



**UNIVERSITI PUTRA MALAYSIA**

**MAPPING THE CENTRAL MATANG MANGROVE FOREST  
RESERVE, PERAK, USING REMOTE SENSING AND GEOGRAPHIC  
INFORMATION SYSTEM**

**AZIAN BINTI MOHTI**

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PERAK, USING REMOTE SENSING AND GEOGRAPHIC  
INFORMATION SYSTEM**

**By**

**AZIAN BINTI MOHTI**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra  
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Science**

**April 2006**



## DEDICATION

*Wish to thank ALLAH the Almighty  
for his wisdom, guidance and strength in completing this Master*

*Dedicated to my daughter FIEFA  
my family members; MAK, ABAH, LAN, YAYA, AAH, IZAM, K.CHIK, UDIN,  
IETA, ENKGUK, arwah ADIK DULLAH and also IEMA  
last but not least ABANG...  
for their love, continuous moral support and encouragement.*

*"I'm the winner after going through the bad and good time within 7 years..."*



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

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**April 2006**

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**Faculty : Forestry**

Mangroves are characterized by littoral forest formation occurring in all estuaries of the Peninsular Malaysia. It plays an important role to protect the shoreline along the coast. In Malaysia, although mangroves are well managed especially in Perak, Johor and Selangor but the integration of remote sensing with geographic information system (GIS) for mapping and managing mangrove forest is not widely practiced. The purpose of this study is to use remote sensing technique using SPOT and IKONOS data integrated with GIS for mapping the extent of mangrove forest in central part of MMFR and for quantifying temporal changes in stand density and areal extent within the MMFR from year 1989 - 2000.



A study in mapping the mangrove forest using remote sensing integration with GIS was carried out in central part of Matang Mangrove Forest Reserve (MMFR) in the Range Kuala Trong, Perak. The study area faces the Straits of Malacca lying between latitudes 4°38'N to 4°49'N and longitudes 100°20'E to 100°36'E, where the classification of mangrove forest areas was carried out and recorded.

Multispectral SPOT (Systeme Pour l'Observation de la Terre) images of 1989, 1993, 1997 and 2000 and IKONOS image of 2000 for Kuala Trong areas (based on AOI) were enhanced, classified and vectorized using image processing software for the purpose of mapping the mangrove forest. Spatial data for the mangrove forests such as information of compartments, blocks, names of area digitized by the Forestry Department (Mapping and GIS Section) using ARC/INFO Version 3.4.2 Geographic Information System (GIS) software were used as secondary data in the study.

Based on the image analysis of the SPOT images, the mangrove forest reserves were classified as Excellent Forest Reserve, Good Forest Reserve, Poor Forest Reserve, Dryland Forest Reserve and Damaged Forest Reserve. These five classes of mangrove forests, can be further categorised as Productive and Non-productive area. The analysis showed that the average volumes of timber available within the productive areas of the study site were Excellent Forest (362.50m<sup>3</sup>/ha - 50.82%); Good Forest (256.31m<sup>3</sup>/ha -

5.93%) and Poor Forest (94.54m<sup>3</sup>/ha - 13.25%) with an overall classification accuracy of more than 70% while the statistics value obtained from Kappa's was shown more than 0.6 which is relatively quite good results for image processing.

It can be concluded that the satellite remote sensing with the integration of GIS can be successfully used and implemented for mangrove classification and mapping for the advance purposes of providing fast, efficient and accurate information on the mangrove resource.

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

**PEMETAAN BAHAGIAN TENGAH HUTAN SIMPAN PAYA BAKAU  
MATANG, PERAK, MENGGUNAKAN PENDERIAAN JAUH (RS) DAN  
SISTEM MAKLUMAT GEOGRAFI (GIS)**

Oleh

**AZIAN BINTI MOHTI**

**April 2006**

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Di Semenanjung Malaysia bakau mempunyai karektor untuk hidup subur di sepanjang muara sungai. Bakau penting untuk melindungi kawasan tebing laut. Walaupun hutan bakau diuruskan dengan baik di Malaysia terutama di negeri Perak, Johor dan Selangor tetapi, integrasi teknololgi penderiaan jauh dengan sistem maklumat geografi untuk pemetaan dan pengurusan hutan paya bakau merupakan satu fenomena baru. Kajian berkenaan pemetaan dan pengurusan hutan paya bakau menggunakan penderiaan jauh dengan GIS dilakukan di bahagian tengah Hutan Simpan Paya Bakau (HSPB) iaitu kawasan Kuala Trong, Perak. Kawasan kajian ini mengadap Selat Melaka dengan latitud di antara 4°38'U hingga 4°49'U dan longitud di antara 100°20'T hingga 100°36'T.



Imej satelit SPOT tahun 1989, 1993, 1997 dan tahun 2000 serta imej satelit IKONOS tahun 2000 bagi kawasan Kuala Trong (hanya mengambil kira kawasan kajian) telah dipertingkatkan, dikelaskan dan divektorkan menggunakan perisian yang dikhaskan untuk pemrosesan imej bagi pemetaan hutan paya bakau ini. Data spasial untuk kawasan hutan paya bakau seperti maklumat kompartmen, blok, nama, kawasan dan sebagainya lagi telah juga digunakan. Maklumat ini telah ditukarkan dalam format digital oleh Jabatan Perhutanan (Bahagian Pemetaan dan GIS) menggunakan perisian Sistem Maklumat Geografi (GIS) ARC/INFO versi 3.4.2 dan digunakan sebagai data sekunder dalam kajian ini.

