Rainforest Alliance SmartWood Program
High Conservation Value Forest (HCVF) Assessment Report

for:

Asia Pulp & Paper/Sinar Mas Group (Pulau Muda District)

Date of Final Report: 1 October 2004
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DISCLAIMER: This report is NOT for the purposes of Forest Stewardship Council (FSC) certification nor has it been reviewed or approved by the FSC in any manner. The presentation herein is based on the Rainforest Alliance SmartWood Program's adoption and use of some principles, models, or tools developed for the identification and assessment of HCVF, based on FSC definitions.

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ACRONYMS

AA	PT. Arara Abadi
AAC	Annual Allowable Cut
adat	Customary or Traditional Law
APL	*Areal dengan Penggunaan Lain* /Area of Other [non-forestry] Use
APP	Asia Pulp and Paper
CITES	Convention on International Trade in Endangered Species
CE	Critically Endangered Species
dbh	Diameter at Breast Height
FMP	Forest Management Plan
ES	Endangered Species
FMU	Forest Management Unit
FMP	Forest Management Plan
FSC	Forest Stewardship Council
GIS	Geographic Information Systems
GPS	Global Positioning System
HCV	High Conservation Value
HCVF	High Conservation Value Forest
HK	*Hutan Konservasi / Conservation Forest*
HPH	*Hak Pengusahan Hutan* / Production Forest Concession Right
HTI	*Hutan Tanaman Industri* / Industrial Timber Plantation
IBSAP	Indonesian Biodiversity Strategy and Action Plan 2003 – 2020
ILO	International Labor Organization
IUCN	The World Conservation Union
Kab.	*Kabupaten* / District or Regency
Kec.	*Kecamatan* / Sub-District
KTH	*Kemitraan Tanam Hutan* / Community Planting Partnership
MGI	PT Multi Gambut Industri, oil palm plantation adjacent to FMU
MTH	Mixed tropical hardwoods
MAI	Mean annual increment
MoF	Ministry of Forestry
NCAP	National Conservation Plan for Indonesia
NTFP	Non-timber forest product(s)
PA	Protected Areas
P&C	Principles and Criteria
PSF	Peat Swamp Forest
PT.	*Persero Terbatas* / Limited Liability Company
RDB	Red Data Book
RKPH	*Rencana Karya Pengusahaan Hutan* / Forest Concession Master Management Plan
RKT	*Rencana Karya Tahunan* / Annual Workplan
SAP	Sustainability Action Plan of APP.
SFM	Sustainable Forest Management
Sg.	*Sungai* / River
SMG	Sinar Mas Group
SPA	PT. Satria Perkasa Agung
TNC	The Nature Conservancy
TPTI	*Tebang Pilih Tanam Indonesia* / Indonesian Selective Logging System
WKS	PT. Wira Karya Sakti
VS	Vulnerable species
WWF	World Wide Fund for Nature

(See Appendix 5 – Glossary for definition and/or usage of terms)

1. Introduction

This report presents the findings of an independent assessment of High Conservation Value Forests (HCVFs) in an industrial timber plantation (*Hutan Tanaman Industri, HTI*) in Riau Province, Sumatra, Indonesia. From July to August 2004, the Rainforest Alliance's SmartWood program conducted an independent assessment of Asia Pulp and Paper's (APP) 79,754 ha Pulau Muda forest management unit (FMU). The Pulau Muda District (PMD) is one of APP's industrial timber plantations in Riau Province (Sumatra, Indonesia). Pulau Muda District is comprised of three HTI companies managed by one of the companies, PT. Arara Abadi (AA), a subsidiary company of APP. The HCVF assessment was conducted by a team of specialists representing the SmartWood Program of the Rainforest Alliance.

APP requested this assessment as it was necessitated by company commitments made to customers and to export credit agencies, and as specified in forestry-related environmental covenants between APP and its creditors. SmartWood was selected as an independent conservation expert to develop a methodology for this assessment, and to conduct a field-based trial analysis of the assessment process at the Pulau Muda District.

1.1 Purpose

The purpose of the present HCVF assessment was a) to identify the High Conservation Values (HCV) within the defined Forest Management Unit (FMU) of the Pulau Muda District managed by PT Arara Abadi, a subsidiary of the Asia Pulp and Paper Company (APP), b) to propose a boundary delineation for High Conservation Value Forest (HCVF) within this FMU, and c) outline basic management and monitoring implications for maintenance of identified HCVFs.

This assessment did not evaluate nor verify APP legal compliance, forest practices, or any aspect of APP forest management other than what is described herein.

1.2 Approach

The approach adopted by SmartWood for this assessment was to start with the guidance provided in the document prepared by Proforest and Rainforest Alliance, *Identifying, Managing, and Monitoring High Conservation Value Forests in Indonesia: A Toolkit for Forest Managers and other Stakeholders, Version 1, August 2003*, hereinafter referred to as the 'Indonesian HCVF Toolkit', 'HCVF Toolkit, or simply the 'Toolkit'. The concept of High Conservation Value Forests was developed by the Forest Stewardship Council (FSC) in 1999. Central to the determination of HCVF within a forest management unit is the assessment and identification of High Conservation Values. The HCVF toolkit takes the FSC definitions of HCVs and describes a series of steps to conduct a systematic evaluation of the conservation values that exist in a forest area, and to establish a rationale for those values that are particularly significant and whose conservation is of critical importance. The Indonesian interpretation of the HCVF toolkit has been applied at other FMUs in Indonesia, for example TNC's HCVF assessments of PT Intracawood Manufacturing and PT Sumalindo Lestari Jaya II natural forest concessions in East Kalimantan in 2002. Similarly, WWF conducted a preliminary assessment of Riau Province and an HCVF analysis of the Giam Siak Kecil landscape in 2003. In the current trial, SmartWood developed a methodology based on this toolkit, but adapted and further defined its provisions to be more practical for the purposes of identification and assessment.

1.3 HCVF Assessment Team

SmartWood assembled a team of assessors with expertise in ecology and social sciences to conduct the HCVF assessment and delineation. The team's specialized scope covered habitat

and species ecology in tropical forests, the socio-economics of village communities, Geographic Information Systems (GIS), and the application of independent forest certification methods.

The background experience and competencies of the team are summarized in the following bio-sketches, and table 1 indicates the HCVs that they focused on.

Table 1. Assessment Team Expertise and HCVF Assessment Focus

Name	Fields of Expertise	HCV Aspect
Jeff Hayward	Forest Management	Project Manager
Anthony Sebastian	Wildlife Ecologist	HCV 1
Mark Leighton	Forest Ecologist	HCV 2, 3 & 4
Chris Bennett	Social Scientist	HCV 4, 5 & 6
Martin Hardiono	GIS	GIS analysis & Mapping

Jeff Hawyard, Msc.
Mr. Hayward is Asia Pacific Regional Manager, of the Rainforest Alliance SmartWood Certification Program, based in Jakarta, Indonesia. He has conducted over 20 forest management assessments, scopings, and/or audits and over 60 chain of custody assessments and/or audits.He has conducted silviculture and ecology research for the B.C. Ministry of Forests and UBC Alex Fraser Research Forest in Canada. In Oregon State, he worked for the federal government in the U.S. Bureau of Land Management in forest inventory and timber sale administration. For three years he worked with the U.S. Peace Corps as a community forester in Guatemala, providing technical extension services to an agroforestry and conservation of natural resources program. His private forestry consulting has been for the B.C. Ministry of Forests, the FSC and IIED. Publications include research on forest certification and forest silviculture.

Anthony Sebastian, BSc.
A wildlife ecologist by training, he is a natural resource management consultant with Aonyx Environmental, an international specialist consultancy based in Kuching, Malaysia. Mr. Sebastian has 13 years experience in species and habitat management in Southeast Asia, with specific experience with floodplain and tropical peat ecosystems. He has worked in almost all the remaining peat swamp forests on the Malay Peninsula and Borneo. He brings considerable wetland conservation and management experience, particularly from a protected area management planning perspective, to the team.

Mark Leighton, PhD.
Dr. Leighton is a tropical forest ecologist with 27 years of research experience in basic and applied rainforest ecology, mostly focused in Indonesia, and especially Kalimantan. For over 20 years he has taught courses in rainforest ecology, vertebrate ecology, and forest management systems while on the faculty at Harvard University. He has directed research programs that span tropical plant ecology, vertebrate ecology, plant-vertebrate ecological interactions, conservation biology, and financial and ecological appraisals of sustainable forest management systems. He founded the Gunung Palung Research Station in 1984, which has supported nearly 200 research publications by himself and his colleagues and students. He has advised policies for the Indonesian Ministry of Forestry, numerous conservation initiatives and UNESCO and UNEP. His consulting work includes work on tropical landscape conservation planning, forest certification and the design of mixed function sustainable forestry enterprises that incorporate conservation objectives.

Chris Bennett, MSc.
Over the past 20 years, Mr. Bennett has worked mostly in Indonesia, but also in Laos and Malaysia, on forestry and agroforestry development and broader issues in natural resource management. In recent years, he has carried out policy and institutional analysis linked to broad-based dialogue through shared learning for good governance of decentralized natural resource management. This has included national policies and regulations, participative decision-making for land management and village-based co-management of public forestry land resources. Much of his policy analysis has been through consultancies for organizations such as the Harvard Institute for International Development (HIID), World Bank, United States Agency for International Development (USAID), U.K. Department for International Development (DfID), F.A.O., Centre for International Forestry Research (CIFOR), the Ford Foundation, SmartWood (Rainforest Alliance), The Nature Conservancy (TNC), and Birdlife International. An Adjunct Professor at the University of British Columbia with the Food and Resource Economics Centre, he teaches a course on rural development.

Martin Y. Hardiono, BSc.
Mr. Hardiono has been working in the field of GIS and Remote Sensing for the past 10 years mainly in conservation, which he has chosen as his field of interest for the past 15 years. He has intensive field experience in Indonesia, and also worked in Sabah, Cambodia and Lao PDR. He has worked as an independent consultant for almost 6 years since he left WWF Indonesia in 1995. He has worked for various conservation and research organization including The Nature Conservancy, World Wide Fund for Nature, the East-West Center, the Yale University field study in West Kalimantan and numerous Indonesian organizations. He contributed to the production of GIS overlays, maps, and spatial analysis of all HCVs.

1.4 Report Availability, Layout, and Review

Initially, this report was to be divided into two parts, publicly-available and confidential. APP has decided to make the entire written report publicly available, so the public portion (Sections 1, 2, 3 and appendices) and the private portion (Sections 4, 5, 6, and technical annexes) are now available to the public.

The format of the reporting is as follows:
1: *Introduction*
2: *Organisation and Landscape Context of the FMU*
3: *Assessment Methodology*
4: *Determination of the Presence and Location of HCVs*
5: *Delineation of HCVF(s).*
6: *Management and Monitoring Implications of the HCVF(s).*
Bibliography

Appendices include:
(1) Data Sources
(2) APP / SMG Contacts
(3) Interviewed Stakeholders
(4) Itinerary
(5) Glossary of Terms

Technical Annexes include:
(1) Assessment checklist
(2) C.V.s of the assessors and reviewers
(3) Peer reviewer reports
(4) Photographs and maps
(5) Tables of plants, NTFPs, rainfall data, landscape data, village demographics, etc.

This report was peer reviewed by Dr. Steve Jennings (of ProForest) a tropical forest ecologist and principal architect of the HCVF Toolkit and Dr. Darrell Kitchener, a wildlife zoologist with over 30 years experience in conservation of biological diversity. The final report does not necessarily reflect the views of Dr. Kitchener, Dr. Jennings or ProForest.

