The future of SMS appears to be bright, but the system needs to consider and solve the uncertainties with regard to various assumptions in SMS to make it more functional, based on the present results of research and development.

**Key words:** Selective Management System, timber management, professionalism in forest management.

# TIMBER YIELD FROM SECOND ENTRY LOGGING IN THE LOWLAND MIXED DIPTEROCARP FOREST OF DERAMAKOT, SABAH

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**Abstract:** Whilst timber production from first entry logging in dipterocarp forests is well reported, there is relatively little published information on timber yields from second entry logging. Such information is useful in providing an indication of the long-term sustainability of timber output from repeated logging. We studied timber yield from second entry logging in the lowland mixed dipterocarp forest of the Deramakot Forest Reserve, Sabah, about 30 years after the first logging. Logging operations in Deramakot follow the standards prescribed in the Reduced Impact Logging (RIL) Guidelines for Sabah. Up to end of 2006, RIL had been carried out in 19 compartments in Deramakot, ranging in size from 315–770 *ha*. The net logged area, or net area affected by logging operations, averaged 27.8 % of the compartment size. Logging intensity averaged 8.6 trees *ha*<sup>-1</sup>, or roughly, 55 *m*<sup>3</sup> *ha*<sup>-1</sup>, and salvaged logging residue was 5.2 *m*<sup>3</sup> *ha*<sup>-1</sup>; hence, the total net volume extracted was 60.2 *m*<sup>3</sup> *ha*<sup>-1</sup>. The dipterocarps accounted for the largest proportion (90%) of merchantable timber yield from Deramakot. The species were mainly Keruing (*Dipterocarpus* spp.: 28.7%), Red seraya (*Shorea* spp.: 23.2%), and White seraya (*Parashorea* spp.: 12.7%). Timber output from second entry logging in Deramakot was much lower than those figures reported from logging operations using similar harvesting guidelines in the primary forests of Sabah. This could mean that after 30 years since the first logging, the forest has not attained its original mature phase structure, and is therefore still in a growing phase. However, the relatively low proportion of net logged area raises concern as to whether the harvesting was properly planned to optimize extraction rates. The results also do not support the suggestion that repeated logging may shift the composition of timber stands from one that was formerly dominated by dipterocarps to one dominated by non-dipterocarps, at least not for the second round of logging. Realistically, it would take several cutting cycles to draw any conclusions on the long-term sustainability of timber yield from Deramakot.

**Key words:** Logged-over lowland mixed dipterocarp forest, timber output, reduced impact logging, Deramakot, Sabah