Berdasarkan analisis yang telah dijalankan pada data SPOT, lima kelas hutan paya bakau dapat dikelaskan iaitu Hutan Paling Bagus, Hutan Bagus, Hutan Miskin, Hutan Darat dan Hutan Rosak. Seterusnya daripada lima kelas hutan paya bakau ini, dua daripadanya dapat dinyatakan iaitu kawasan yang Produktif dan kawasan yang Tidak Produktif. Analisis purata isipadu kayu balak telah dapat mengenal pasti bagi kawasan produktif di dalam kawasan kajian yang mana Hutan Paling Bagus ialah  $362.50\text{m}^3/\text{ha}$  meliputi 50.82%, Hutan Bagus  $256.31\text{m}^3/\text{ha}$  meliputi 35.93% dan Hutan Miskin  $94.54\text{m}^3/\text{ha}$  meliputi 13.25%. Ketepatan pengelasan keseluruhan kawasan menggunakan kaedah penderiaan jauh melebihi 70%. Manakala nilai statistik yang diperolehi daripada Kappa pula melebihi 0.6. Ini jelas menunjukkan keputusan ini adalah baik bagi pengelasan imej.



Kesimpulannya, satelit penderiaan jarak jauh (RS) dengan integrasi Sistem Maklumat Geografi (GIS) boleh digunakan atau dilaksanakan dengan jayanya untuk pengkelasan hutan paya bakau dan pemetaan bagi tujuan selanjutnya supaya maklumat dapat disampaikan dengan cepat, efisien dan infomasi yang lebih tepat.

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I certify that an Examination Committee has met on 5<sup>th</sup> April 2006 to conduct the final examination of Azian Binti Mohti on his Master of Science thesis entitled “Mapping The Central Matang Mangrove Forest Reserve, Perak, using Remote Sensing and Geographic Information System” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommended that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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## DECLARATION

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

---

**AZIAN BINTI MOHTI**

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## GLOSSARY OF TERMS

|           |   |
|-----------|---|
| AOI       | Area of Interest                              |
| CASI      | Compact Airborne Spectrographic Imager        |
| CCRS      | Canada Centre for Remote Sensing              |
| CD        | Compact Disk                                  |
| CD-ROM    | Compact Disk – Read Only Memory               |
| CNES      | Centre National d’Etudes Spatiales            |
| DEMs      | Digital Elevation Models                      |
| DN        | Digital Number                                |
| ENVI      | Environmental for Visualizing Images          |
| ESRI      | Environmental Systems Research Institute      |
| etc       | et cetera                                     |
| FAO       | Food and Agricultural Organization            |
| FCC       | False colour composite                        |
| F.D.(MGS) | Forestry Department (Mapping and GIS Section) |
| GCPs      | Ground Control Points                         |
| GIS       | Geographic Information Systems                |
| GPS       | Global Positioning Systems                    |
| HRV       | High Resolution Visible                       |
| IIFOV     | Instantaneous Field of View                   |



|        |  |
|--------|--|
| IRS    | Indian Remote Sensing                      |
| ITTO   | International Tropical Timber Organization |
| LiDAR  | Light Detection and Ranging                |
| LISS   | Linear Imaging Self-scanning Sensor        |
| LUT    | Look Up Table                              |
| MACRES | Malaysian Centre for Remote Sensing        |
| MLC    | Maximum Likelihood Classifier              |
| MMFR   | Matang Mangrove Forest Reserve             |
| NDVI   | Normalized Difference Vegetation Index     |
| NIR    | Near Infrared                              |
| PFE    | Permanent Forest Estate                    |
| pixel  | picture elements                           |
| R-G-B  | Red - Green - Blue                         |
| r.m.s  | root mean square                           |
| RSO    | Rectified Skew Orthomorphic Projection     |
| ROI    | Region of Interest                         |
| SPOT   | Systeme Pour'l Observation de la Terre     |
| TM     | Thematic Mapper                            |
| USGS   | United State Geological Survey             |
| UPM    | Universiti Putra Malaysia                  |
| UTM    | Universal Transverse Mercator              |



|       |                    |
|-------|--------------------|
| www   | world wide web     |
| XP/P  | Panchromatic mode  |
| XS/Xi | Multispectral mode |





# CHAPTER I

## INTRODUCTION

### General Background

Mangrove forests form an integral component of the dynamic homeostatic coastal ecosystem. They are also termed as "Coastal Woodlands" or "Tidal Forest" mangroves (Kumari *et al.*, 1999), which are composed of salt tolerant, inter tidal halophytic vegetation forming a locale specific unique community with specific ecological amplitude. Mangroves are an integral part of the coastal environment extending throughout the tropics and sub-tropics of the world. It covers an area of one third of the world's total in South East Asia (Rao, 1992), and is considered rich in species diversity and luxuriant in growth (FAO, 1984).

Mangrove forests occur in the intertidal zone along the seacoast in most of the tropical and sub-tropical region (Arksornkoae, 1995). Although mangrove forests have multiple functions (such as human settlement, transportation and resource utilization) their occurrences are frequently regarded as wasteland having low economic value. Even if they are productive, there is a general early perception that mangroves are of lower value and their contribution to the adjacent ecosystem is not clear (Ong, 1984). Consequently, as human population increases and urbanization accelerates, mangrove land and resources are often converted to other uses.