2. Organisation and Landscape Context of the Forest Management Unit

2.1 Contact information

FMU Name: Pulau Muda District
FMU Manager: Mr. Kho Tjin Ho, Senior District Manager, PT Arara Abadi
FMU Contact: Mr. Arian Ardie, Director of Sustainability and Stakeholder Engagement, APP
Address: APP, c/o Plaza BII, Tower II, 19th Floor
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Tel: +62-21-392-9266
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2.2 FMU Description

2.1.1 Type and Period

The Pulau Muda District is comprised of three concessions managed as a single entity for the conversion of logged natural forest areas to establish an Industrial Timber Plantation (*Hutan Tanaman Industri, HTI*). The three concession license areas are PT. Arara Abadi (AA), PT. Satria Perkasa Agung (SPA) and a collaborative venture with local communities known as KTH (*Kemitraan Tanam Hutan*) Sinar Merawang. The FMU is managed by PT. Arara Abadi (AA). During the early 1980s, the FMU was selectively harvested under the Indonesian Selective Logging and Planting System or *TPTI*, under concession licenses granted to PT. Alam Jaya and later to PT. Wira Karya Sakti (WKS). In the mid-1990s, 20-year HTI licenses were granted for the area.[1]

The current HTI licenses under AA management permit land clearing of the logged-over forest areas, the establishment of canals and drainage ditches, and the planting of species suitable for commercial production of pulpwood. AA has established, almost without exception, *Acacia crassicarpa* on peatland areas. All of the timber obtained from the land clearing is logs of Mixed Tropical Hardwoods (MTH), suppling PT Indah Kiat Pulp & Paper mill in Perawang, Riau Province. Small volumes of larger-diameter logs are supplied to plywood mills.

2.1.2 Location

Pulau Muda District is divided by the Kampar River into two distinct management sub-units. The management unit under assessment is located upstream and south of the Kampar River, and unless otherwise stated, is referred to as Pulau Muda District in this report. This is termed the "FMU". The area north of the Kampar River, known as 'Serapung', was not included in the assessment[2].

The FMU is located within the lower tidal reaches of the Kampar river, east of the Kerumutan Wildlife Reserve. Around 102° 36' East and 0° 15' North to 103° East and 0° 2' South, the FMU's northern limit is aligned with the southern bank of the Kampar river and on average 2.4km from the river's high tide mark, runs from its eastern-most point at longitude 102° 36' East and latitude 0° 7' North. Its southern limit, 36km from the

[1] The master management plans or *RKPH* for the HTI were approved in 1999 and 2000 for PT. SPA and PT. AA, respectively.
[2] APP has stated that Serapong will be included in future HCVF assessments.

Kampar river, is at longitude 102° 47' East and latitude 0° 4' South. The FMU reaches its western-most point at longitude 102° 53' East and latitude 0° 14' North.

The FMU is situated within three districts (Kabupatens), namely, Kab. Pelalawan, Kab. Indragiri Hulu, and Kab. Indragiri Hilir, and all are within Riau Province, Sumatra.

2.3 Forest Management System

2.3.1 Forest Land Classification

Most of the HTI area is designated by the Provincial government as production forest for clear-felling and replanting with fast-growing *Acacia* species to supply APP's pulp and paper operations. HTI licenses mandate three other uses for the forest areas, namely:

- *Kehidupan* (development for local community livelihoods),
- *Unggulan* (development of high-quality local tree species)
- *Konservasi* (conservation).

Table 2 summarizes by area and percentage the remaining natural forest within these land use categories within the FMU at the time of the HCVF assessment.

Table 2. Proportion of Natural Forest Cover by Land Use Category at time of assessment

Land Use Category	Total Land Area		Natural Forest Cover /2/	
	Ha. /1/	%	Ha.	%
Production Forest for Plantation / *Produksi*	51,441	64.5	14,062	35.3
Conservation / *Konservasi* /3/	14,447	18.1	14,100	35.4
Livelihoods / *Kehidupan*	3,525	4.4	3,050	7.7
High-quality Local Species / *Unggulan*	9,567	12.0	8,588	21.6
Totals	79,752	100	39,805	100

Sources: SAP, RKPH; and interpretation of Spot 2 Image May 9, 2004
Notes- /1/ Includes canals & drainage ditches; /2/ Lightly to severely-degraded; /3/ Includes 773 ha of oil palm encroachment by PT MGI plantation.

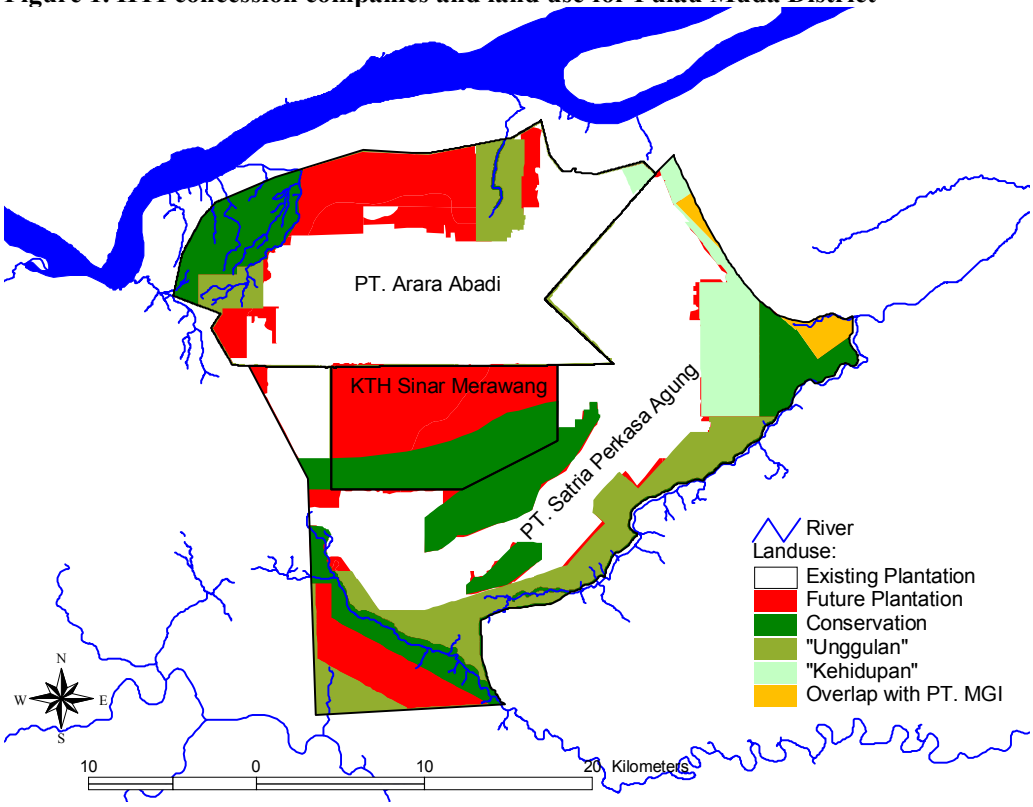
2.3.2 Land Use Objectives of the Forest Management System

The primary purpose of the FMU is to access wood fibre in the short-term and to provide AA with a land base for plantation development for the long-term.

Plantation establishment begins with harvesting and transport of MTH logs of approximately 10-30cm DBH. These logs are manually hauled on wood rails to loading points alongside canals. From here they are towed in barges through an extensive grid of minor and major canals to 1,000-ton capacity river barges that are then towed out the Kampar River, along the sea, back up the Siak River to a landing point from where they are trucked to the mill.

The cleared land base is used to plant fast-growing timber species, the main species being *Acacia crassicarpa*. A six to seven-year growing cycle is assumed based upon estimated MAI of 25 m3 ha^{-1}. The first harvest of planted timber in Pulau Muda is scheduled for 2005. To date all plantation establishment has occurred on the AA and SPA concession license areas only (see figure 1).

Figure 1. HTI concession companies and land use for Pulau Muda District



An area originally assigned for plantation development, Kemitraan Tanam Hutan (KTH) Sinar Merawang, was designated as a potential carbon-trade "set-aside", with benefits to be shared with local communities. This carbon-offset plan is no longer being actively pursued. AA had yet to decide with certainty how this area should be managed, and so the forest has remained unharvested.

APP's Sustainability Action Plan (SAP) recognizes various conservation areas (HK – *Hutan Konservasi*) amounting to 14,446.6 ha or 18.1 % of the FMU area, namely,

- Northwestern HK close to the Kampar river, conserved partly because the area has local spiritual value, partly because of the close network of river systems within.
- Eastern HK, primarily intended as a buffer between the FMU and the MGI oil palm plantation. MGI and the FMU land base currently overlap in the eastern corner where forest has been lost to oil palm development extending over the boundary.
- Central HK, much of it designated as *Kawasan Lindung* in the government-approved long-term management plan (*RKPHHTI)*.
- Southern HK, between two plantation areas, chosen due to regulatory prescriptions concerning river systems.

Two other land uses are requirements of the HTI license. *Kehidupan* areas are supposed to be for development of local community livelihoods. Provision is made for forest conversion (e.g. food crop cultivation), but also includes uses that maintain forest functions whether as natural or plantation forest, as long as local community livelihoods are directly supported. There is single *Kehidupan* area west and adjacent to the eastern conservation area amounting to 3,535 ha (4.4%).

Unggulan areas are designated for development of high-quality local tree species. Similarly, this function could be met by maintaining natural forest functions. *Unggulan*

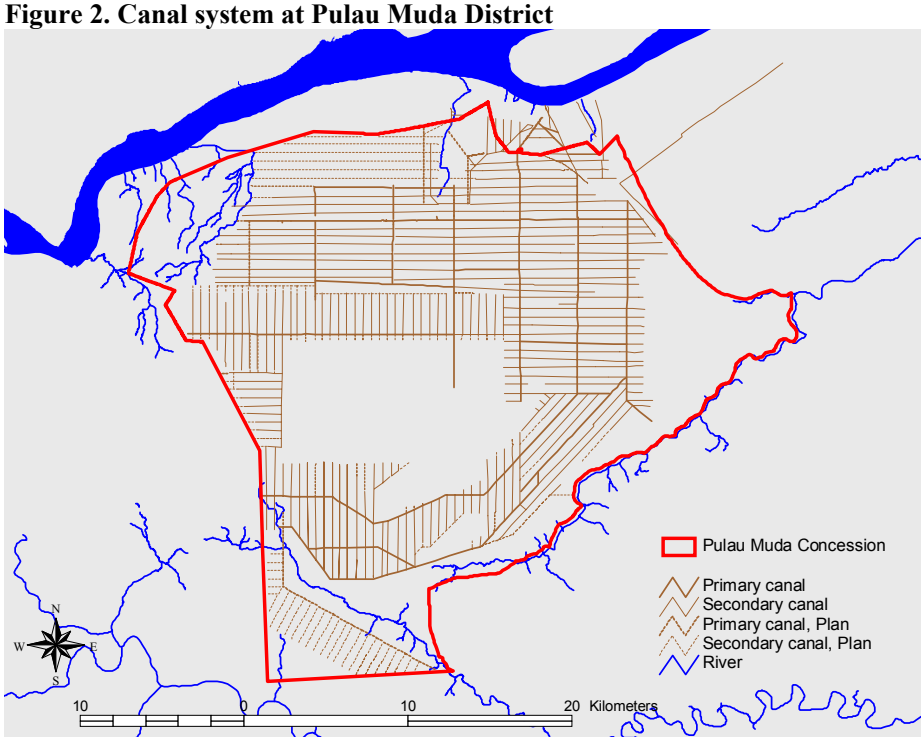
areas are found alongside the Simpang Kanan River that constitutes the southern FMU border and around the Merawang River in the north. The Unggulan area is 9,567 ha (12.0%).

AA had not framed concrete plans for management of either the *Kehidupan* or *Unggulan* areas, although the majority of these areas were natural forest at the time of the assessment.

A final land use feature, worthy of separate consideration because of the way it fundamentally alters the hydrology of the area, is the network of drainage ditches, minor and major canals that provide access to the plantation areas in the FMU. The existing canal system provides access to approximately 50% of the FMU land area, and if plantation development plans were completed, would extend across about 65% of the FMU area. Figure 2 illustrates the existing and proposed drainage and transport network.

The primary function of the canals and associated infrastructure is to control water table depth at an optimum for both plantation growth, for management access into the plantations, and for transport of logs. Main canals are on average 12m wide and 3.5 - 4m deep, while secondary canals are on average 9m wide and 2 - 3m deep. Canals are usually blocked to conserve water once planting and early maintenance operations are completed, and the main transport route may be closed off temporarily with water-gates or other structures. At the time of the field assessment, there was a net outflow from the canal system.

Figure 2. Canal system at Pulau Muda District



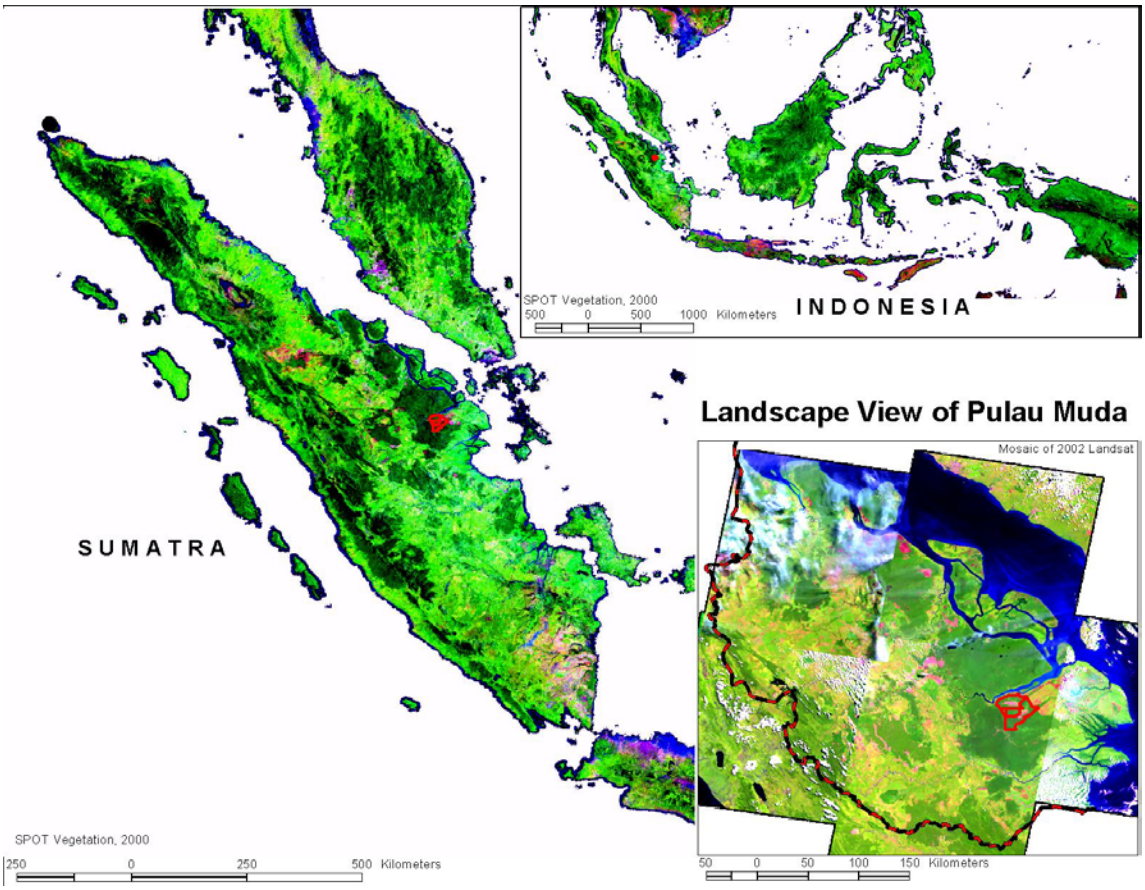
The problems and challenges for water management in the FMU includes flooding in the northwestern corner of the plantation area, potential shortages elsewhere which would require the drawing down of water reserves from higher elevations in the system, and open access to suppress fires should they occur in the FMU at any time (see Section 4.4, below). In response, AA has embarked upon a research and development

programme to engineer a canal system that monitors and manages the FMU's hydrology.

2.4 Ecological Context

The FMU is part of the Kerumutan landscape, one of the few remaining large continuous blocks of peat swamp forest (PSF) within what will be referred to in this report as the East-Central Sumatran PSF ecoregion (see section 2.4.2). The northern portion of the FMU is within the Kampar River Basin, whose upper reaches extend to the Barisan mountains of West Sumatra. The largest remaining representation of this landscape is the Kerumutan Wildlife Reserve, to the west. Only limited areas of the original landscape forest ecosystems remain within the FMU. The ecology of the FMU is therefore best described in relation and comparison with that of Kerumutan, and for the purposes of this report the landscape, which includes a portion of the Kampar River Basin and Kerumutan Wildlife Reserve, is referred to as the "Kerumutan landscape". Figure 3 offers a view from space which situates the Pulau Muda district (note the red outline of the FMU) as located on Indonesia, Sumatra, and Riau Province satellite images.

Figure 3. Landscape Overview of the Pulau Muda District



2.4.1 The Kerumutan Wildlife Reserve

The Kerumutan Wildlife Reserve (*Suaka Margasatwa Kerumutan*) lies due west of the FMU. Covering an area of around 120,000ha, Kerumutan constitutes one of the largest protected areas in Sumatra. It is comprised almost entirely of peat swamp forest, with an estimated 5,000ha of alluvial dryland forests interspersed with mixed swamp forest along the levees of the Sg. Kampar in the north.

Silvius *et.al.* (1987) describe an area of approximately 20,000ha of dryland forest below 50m a.s.l. in the western part of the Reserve. Kerumutan has been described as the best example of inland lowland swamp forests in Riau Province, and the richest in species due to the proximity of dry-land forests (Silvius *et al*, 1987). The National Conservation Plan for Indonesia concluded that of the existing reserves in Riau, Kerumutan is the most valuable (MoF 1995).

There is little ecological information on the Kerumutan Reserve, and no reliable species inventories have been compiled. Anecdotal information and the initial database compilations from the 1987 Wetland Database (Silvius, *et.al.*, 1987) suggest a typical representation of peat swamp forest fauna, including the large mammals (Asian Elephant, Sumatran Tiger and Malayan Tapir).

Between the Kerumutan Wildlife Reserve and the FMU is a strip of contiguous forest cover that runs the length of its north-south aligned 27km long boundary. This intervening forest is 11.5km at its widest, and 5km at its narrowest. The forest is contiguous through its entire length, although the effects of logging have degraded certain stretches. Within a contiguous forest landscape such as was existent prior to the events of the past 20 years that have significantly altered the landscape, the forests of Kerumutan extended eastwards to the coast.

2.4.2 The Ecology of Peat Swamp Forests

The FMU is located in a coastal peatland inland from mangrove swamp where peat has been accumulating over marine sediments (Reiley, Ahmad-Shah & Brady, 1996). Peat soils are typically water-logged and extremely nutrient-poor. Its low pH (typically 3.5-4.5) inhibits vegetative decomposition by microorganisms, causing net accumulation over time, and correspondingly increasing in depth. The soil profiles exposed in the drainage canals of the FMU clearly display un-decomposed limbs, twigs and roots that are characteristic of acidic, anaerobic peat. Large accumulations of peat act like a sponge, absorbing and holding water at a level about 50cm below the surface. In dry seasons the water table drops.

The nutrient-poor, and often waterlogged, peat soils present extreme physiological challenges to plants. Under normal rainfall conditions and short dry periods, the sponge action of peat keeps the water table high, however, in extreme dry seasons the water table falls and plants must be adapted to these drought conditions. Leaves are leathery and tough to resist desiccation and crowns are small relative to tree height and diameter. The peat flora is comprised mostly of plants endemic to peat swamps, and this flora is the most restricted among tropical rainforest vegetation (Cannon & Leighton 2004; Rieley & Ahmad-Shah 1996). Nonetheless, the peat flora is species-rich in trees, and this diversity is mostly at the generic level, with most tree genera of nearby dry lowland forests contributing one or two endemic peat swamp species to the unique flora.

Due to periodic contiguity during the sea level drops associated with the recurrent ice ages over the last two million years, the extensive peat swamps of west and central coastal Borneo, east-central Sumatra and south peninsular Malaysia share many species. However, the species assemblages, or peat plant communities vary regionally. The Sumatran PSF are a distinctive forest type, and their biodiversity is characteristic of the habitat. The East-Central Sumatran peat swamp forests form a unique ecoregion representing the PSF along the eastern coast of Sumatra (Wikramanayake *et. al., 2001*; Jarvie *et. al.,* 2003a). Although few peat forest plant species endemic to Sumatra have been noted in the literature, the flora has not been sampled to identify rare endemics, (Rieley & Ahmad-Shah 1996), which are likely to occur. Because of barriers formed by river systems, and limited dispersal, species assemblages of peat swamp forest vary between the large landscape forest blocks within an ecoregion.

It is expected that the Kerumutan landscape level forest will vary in species composition from other landscape forests of this ecoregion. Differences in species composition and relative abundance can also occur within a contiguous landscape forest. The distribution of insect and other smaller animal taxa is expected to follow plant variation, because many insect herbivores are species endemics adapted to the unique properties of different plants. In summary, even within the same peat swamp forest habitat, plant species diversity varies over space on regional and local levels.

2.4.3 Habitats and Species

The tropical PSF of Southeast Asia exhibit a close correlation between forest structure and peat depth (Rieley & Ahmad-Shah 1996; Tie, 1990; Anderson, 1964; 1983). This relationship is based on three primary factors: Peat depth, Nutrient availability and Water-logging. Peat formations typically form domes, which rise from the levees of rivers, reaching their maximum depths towards the centre, or furthest from the rivers. Peat deposits are shallowest at the edges and deepest in the centres. Plant communities typically differ along these concentric gradients, forming distinct “bands” around a dome.

The soil survey map of the FMU indicates a gradient from a band of shallow peat (<2.5 m deep) parallel to and within 3 to 4km of the Kampar River, rising steeply to a peat dome in the center-west of the FMU where the peat is up to 13m deep. In the band of shallow peat parallel to the Kampar River and inside the northern border of the concession, tree roots can reach mineral soils deposited during its previous flood cycles. The forest here is distinctive, and is termed Mixed PSF (Rieley & Ahmad-Shah 1996; Momose & Shimamura 2002). Mixed PSF peat swamp forest is bordered abruptly by Tall PSF as peat depth increases rapidly away from the river. A third habitat type occurs on the deepest peats (>10 m) of the central peat dome, referred to as Short PSF.

The three PSF habitats described in the FMU are relatively easy to distinguish on the ground and from the air both by stature and indicator species. However, this classification corresponds only roughly to other published studies. Each study of a PSF ecosystem has defined distinct habitats based on criteria of structure and floristics, but each classification is idiosyncratic to some degree (see the review of Reiley, Ahmad-Shah & Brady, 1996). The definition of these three habitats, as used here, follows established nomenclature in Rieley & Ahmad-Shah (1996), but is dissimilar to the peat vegetation classification of Momose & Shimamura (2002), even though the latter was from nearby Kerumutan Wildlife Reserve. Based on the data they present, we do not think their subdivision of the tall PSF into subtypes was justified. SmartWood acknowledges that eight days of field assessment and over flights are inadequate to evaluate important variation for sub-structuring within these broad habitat classes or to detect rarer discrete peat forest habitats.

Two other habitats are present within the FMU. Riverine forest and floodplain lacustrine wetlands. A detailed description of the habitats and the characteristic species within each are given below.

Mixed Peat Swamp Forest (Mixed PSF)
Mixed PSF is a habitat found at the margins of peat swamp forest nearest to sediment-bearing rivers where the shallow peat allows trees to root in mineral soil. Although most of the plants here are typical PSF trees, many are restricted to this zone, and are good indicator species. In this region these include *Koompassia excelsa* and *Durio lowiana*. These shallow peat soils often form a mosaic with two other distinctive habitats, freshwater swamp and alluvial bench forest (Rieley & Ahmad-Shah 1996; Cannon & Leighton 2004). As rivers like the Kampar sporadically flood, silt and clay is deposited in backwaters behind river levees. These freshwater swamp areas are seasonally inundated and hummocky, with muddy mineral soils and absent of peat. Over time these alluvial soil deposits build up above the flood level, forming flat terraces or benches. The flora here is the same as species-rich lowland rainforest, although distinctive alluvial soils and topography distinguish it as Alluvial Bench Forest.

Mixed PSF and these other two associated "minor" habitats are essential and recurrent elements of coastal peat swamp forests. Because all three forest types are on mineral-rich alluvial soils, they support tall and productive forest similar to lowland rainforest. Tree species diversity is high and big woody climbers and figs are species diverse and common, unlike other peat swamp forests. A full range of lowland rainforest vertebrates might be found here if this habitat is extensive enough. The flower, fruit and young leaves eaten by most vertebrate plant feeders, including hornbills, primates, bats, squirrels and many other taxa, are most diverse and most common in Mixed PSF and its associated minor habitats. These areas therefore serve as a refuge habitat, harbouring species at high densities that are relatively rare or only seasonally use the relatively unproductive other peat swamp forests. Because most plant species (ca. 80%) of all peat swamp forest habitats rely on birds and mammals for seed dispersal, and some plants for pollination, it is reasonable to hypothesize that the Mixed PSF serves as a "keystone habitat" (*sensu* Leighton & Leighton 1983) for nearby Tall PSF and Short PSF. That is, the plant species diversity and community integrity of these forests depend on viable populations of these mutualistic vertebrates whose populations are denser in the mixed PSF. In its own right, this habitat can support mammal and avifaunal communities closely resembling dry lowland mixed dipterocarp forests.

Tall peat swamp forest
Widespread across the FMU, tall PSF forms the dominant habitat type. Peat depth ranges roughly from 2- 10m, and is not permanently inundated. The continuous canopy is at 15-20m with scattered large trees (50-80 cm dbh). Emergent trees are most commonly the two *Shorea* spp. (*S. uliginosa* and *S. parvifolia*) and *Palaquium burkii*, whose coppery leaf undersides assist identification of this habitat from the air. Tree diversity is relatively high compared to Short PSF. In both Tall and Short PSF, *Campnosperma* spp. can be locally dominant and emergent, and is indicative of natural disturbance or prior selective logging, as it is a pioneer species which establishes in large open gaps.

Avifauna diversity is consistent with similarly structured PSF elsewhere in the region. Bird species can be broadly differentiated by their stratified utilization of the forest into canopy, middle storey, and understorey species. Canopy species are typified by Scarlet Minivet *Pericrocotus flammeus*, Blue-crowned Hanging Parrot *Loriculus galgulus*, *Megalaima* barbets and the *Aceros* hornbills. Middle-storey species include Scarlet-rumped Trogon *Harpactes duvaucelii*, Green Broadbill *Eurylaimus ochromalus*, and the

Malacopteron Babblers. Understorey species are typified by Red Junglefowl *Gallus gallus*, *Trichastoma* Babblers, White-rumped and Rufous-tailed Shamas *Copsychus malabaricus* and *Trichixos pyrrhopygus* respectively. Ground-living birds such as pheasants and pittas are less common, or entirely absent from pure PSF, but utilise river levees.

The large mammals (Asian Elephant *Elephas maximus*, Sumatran Rhinoceros *Dicerorhinus sumatrensis*, Malayan Tapir *Tapirus indicus*, Sumatran Tiger *Panthera tigris*) were not identified as present in the FMU, with the exception of Sambar deer *Cervus unicolor*, which is reported from the three major forested tracts remaining. Sambar deer tracks were seen at the KSM block and the southern strip, next to KL-2.

Primate diversity and sympatry is typically lower in PSF compared with dryland mixed dipterocarp and mixed PSF. Three monkeys were present in the FMU: the two macaques and a colubine, the Banded Leaf Monkey *Presbytis melalophos*. The Agile Gibbon *Hylobates agilis* is widespread, and the predominance of the black morph in this area is thought to be the reason why this ape is commonly referred to, in reports as well as by the locals, as the Siamang.

Short Peat Swamp Forest (Short PSF)

The forest over the central peat dome is different in structure from the taller PSF on the slopes of the dome. Both Tall and Short PSF are "pole" forests with slender trees and narrow crowns, as described elsewhere from Riau peat swamp forests (Rieley & Ahmad-Shah 1996). The effect is prominent here with dense stands of 10-20 cm dbh poles common in this habitat. The tree species are not unique, but are a subset and of different relative abundance to those of the Tall PSF. Trees are stunted, and the same emergent species of Tall PSF here are only 25-35cm dbh, rising marginally above a continuous canopy of only 8-12m. *Campnosperma*, the tree pandan *Pandanus atrocarpus* and the common *Tristania obovata* are aerial indicators of this habitat, as is its generally fine grained texture of small tree crowns, a distinguishing feature of the habitat from aerial overflights and photographs.

Riverine Forest

This habitat includes the river channels, with aquatic plant communities such as floating and submerged macrophytes (*Uticularia* sp.) and emergent macrophytes (*Hanguana malayana*). No information is available on the fish fauna present, but it can be expected to comprise typical family representation from blackwater fish and invertebrate fauna. Darters *Anhinga melanogaster* is a typical bird of such rivers, and although none were observed, the species is expected to be present. Two species of Otters are present, likely *Aonyx cinerea* and *Lutra sumatrana*, both residents of peat swamp forests,

These forests vary from flood-tolerant communities consisting of *Syzygium* and herbaceous species such as *Stenochlaena* sp. and *Eleocharis* sp.. Typical species found in this habitat are Black-and-red broadbill *Cymbirrhynchus macrorhynchos* and Malaysian Blue Flycatcher *Cyornis turcosus*. The White-winged Duck *Cairina scutulata* is largely confined to swamp forests on Sumatra, primarily in association with water bodies and remote rivers systems.

Floodplain Lacustrine wetlands

This wetland type extends from outside the FMU into the southwest corner. The area inside the FMU is small. This habitat is formed along the upper reaches of shallow water channels, where the water table is constantly at the surface and hence inhibits growth of trees. Sedges dominate these open bogs. Subjected to seasonal flooding, lakes form during the wet season.

Lacustrine habitats such as these provide rich feeding grounds for waterbirds and herbivorous mammals such as Sambar Deer *Cervus unicolor*. These areas are important for Milky Stork *Mycteria cinerea*, Storm's Stork *Ciconia stormi* and White-winged Duck.

Secondary Habitats
The environment within the FMU is greatly modified, and the fauna has been correspondingly altered as new scrubland / open secondary habitat species colonise the open lands and plantation forests. Typical birds associated with modified open habitats include Coucals (*Centropus* spp.), Yellow-bellied Prinia *Prinia flaviventris* and the White-throated Kingfisher *Halcyon smyrnensis*.

Long-tailed Macaque *Macaca fascicularis* and Pig-tailed Macaque *M. nemestrina* are both present within these modified habitats, and readily travel through the plantation forests. Wild Pig *Sus scrofa* is also present throughout the FMU in all habitat types. The presence of Bearded Pig *Sus barbatus* has not been confirmed, but its presence cannot be discounted.

2.4.4 Conservation Value for Globally Threatened Species

The majority of globally threatened vertebrate species in PSF are also found in dry lowland forests. The common factor between tropical wetland and dryland forests is more their level lowland topography, rather than the physical character or structure of the forest types themselves. There are many forest mammals and birds that are confined to these level lowland habitats, and these are referred to as lowland specialists. Wells (1985) described these species as being adapted to closed-canopied tall moist forests and generally confined to the level lowlands, seldom occurring above 100m asl.

PSF are some of the last remaining reservoirs for lowland vertebrate species, a result of the widespread loss of dry lowland forests. Sebastian (2002) emphasized the value of Malaysian PSF for lowland specialists, which naturally occur in both dry and wet lowland habitats, but whose ranges have been "constricted" to remaining PSF tracts as dryland habitats have disappeared. Examples of such species are Wrinkled Hornbill *Aceros corrugatus*, formerly widespread in dry lowland forests, but today found mainly in PSF, and Wallace's Hawk-Eagle *Spizaetus nanus*, a lowland specialist that has disappeared over much of its former range, with the majority of recent records from PSF.

The loss of moist lowland forests throughout the region has placed pressure on a large number of these lowland specialist species. This habitat has been identified as the single most important forest type, supporting c.70% of threatened forest species (Birdlife International, 2003).

The Kerumutan landscape forest block importantly conserves many globally significant vertebrate species. The forest areas within the FMU continue to support naturally occurring populations of these species. Table 3 summarises the globally significant species known to occur within the FMU. Definitions of the categories of threat according to IUCN are provided in Appendix 5.

Table 3. Globally-significant species occurring in the FMU

	CR	EN	VU	LOW RISK			TOTAL
				nt	cd	dd	
Mammals			2	5		1	8
Birds		2	4	23			29
Reptiles & Amphibians		1					1
Total	-	3	6	28	-	1	***38***

Refer to Appendix 5, Glossary of Terms for definitions of criteria of threat.

2.5 Social and Economic Impacts on the FMU Landscape

Like other major lowland river basins in eastern Sumatra, the Kampar river basin's peat swamp forests have a long history of natural forest disturbance, degradation and loss from logging, small- and large-scale land clearing as well as forest fires. Patterns of unauthorized logging, clearing for timber and oil palm plantation development and agricultural encroachment by smaller-scale and smallholder farming systems, as reported for lowland forest areas elsewhere in Riau province (Jarvie *et al.* 2003a, b) are a feature of the landscape of the Kampar river basin. The landscape of which the FMU is a part, however, appears to have suffered lower levels of exploitation than in the neighbouring major river basins to the north and the south. Various factors may account for this such as remoteness from urban and agricultural development centres as well as lower-cost extractive conditions elsewhere.

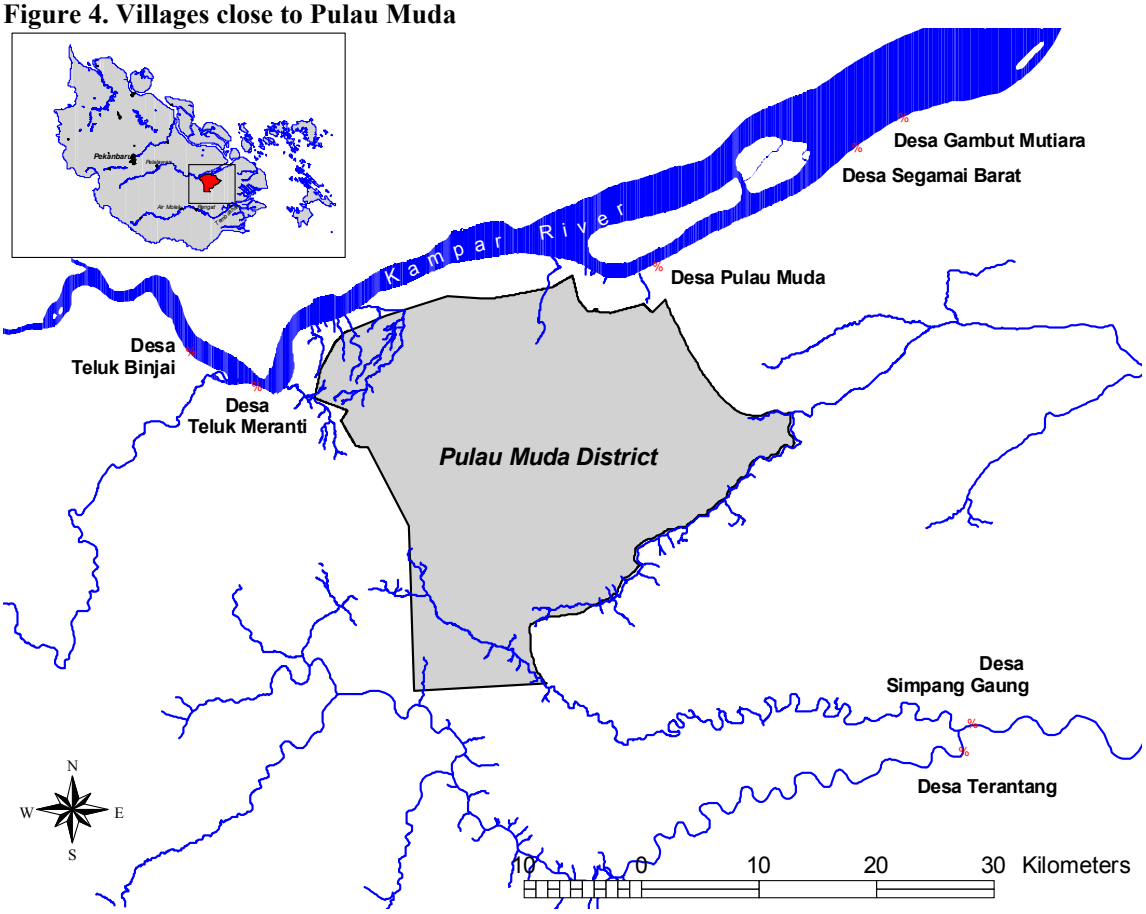
One feature that may have played an enduring role in slowing down the rate of logging is the tidal bore or *bono*, a wave front at the turn of the low tide that can be over 3m high around the full moon when the high-low tide differential is greatest. The phenomenon is most prominent between the villages of Pulau Muda and Teluk Meranti that flank the northern part of the FMU, and is particularly pronounced during the December solstice when the highest tidal differential and opposing river flows coincide. Shifting sand-banks along the river add to the destructive and sometimes fatal force of the *bono* wave for any vessels on the river. Log booms are especially vulnerable. One of the company's 1,000-ton log barges was once carried some three kilometers upstream before it came to rest. A few years ago, the *bono* claimed the lives of some 15 villagers and company staff when it overran their boat which had run aground in the river shallows.

Illegal logging may occur at a slower rate because of the *bono,* but is otherwise as uncontrolled as elsewhere. Logging rates among the myriad of small-scale illegal operations along the other, smaller rivers in the Kerumutan landscape appears to be high, ranging from scattered frontier locations to contiguous heavily-logged areas along parts of the Simpang Kanan River. Aerial observations of the southern and southeastern areas outside the FMU and within its borders indicate an expanding zone of illegal logging. The Simpang Kanan River was observed to be swollen by flow constrictions through the adjacent MGI oil palm concession and served as an access route for illegal logging. Furthermore, trees now debilitated and dying as the result of the inundation would be vulnerable to fire in periods of drought as the exposed peat soils would be prone drying and easier ignition. Illegal logging incursions into the Kerumutan Wildlife Reserve are a serious threat to this large expanse of peat swamp forest.

The era of government-approved selective logging of natural peat swamp and other lowland natural forest in the production forest areas (*Hutan Produksi*) of the Kampar river basin that began in the 1970s are being replaced by forest conversion to large-scale industrial timber plantations and oil palm plantations, as well as succumbing to smallholder agricultural encroachment. Natural forest areas, ever more fragmented, survive between these land use conversion systems.

Two villages are located north of the FMU along the south bank of the Kampar River. Teluk Meranti to the west and Pulau Muda to the east, as depicted in Figure 4.

Figure 4. Villages close to Pulau Muda



The locally recognized boundary between the villages is the Merawang river, a tributary of the Kampar flowing through the central north portion of the FMU. Villages to the south of the FMU include Simpang Gaung and Terantang.

The villages of Teluk Meranti and Pulau Muda illustrate how rural livelihood strategies are eroding the natural forest resource base which is nonetheless valued for some functions[3]. Each village consists of land areas either side of the Kampar River. Most of the smallscale logging takes place on the north side of the river. Agricultural uses are concentrated to 500 - 1,500 metre strips of forest that remain inside village areas, inland from the banks of the river and bounded beyond by the MGI oil palm plantation or the Kerumutan Wildlife Reserve.

Both villages are so-called *muara* villages in contrast to the upstream *pangkalan* villages that used to be important staging grounds for estate crop commodities such as coffee and rubber (Kuniyasu 2002). Historically, *muara* villages were poorer. The replacement of river transport with roads, employment opportunities in downstream timber and oil palm plantations and above all opportunities to sell timber from village forests have transformed this social equation. Thus, *muara* villages have risen in economic importance relative to the *pangkalan* villages.

At the village level, the earlier agroforestry systems based upon rubber and coconut cultivation are increasingly being replaced by oil palm smallholdings. The attractions of oil palm cultivation are causing forest and land clearing by small and medium scale

[3] Detailed raw data collected for each village is available in tables within the Technical Annexes.

farmers inside both villages. A road through the natural forest hinterland of Teluk Meranti village is being constructed as far as the border with the Kerumutan Wildlife Reserve, with oil palm allotments being planned along its length. A similar road has been cut through the remaining forest strip between the village of Pulau Muda and the adjacent MGI oil palm plantation. The village head stated hopes that over 1,000 ha of this natural forest strip could be cleared in the future to cultivate oil palm.

Sustainable natural forest uses by local communities, as referred to by Kuniyasu (Kuniyasu 2002), is not apparently widespread. There are few hunters, fishermen, and gatherers of wild vegetables and medicinal plants who use the forest for its produce. Due to higher productivity elsewhere, better transport facilities linking these areas to Pulau Muda and Teluk Meranti, and increased incomes (from informal timber harvesting on the north bank of the Kampar river and from settled employment in the MGI and AA plantations), there are now ready substitutes of comparable quality such as highland vegetables and meat at competitive prices. Modern medicines are supplanting traditional medicines from agroforestry and natural forest areas, although complementarities between the two is sometimes apparent, e.g., for childbirth (see below).

Profiling the two villages revealed common origins, similar and different development directions as well as changing relationships with the natural forest domain. Teluk Meranti is the older of the two villages. Settled by Minangkabau people from West Sumatra, it was established in 1918; in 1968, the village was divided in two, the eastern half becoming Pulau Muda village (in 2002, the western part of Teluk Meranti became Teluk Binjai village). The Teluk Meranti settlement site was originally a safe place to wait for the *bono* tidal bore to pass (during the colonial era Dutch tourists would watch the *bono* from here). Trade in timber and dammar resin from natural forests, controlled by the Dutch, as well as river staging posts for other commodities shipped from upland areas, were the main reasons for settlement. Later, smallholder rubber cultivation and trade became important with shipments direct to Singapore until the early 1970s when such direct trade was no longer allowed.

Teluk Meranti has a smaller population (2,022 among 567 households) than Pulau Muda (3,906 among 905 households). More than 90% of each village are Melayu people, with an array of minority groups living interspersed with the majority cultural group. Of the 990 adults of Teluk Meranti, 70%[4] are farmers and fishermen. About a half of these cultivate 426 ha with traditional varieties of rice on alluvial soils, mostly on the north side of the river. 10% of rice farmers switch to fishing activities after the annual rice season. Smallholder rubber cultivation in peat areas is now minimal and typified by old stands of low productivity. Some 25% of farmers now cultivate a total of 375 ha of oil palm holdings in peat soil, typically in 1-2 ha plots. Few farmers produce surplus vegetables for market. Large quantities of vegetables and fruit are now readily available in the local market.

Small quantities of vegetables are gathered from the natural forest inland of the settlement. Such gathering is done by women. Though small in quantity, variety is high. Rattans from the natural forest are no longer traded internationally or regionally, although remain important as raw material for fish traps and agricultural tools. Hunting in forest and non-forest areas is a minor activity.

It is estimated that around 50% of the population are involved in the wood industry from (unauthorized) logging to sawn wood production and trade. Most of the timber is sourced

[4] Livelihood percentages presented do not add up to 100%. Some adults do more than one thing, e.g., farmers are also in the (unauthorized) wood industry, or some are AA and MGI employees, etc.

from village forest areas on the north side of the river; a tiny amount of wood has been sourced from the Tanjung Bebayang area. Evidence of several idle sawn timber mills and low wood prices indicated that the wood exploitation boom, locally, may now be over. Villagers reported that some in the wood industry were now returning to their farm plots.

Another important source of income for about 15% of the adults is employment as labourers or salaried staff of nearby private companies, such as AA, MGI, and RAPP. The remaining 5% of the adult population are civil servants and military personnel.

Pulau Muda village manifests a number of socio-economic conditions and trends similar to Teluk Meranti. Apparently, the oldest settlement was one that failed. According to village elders, early settlers along the Merawang River succumbed to human and crop diseases and pests. This happened long before the first successful settlement in the area, that of the Pulau Muda Island beginning in 1968, primarily for rice cultivation. The Merawang River is still a source of fish, forest rattans and medicinal plants as well as unauthorized timber. In 1971, these settlers moved to the south bank of the river (*Daratan Sumatera*) to establish the present main settlement of Pulau Muda.

As an example of the livelihoods in Pulau Muda, in one of three sub-villages or *Dusun* which borders the FMU, over 50% of adults are smallholder farmers of rice and coconut-based agroforestry systems. As in Teluk Meranti, oil palm cultivation is rising in importance as coconut cultivation wanes. Coconut palms are often heavily attacked by the rhinoceros beetle, left abandoned and are at high risk of fire. Around 10% of adults fish in the Kampar river, in the FMU's canals and in the southern Simpang Kanan and Gaung Kiri rivers and 5% of adults are traders.

A small minority gathers rattans from natural forests for the production of fish traps and agricultural tools and Nipa palm for the roofing of modest dwellings. Damar is still harvested but like rattan is not traded outside the village area. It is used mostly as a sealant for boats.

Around 35% of adults are involved in the wood industry, many of whom are also smallholder farmers. 90% of timber is sourced from the north side of the Kampar river, 10% from inland village forest areas on the south side. More stable longer term sources of income are derived from employment opportunities with plantation companies. About 40% of adults have found employment, some two thirds of them with AA (300), the remainder with MGI, though this may include members of families that enjoy both sources of income.

In summary, the pattern of village economic activities in the two villages is a combination of timber trade as long as stocks last, rice cultivation wherever feasible, a growing trend of oil palm cultivation, and significant employment with nearby plantation companies, especially AA. Fish sources of protein are abundant, particularly from the FMU's canal system that provide the most dependable supply of fish for Pulau Muda, as compared to the seasonal supply variations of river fish. Imported meat, fish, and large quantities of vegetables are likely to increase over time.

With few exceptions (discussed in section 4.5 and 4.6), local communities do not perceive a major role for natural forest management in their scheme of income-earning. For these communities it would appear that the forest is not valued as forest per se (to be continuously managed or protected as a forest) but valued primarily for other purposes such as a source of timber at the lowest cost (regardless of whether or not the forest survives), or as a means to obtain land for agricultural development.

3. *Assessment Methodology*

The following sections describe the manner by which SmartWood applied the Indonesian HCVF toolkit to identify HCVs and delineate HCVF(s) in the FMU of Pulau Muda District.

3.1 Three Phases of the Assessment Approach

SmartWood undertook this independent HCVF assessment in three phases, each one with specific objectives and measurable deliverables.

Phase I: SmartWood brought together a team of four conservation biologists and wildlife ecologists, one forester, and one social scientist to clarify a series of specific questions that APP had about how an HCVF assessment would be applied to company FMUs. This clarification was done for APP so that the company could make a more informed decision, with greater understanding, prior to engaging SmartWood to conduct a trial assessment at Pulau Muda District. This work was completed in April 2004.

Phase II: SmartWood then continued with a smaller team of specialists (two wildlife ecologists, one social scientist, and one forester) to develop a methodology that could guide adaptation and field use of the HCVF toolkit in a pilot assessment scheduled for the Pulau Muda District. The result was a series of documents that would draw from the HCVF toolkit, but be operational and focused on guiding the assessment team and the company as to what criteria would be evaluated, what methods would be used, what data was needed, and how the information the team analyzed would be presented and reported. SmartWood prepared an assessment checklist with guiding questions or criteria related to each of the HCV definitions (see section 3.2 below) originating from the toolkit. The checklist indicated key tasks and methods for the SmartWood assessors and for the FMU managers to enable identification of the presence of HCVs within the FMU. SmartWood then established threshold criteria for qualifying and delineating HCVF areas within the FMU based on the identified HCVs (see section 3.3.2 below). The methodology was shared and discussed with Rainforest Alliance, the World Wide Fund for Nature (WWF), The Nature Conservancy (TNC), and APP. This phase was completed in mid-July 2004.

Phase III: SmartWood began the pilot field HCVF assessment for the Pulau Muda district on 19 July and concluded the field work on 30 July 2004. Report writing took place between 02 and 23 August 2004, when the draft report was submitted to APP and the two independent peer reviewers. The report was also reviewed by Richard Donovan, SmartWood Director and Chief of Forestry, Rainforest Alliance. The report was revised to incorporate the comments from all reviewers and APP. After technical clarifications, the report was finalized by SmartWood. A publicly available version of the final report was published on the SmartWood website on October 10, 2004.

3.2 Defining High Conservation Values (HCV)

The FSC (2000) has established six definitions of High Conservation Values (HCVs). Components to determine the presence of these HCVs were developed by Proforest, through the development of a Global HCVF Toolkit framework and as interpreted by the Indonesian HCVF toolkit, which follows a format similar to the Global Toolkit. Identification of the presence of HCVs in the Pulau Muda FMU was based on the guidance provided in the

Indonesian HCVF toolkit. These six HCV definitions and their main components from the HCVF Toolkit are:

HCV 1: *Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia)*;

HCV component threshold definitions:

1.1 Protected areas - All protected areas and proposed protected areas are considered HCVs.

1.2 Critically Endangered Species - Any species listed as critically endangered by IUCN or on Appendix I of CITES that is actually or potentially present within the FMU is an HCV.

1.3 Concentrations of Threatened or Endangered or Endemic species - A forest containing a concentration of threatened of endangered species or a concentration of endemic species, as recognised by national and international experts, is an HCV.

1.4 Critical Temporal Concentrations - A globally significant concentration of migratory species or a nationally significant temporary concentration or migration route is an HCV.

HCV 2: *Forest areas containing globally, regionally, or nationally significant large landscape level forests, contained within, or containing the management unit, where viable population of most if not all naturally occurring species exist in natural patterns or distribution and abundance.*

HCV component threshold definitions:

2.1 A FMU which is a large landscape forest is considered an HCV.

2.2 A FMU which is an integral part of a large landscape forest is considered an HCV.

2.3 A FMU which contains viable populations of most naturally occurring species is an HCV.

HCV 3: *Forest areas that are in or contain rare, threatened or endangered ecosystems.*

HCV component threshold definitions:

3.1 Where and FMU contains significant size of these rare, threatened, and endangered forest types and has been identified as a conservation priority area by an independent organization, then the forest types is an HCV. Rare, threatened or endangered ecosystems that are located outside the FMU that are impacted heavily by FMU activities is also an HCV.

HCV 4: *Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control)*

HCV component threshold definitions:

4.1 Where forests provide the only source of water for daily use to a community, this will be an HCV.

4.2 Forests that are protected, DAS Super-Prioritas and Prioritas, other significant DAS and Sub-DAS areas designated by relevant experts, as well as cloud forests, will be HCVs.

4.3 Any forest boundary that protects against large scale fire is an HCV.

4.4 Any forest that has a critical impact on the forest services that agriculture or aquaculture are dependent upon is an HCV.

HCV 5: *Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health)*

HCV component threshold definitions:

If local communities obtain essential fuel, fodder, medicines, or building materials from the forest, without readily available alternatives, then the forest is an HCV. HCV5 applies only to basic needs.

HCV 6: *Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance in cooperation with such local communities).*

HCV component threshold definitions:
If forest areas are critical to the traditional cultural identity of local communities, e.g., restricted-use and reserve forest, ancestral burial, spiritual, religious, and taboo sites, then the forest area will be HCV.

To assess and determine the presence of conservation values that would be considered HCV according to these definitions requires highly trained ecological and social experts; further consultation with relevant stakeholders (communities, government bodies, forest managers, scientists, and NGOs); access to baseline inventories, data sets, maps, and spatial imagery; and professional judgment based on field evaluation. The steps taken to perform these assessment tasks are described below.

3.3 HCV Identification and HCVF Delineation

3.3.1 Steps to implementation of field assessment, data collection, and analysis

Step 1. Preliminary Assessment and Preparation for Field Assessment

Preliminary assessment of spatial data and literature supported the decision to proceed with an HCVF assessment, as it was evident that some, and potentially all, HCVs were present.

⇒ Recent satellite imagery was reviewed, indicating that the Kerumutan landscape forest is isolated from other forested landscapes by major rivers and severely degraded forest and agricultural areas. It was evident that this landscape is one of a few remaining tracts of large landscape forests of the East-Central Sumatran peat swamp forests.
⇒ The FMU, located in the northeast portion of the Kerumutan landscape, is contiguous with the Kerumutan Wildlife Reserve, and part of a large landscape of peat swamp forest, as shown by satellite imagery.
⇒ GIS overlays of concessions already licensed by the government for conversion indicated that planned land use changes for the landscape will further reduce the area of contiguous forest.
⇒ The preliminary HCVF assessments of the Riau PSF by WWF (Jarvie *et al*. 2003a, c) were evaluated and indicated the potential HCV presence in the natural forests within the FMU as related to other PSF areas.
⇒ Literature research included consultation of indices and databases of endangered and threatened species, maps, government legislation, and definition of various PSF habitats within the East-Central Sumatran peat swamp forest ecoregion.

Step 2. Field Observations and Data Collection

The SmartWood HCVF assessment checklist identified information to be acquired from the company and other sources, and that from direct field observations. Due to the limitations of company ecological data, the assessment would rely greatly upon the expertise of the team to collect primary data.

⇒ Data were gathered through meetings with APP/SMG and AA staff and workers at their Jakarta, Perawang, and Pulau Muda District offices. Data were acquired firsthand by meeting with members of local communities.
⇒ Observations, ground-truthing, and rapid survey of conservation values were conducted for species, ecosystems, forest services and community resource uses (basic needs and cultural). These were obtained through field visits to

locations within and surrounding the FMU on foot, motorbike, speedboat, and small boats.

⇒ Baseline spatial information on forest cover and landscape features was obtained from remote-sensing imagery (SPOT2A, May 2004 and Landsat7, August 2002).

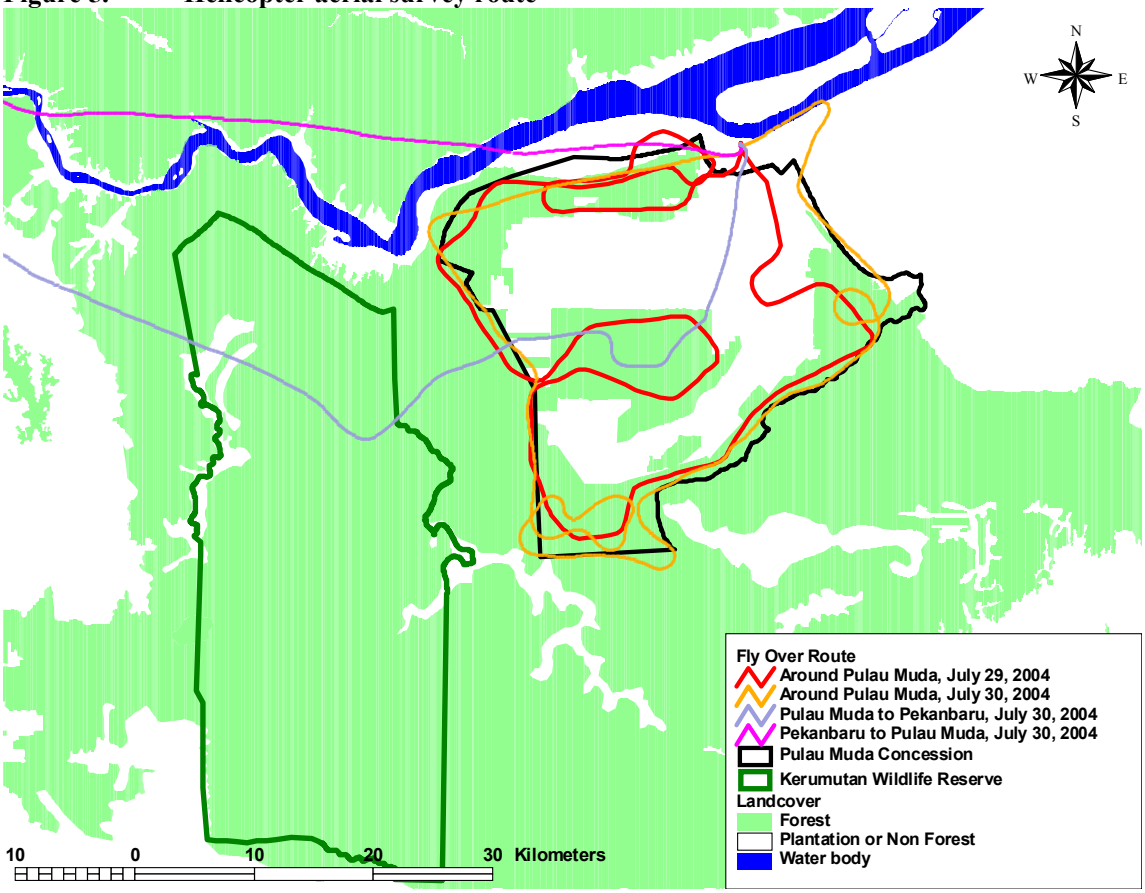
⇒ Vegetation and habitat mapping of the FMU was not available, and thus required primary data from aerial reconnaissance and preliminary ground-truthing

⇒ Species inventory baselines were developed through anecdotal information, available literature on the Kerumutan Wildlife Reserve, and from the company AMDAL reports. [Data were sparse and/or inaccurate, requiring primary data gathering at accessible locations.]

⇒ Background information on species and conservation status was gathered from literature searches and documents provided by APP, from interviews with local people and staff / workforce [although turnover of the largely immigrant workforce meant few sources of reliable local knowledge], and from conservation organizations.

⇒ 2 helicopter aerial surveys of the concession and landscape (See Figure 5 for a map of the flight path.)

Figure 5. Helicopter aerial survey route



Step 3. Data analysis to determine potential HCV areas

The data analysis instrumental for the determination of HCV areas required significant professional expertise from the ecologists and social scientists working in the forest

and villages. The comparative analysis of different key data sources is outlined here to support the rationale for HCV identification presented in section 4.

Habitat

⇒ Evaluation of soil and topographic maps to determine soil and hydrological conditions was used as a basis for habitat distinctions.

⇒ Analysis of recent satellite images to delineate remaining forest areas and water bodies, and their contiguity or condition, within the FMU.

⇒ Comparison of natural forest types sampled at a few locations to characterize structure, indicator plant species, and abiotic conditions within the FMU.

⇒ Checking consistency of vernacular tree names with timber cruising staff to evaluate their correspondence to botanical tree names.

⇒ Collecting leaf and twig samples to create a field herbarium for identification of dominant plants; consultation with botanical references and published studies of peat swamp species.

⇒ Classification of forests and riparian areas into habitat types defined by vegetative structure and floristics, and combinations of peat depth and drainage.

⇒ Observations of vertebrates to establish indicative representation of faunal communities in relation to vegetation types or habitats.

⇒ Analysis of monthly rainfall records to determine frequency and intensity of drought conditions as threats to peat forest.

⇒ Mapping habitats within the FMU through direct observations from helicopter overflights and photographic analysis with computerized enhancement.

Species

⇒ Analysis of available information and published sources to establish a baseline for the FMU.

⇒ Evaluation of globally significant species in terms of habitat requirements and ecological behaviour through published sources of ecological knowledge on these species.

⇒ Analysis of habitat requirements provided the first layer for each target species, which was then correlated with presence of preferred habitats within the FMU, and ground-truthed where possible.

Social

⇒ Data on the importance of FMU forest areas to local community values primarily relied upon interviews with various village groups (e.g., executive and council, hunters, fishermen, *bidan* and *dukun*) to fill out data sheets on the significance of FMU forests as sources of basic needs or as areas of cultural value.

⇒ Social data included estimates of livelihood trends and extractive sustainability.

⇒ Watershed, river and canal observations were used to determine whether there were HCVs related to water resource protection.

3.3.2 Mapping the extent of identified HCVs

The occurrence and distribution of all identified HCVs were mapped using GIS. The use of GIS was necessary to take data collected from hundreds of locations within the FMU and place them on a map. However, the specific location of a particular value (e.g., endangered species) does not immediately translate to a hard HCV boundary on a map. Rather, the team had to interpret species and habitat information to best

estimate the real world occurrence and extent of the forest in which the HCV was present. For example, the HCV boundaries for species were delineated based on presence and extent of their identified or predicted preferred habitats, both inside and outside the FMU. Some HCVs were more straightforward to map, such as protected areas within the concession or cultural sites that village elders could describe.

Once the team had classified and ascribed where the HCVs occur within the FMU, a spatial GIS overlay for each HCV definition was produced. Since this would enable putting one GIS layer on top of the other, the technology could facilitate further review and understanding of the final HCVF area.

Overlays represent approximate locations of HCV boundaries and are therefore indicative not prescriptive. Actual demarcation on the ground would be guided by the mapped borders and be subject to ground-truthing but is not expected to deviate markedly from the indicated borders.

3.3.3 Delineating the HCVF Boundary

The final step in the process was to analyze whether the HCV areas mapped in the multiple overlays should concide with the areas delineated as the HCVF boundary.

The team analyzed interacting and other contributing factors and conditions to delineate the HCVF boundary with respect to whether the forest area could be expected to maintain the identified HCVs. The team produced a decision support matrix of criteria to guide final decisions as to whether a particular forest area would qualify as HCVF (and included in Technical Annexes).

The following basic precepts underscore considerations used in this judgment process:

- Each HCVF area is a viable and functional ecosystem unit itself or has the realistic possibility of future management practice allowing it to become a functional unit.

- Contiguity is paramount in identifying HCVFs. Single large areas of habitat, or mosaics of different habitats, are of higher value and priority than a series of smaller, isolated forest areas.

- Each HCVF protects a significant portion of overall biological diversity and/or safeguards significant local community dependence on forests in the FMU.

- Each HCVF assumes company and local community commitment to effective management, resources and appropriate research to ensure optimal short- and long-term conservation while providing opportunities and knowledge for future improvements within the FMU.

The HCVF (s) arising from the integration of the HCV assessments were indicated on a single HCVF map of the Pulau Muda District.

3.3.4 Application of the Precautionary Approach

The FSC (2000) recognizes the Precautionary Principle (PP) for decision-making processes about HCVs in the absence of adequate scientific knowledge on the

consequences of human impact on forest areas. FSC Principle 9 states that "decisions regarding high value conservation forests shall always be considered in the context of a precautionary approach". The definition of the precautionary approach used by the FSC was ratified during the FSC General Assembly in June 1999. The term is defined as: "Tool for the implementation of the precautionary principle. The term 'principle' is defined as: An essential rule or element; in FSC's case, of forest stewardship.

While there are multiple definitions of the PP in circulation, probably the most widely accepted is from the Rio Declaration, "In order to protect the environment the Precautionary Approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

The IUCN has launched an evaluation into the application, effectiveness, and controversy surrounding the PP in natural resource management, and Cooney (2003) indicates that "considerable ambiguity remains regarding the meaning and context of the precautionary principle … [its] meaning and application are unclear in situations where sources of risk are complex and multiple, which is frequently the case in the context of natural resource management and conservation"

The clearest guidance in the Indonesian HCVF Toolkit on the precautionary approach is with respect to *managing* HCVF. The guidance itself comes from the FSC: "Planning, management activities and monitoring of the attributes that make a forest management unit a HCVF should de designed, based on existing scientific and indigenous/traditional knowledge, to ensure that these attributes do not come under threat of significant reduction or loss of the attribute and that any threat of reduction or loss is detected long before the reduction becomes irreversible. Where a threat has been identified, early preventive action, including halting existing action, should be taken to avoid or minimise such a threat despite lack of full scientific certainty as to causes and effects of the threat" (FSC Principle 9 Advisory Panel, 2000).

For the *identification* of HCVF, the toolkit states that "where doubt exists as to whether an attribute, or collection of attributes, are sufficient to signify HCVs, then the forest manager will treat these attributes as HCVs, until information proves otherwise."

Given the current limited state of knowledge about biodiversity attributes in tropical PSF, a presumptive interpretation of the precautionary principle might conclude that all such forests hold HCV and hence all should be assigned HCVF status. SmartWood has found through its experience in conducting certification assessments in Indonesia that many stakeholders, especially forest managers, perceive the FSC HCVF definitions to imply that all natural forest in Indonesia is HCVF. While the Toolkit does not state this, the present assessment team felt it was important to emphasise herein that the use of a precautionary approach does not begin with a foregone conclusion, but works to fill knowledge gaps wherever possible.

There are two kinds of knowledge gaps surrounding an HCVF assessment, which would probably be similar to others in Indonesia. First, the lack of available baseline inventory data on flora, fauna, human uses, etc. as well as the limited time or resources to conduct comprehensive biodiversity surveys. Second, the lack of scientific knowledge on Sumtran PSF *per se*.

This HCVF identification process applied by SmartWood aimed to introduce as much measurable, observable and objective data analysis through the field assessment and consultation to close the first kind of knowledge gap and require less 'fallback' on the PP when making decisions concerning the presence of HCVs. Nevertheless, there were situations in determining the presence, or extent of the areas considered as HCVs, where the combined knowledge of the team and other expert sources were not sufficient to make a completely informed decision and a precautionary approach was invoked.

4. *Determination of High Conservation Values in the FMU Landscape*

This section covers the treatment of the observed ecological and social conservation values of the FMU within the surrounding landscape according to the assessment criteria. The assessment team used an Assessment Checklist to determine that each of the guiding assessment criteria was evaluated in order to assess presence or identification of particular values as being HCVs.

For each of the six HCV definitions and their components, findings are provided to describe and analyze the conservation values, and what makes them high conservation values for the FMU within the wider ecological landscape. HCVs and their components are explained within the context of the site and rationale is given for the forest area delineated which pertains to these HCVs.

4.1 High Conservation Value 1

Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).

Four sub-categories (components) have been set to assess the presence of such forest areas, and each are treated separately below.

4.1.1 HCV 1.1 Protected Areas

Definition

The Indonesian HCVF Toolkit states that all protected areas and proposed protected areas are considered HCVs.

HCV1.1 relates to legally constituted protected areas[5] within the country, and how they contribute to conservation of biological diversity in the context of forest management. The objective of this HCV as "gazetted or proposed protected areas within, adjacent or in the immediate vicinity of the FMU are identified as HCVs and protected from any potential impact of FMU operations".

Any protected area within the FMU automatically qualifies as a HCV. Protected areas immediately adjacent to the FMU, in the immediate vicinity or having physical and ecological connection with the FMU are HCVs. Those forests or habitats within the FMU that contribute to protecting the values for which a protected area was established, are given due consideration as HCVs.

Site Context

Kerumutan Wildlife Reserve (Suaka Margasatwa) is a nearby 120,000ha protected area (legally constituted through Ministerial Decree, SK Mentri Pertanian No. 350/Kpts/II/6/79) protecting the largest contiguous representative tract of peat swamp forest in Riau Province[6]. The forests of the FMU are part of the Kerumutan landscape, and represent the easternmost fringe of what remains of this ecosystem, estimated as originally extending over some 440,000ha[7]. The Kerumutan Wildlife Reserve is separated

[5] Protected areas are defined as areas legally gazetted under national laws, and include those equivalent to IUCN categories I-V. Areas proposed for protected area status by the relevant statutory body, but not yet gazetted, are also included.
[6] Berbak National Park in Jambi is larger in size but smaller in contiguous tracts of undisturbed beat swamp forest.
[7] 1973 Remote sensing data for Riau province, Sumatra.

from the FMU by strip varying in approximate width between 11.5km at its widest to 5km at its narrowest.

Given this distance between the boundaries of the Kerumutan Wildlife Reserve and the FMU, and the contiguity and homogeneity of the forest in between the two, the FMU forests are not identified as HCV1.1. The forest areas within the FMU that are nearest to the contiguous forest that connects to the Reserve are, however, considered under HCV 2.2, as these relate to being part of a landscape-level forest.

Two legally constituted protected areas were identified within the FMU. These areas are delineated as *kawasan lindung* (which translates as protected area) and are to be protected from harvesting as per the articles of Presidential Decree Number 32 (KepPres 1990). *Kawasan lindung*, in this sense, would not be a forest classification, but a management classification. As such, it is an area that would legally exclude management actions within a HTI. Though not legally gazetted, these areas are identified within the RKPHHTI and the concession license.

These *kawaswan lindung* are referred to in this report as KL-1 and KL-2 and are indicated on the HCV overlay map below. Their characteristics are summarized as follows:

KL-1 3,126.9 ha block of tall PSF following the 26-27m contour in a southwest-northeast direction. This block of forest is an unlogged remnant along the southeastern downward slope of the central peat dome located in the north-central area of the FMU. KL-1 is contiguous with the rectangular forest currently excluded from operations, possibly as a set-aside for carbon trade or a community joint-venture.

The forest is dominated by *Palaquim burkii* (Suntai), a copper-crown peat swamp forest tree, a characteristic species of the Kerumutan landscape PSF[8]. The north-eastern point tapers into a segmented outline from blocks of planted *Acacia crassicarpa*, and the forest here has consequently suffered from edge-effects, timber extraction and wind-throw damage. The south-western corner also tapers, but is a relatively better condition. The faunal composition is presumably a typical representation of the dominant PSF formations of the FMU[9].

KL-2 1,142.3 ha block of tall PSF straddling the 24-26m contour in a southwest-northeast direction. As with KL-1, this smaller block of forest is also an unlogged remnant representation of the lower southeastern downward slope of the central peat dome. KL-2 is separated by a canal from the southern strip of PSF retained along the alignment of the Sg. Simpang Kanan, which forms the southern boundary of the FMU. Apart from an 80m stretch of forest separated only by the canal (and its peripheral earth works), the block has been separated on both ends from the southern strip by recent forest clearing.

The floristic composition is consistent with KL-1, but without the pure stands of tall *Palaquim burkii* which characterizes the KL-1 block. The faunal composition is a typical representation of the dominant PSF formations of the FMU[10].

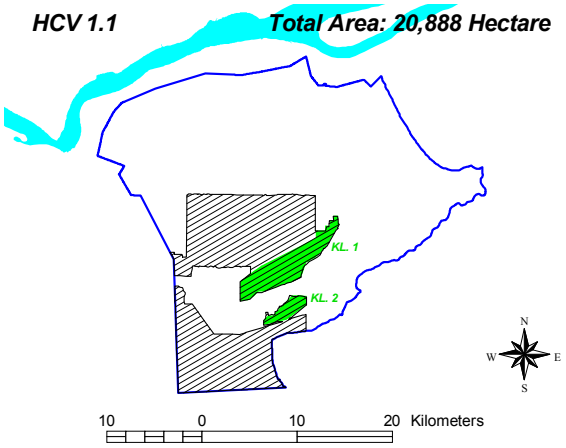
[8] A description of the floristic composition of the area is found in section 2.4.3
[9] A more detailed description in section 2.4.3.
[10] A more detailed description in section 2.4.3.

Rationale for Boundary Delineation
As the two KL blocks are legally defined protected areas, their immediate boundaries would define the initial HCV boundary. In the case of Pulau Muda, these KL blocks have been delineated on maps and are well-defined on the ground.

In addition to the defined area of these KLs, the team had to consider as HCV forests surrounding the protected areas whereby forest management actions could negatively impact these protected areas. The original Environmental Impact Assessment (AMDAL) and the long-term management plan did not establish the functions of these KLs. Therefore, the team did not have sufficient information to judge what ecological functions the KLs were intended to protect.

What was evident, however, was that the clearing of forest and construction of additional canals around both KLs would likely have edge effects and isolating impacts. Taking a precautionary approach, the assessment identified forest areas that would support and protect the ecological functioning of these two protected areas, as per the following rationale:

- The two blocks are effectively islands in a modified landscape. The surrounding remaining natural forest will reduce the impacts from plantation operations along there boundaries.
- The delineated additional forest areas substantially increase the habitat available for animal and plant populations present within these two blocks, thus enhancing the long-term viability of habitat and species.



- The impacts of the separation of the KL-2 block from the larger forest area to the south by the canal will be greatest on large-bodied, wide-ranging arboreal species, such as gibbons, which are unable to cross gaps in forest canopy, however smaller terrestrial animals will also be affected by the disruptive effects of the canals. The larger forest area to the south of the KL-2 block will reduce, over time, the impacts of the canal currently separating it from the larger forest block to the south.

4.1.2 HCV 1.2 Critically Endangered Species

Definition
The Indonesian HCVF Toolkit states that any species listed as critically endangered by IUCN or on Appendix I of CITES that is actually or potentially present within the FMU is an HCV.

HCV 1.2 relates to critically endangered[11] species known to occur within the FMU, their habitat requirements and ensuring their continued existence and viability is not

[11] Refer to Appendix 5 for IUCN Red List Categories

compromised by operations. The objective of this HCV is that critically endangered species dependent upon, or using, the FMU are identified and their ecological requirements protected and managed.

Site Context

The presence of critically endangered species within the FMU is correlated with extent, distribution and ecological health of habitats. The White-winged Duck *Cairina scutulata* is found in forested wetlands with secluded and over-grown water bodies, the majority of sightings from freshwater and peat swamp forests (Green, 1992). Most recent Indonesian records are within 10km of permanent waterlogged plains, suggesting a degree of dependence on the permanent freshwater swamps that occur in these areas (Lambert, 1988).

The status assigned to the White-winged Duck by the IUCN / SSC Red Data Book (IUCN, 2003) and Birdlife International is Endangered (EN). This relates to the species' global range and conservation status. This process has advanced a step further in some countries, with threat criteria being developed at national levels (Birdlife International, 2001; 2002). Such national exercises provide more detailed treatments of globally threatened species within the national context, but the status assigned to a species at a national level may differ from its status globally. Two scenarios illustrate this:

- A species is listed as endangered globally, but within one of its range states (a country which has a population of a species), the species is not under threat. Such countries are of significant importance to the species, likely holding a high core percentage of the world's population, and although not threatened within that country, representing a globally important population.

- A species is endangered globally, but within one of its range states it is on the verge of extinction. The country has a tiny, remnant population. In such cases, the species is classified as critically endangered in that country.

The challenge for conservationists is to evaluate the contribution from such a population. It may be within a peripheral range state, holding an extra-limital population, which is of importance for preserving the species across its natural distributional range, but of less importance to the survival of the species as a whole. On the other hand, it may be a core range state, holding a significant portion of the entire world's population, and is under severe threat, thus affecting the survival of the species as a whole.

In the case of the White-winged Duck on Sumatra, the latter argument applies. Sumatra holds at least a third of the world's population, possibly more (Wetlands International, 2002). The species is under severe threat from loss of primary habitat. If operative factors continue unabated, the species is expected to suffer further decline on Sumatra. Given its already tiny population (est. 150 individuals on Sumatra), the species will move to critically endangered status for the global population.

The White-winged Duck is an HCV for the following reasons:

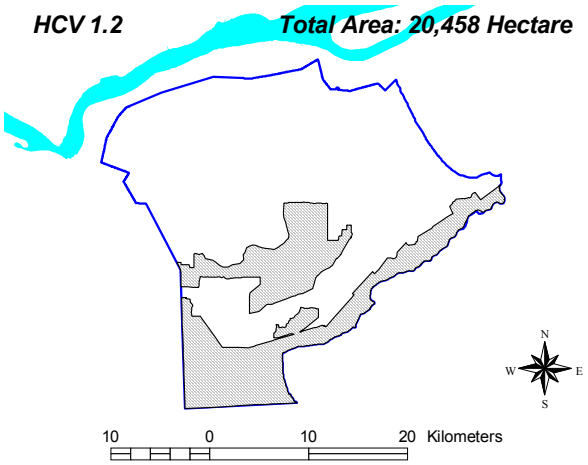
- Two pairs were observed along an un-used canal within the KSM block. This confirms the continued presence of this species in the Kerumutan landscape. The species was last observed along the Sg. Rengat in 1992 (Burns & Brickle, 1992).
- *C. scutulata* is listed as Endangered (EN) in the IUCN Red Data Book, with a global population of less than 450 birds (Birdlife International, 2003). Sumatra supports an

estimated 150 individuals (Wetlands International, 2002), approximately a third of the world's population[12].

- The Sumatran population is recognized as distinct from the other populations, with a high incidence of albinism (Ounsted *et.al.*, 1994).
- In the Indonesian context, this population on Sumatra is in imminent danger of going extinct in the near future unless immediate measures are taken to address its decline. Its dependence on PSF, and the rate of habitat loss faced by PSFs in Sumatra, could justify its status as critically endangered in Indonesia.

Rationale for Boundary Delineation

- The HCV boundary is delineated to encompass all the forested areas which form the primary habitat for the species.
- The boundary has been delineated based on a 2km extension (through GIS) on either side of rivers or other water channels, because the extent of the duck's usage of riverine forests is unknown, and the precautionary principle is applied to ensure habitat viability.
- The boundaries have been aligned to natural / man-made features to enable more efficient management. This relates to the eastern portion, where the 2km forest strip has been modified to follow the alignment of a large logging canal extending west-east across the forest block.



- The south-western block has been delineated in its entirety because of the two river systems present in the upper part, and the lower corner of the FMU boundary adding another wetland habitat (open floodplain subjected to periodic inundation) which also has value for the species. The forest areas in between form a contiguous block which allows movement between potential breeding and feeding areas.
- The KSM block is also included as a refugial habitat, which has been confirmed during field investigations to be used by the species. The areas of this block included in this HCV are consistent with the extent of tall PSF. The low stature vegetation community over the higher part of the peat dome has been excluded. The open structure of this forest type is not expected to be used by this species. Exact differentiation between these two habitats will be dealt with under habitat mapping.

[12] Ramsar Convention Resolution VIII.38 - Waterbird population estimates and the identification and designation of Wetlands of International Importance: URGES all Contracting Parties to use appropriate 1% thresholds contained in the third edition of *Waterbird Population Estimates* as the official and consistent basis for their application of Criterion 6 of the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* for the designation of Ramsar sites during the 2003-2005 triennium;

The 1% criterion is used to determine globally significant wetlands. A site which regularly supports at least 1% of the world's population of a globally threatened species qualifies as a site of international importance, under the Ramsar Convention on Wetlands.

- The White-winged Duck is expected to utilize (a) all areas within the FMU which are suitable as breeding habitat, which is in tall unlogged forests close to waterways; and (b) all areas within the FMU which are suitable for roosting or as refuges.

4.1.3 HCV 1.3 Concentrations of threatened or endangered or endemic species

Definition

The Indonesian HCVF Toolkit states that a forest containing a concentration of threatened of endangered species or a concentration of endemic species, as recognised by national and international experts, is an HCV. The HCV relates to areas which support concentrations of significant species. This implies a comparison between such areas, or habitat types, and other habitats present. These HCVs will be areas of exceptional importance to more than one globally significant species.

Site Context

All the globally threatened species observed within the FMU (that is, White-winged Duck, Storm's Stork and Tomistoma) are associated with forested habitats in combination with both natural and man-made water features. All three species are associated with flooded areas within forests, primarily the forested streams and rivers. This riverine habitat type occurs only in the southern part of the FMU, along the Sg. Simpang Kanan and the Sg. Gaung Kiri, and is considered to be HCV. Table 4 details the species which occur within this HCV.

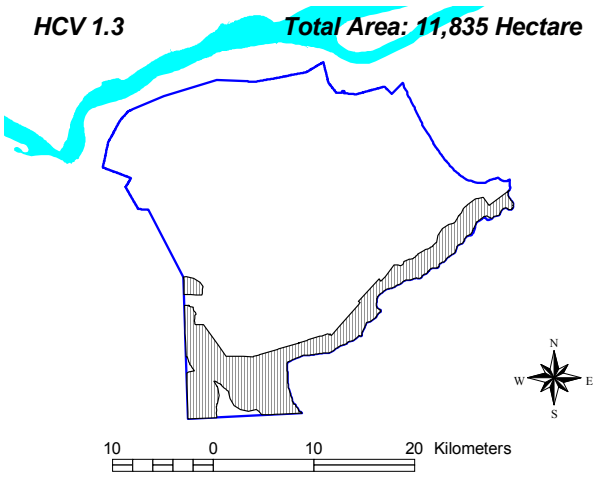
Table 4. IUCN Status of Species Potentially Occuring at FMU

SPECIES	STATUS	DESCRIPTION
White-winged Duck *Cairina scutulata*	**EN**	One of the most threatened southeast Asian resident anatids. A swamp forest specialist, ranging from northeastern Myanmar to Sumatra. The world population is estimated at below 450 individuals (Birdlife International, 2002). The species is likely extirpated from Thailand and Malaysia, with no records since the mid 20th century. Sumatra's is the last stronghold for the species, holding an estimated population of 150 individuals (Birdlife International (2003). The Sumatran population also regularly exhibits albinism (MacKinnon & Phillipps, 1993). This is a forest duck, preferring secluded water bodies and tall forest. The species is endangered because of a small, declining population and continuing widespread loss of habitat. **Four birds were observed in the FMU.**
Storm's Stork *Ciconia stormi*	**EN**	The world's most threatened stork, with a remaining world range distributed between eastern Malaysia (Sarawak and Sabah on Borneo) and Indonesia. Extinct in Thailand, with a relict population on the Malay Peninsula (Sebastian, 2002). World population estimated at below 1,000 individuals (Birdlife International, 2002). An extreme lowland swamp forest specialist, preferring open marshes and ox-bow lakes, interspersed with swamp forest (Sebastian, 2002). The species is endangered because of small, declining population and widespread conversion of its lowland forest habitats. **Eleven individuals were observed at different times at four locations within the FMU, including a flock of 3 at 300m asl, from a helicopter.**
Tomistoma *Tomistoma schlegelii*	**EN**	One of the most endangered and least studied of the world's crocodilians. Extirpated throughout most of its former range, with remaining populations only known today from Sumatra and Borneo (Sebastian, 1993; 1994). The world population is estimated at below 2,500 individuals (Birdlife International, 2002). A large fish-eating reptile of small slow-flowing rivers in forested environments. Confined to water channels, it breeds above the water-marks in peat swamp forest, and is known to utilize peat hummocks. **None of the**

SPECIES	STATUS	DESCRIPTION
		rivers were accessed during the field assessment, but the species is well known by locals and from literature.
Pig-tailed Macaque *Macaca nemestrina*	**VU**	While this species is not uncommon in Sumatra, this predominantly ground-living social primate is listed as vulnerable due to the threat to its lowland forest habitat. Groups require large areas of forests, and landscape fragmentation has compromised the viability of populations throughout southeast Asia. **Two groups were observed in the FMU, at the forest edge and inside the 5-year-old *Acacia* planting.**
Clouded Leopard *Neofelis nebulosa*	**VU**	A large, shy primarily arboreal cat of southeast Asia forests. Populations are threatened by deforestation and fragmentation of suitable areas of habitat. One foot-print was observed on a canal bund along the western boundary of the FMU. **Locals report occasional sightings throughout the forest areas, and descriptions of a "harimau" caught in a snare-trap close to Pulau Muda in 2002 match this species.**
Milky Stork *Mycteria cinerea*	**VU**	The global population is estimated at just over 6,000 individuals (Birdlife International, 2002). More than half the world's population is found in the coastal swamps and mangroves along the east coast of Sumatra, with smaller numbers on Java and Sulawesi. Two other small populations are known: along the west coast of the Malay Peninsula and at Tonle Sap in Cambodia. Sumatra is the main stronghold for this stork. **Three individuals were observed soaring at separate times in the FMU.**
Lesser Adjutant *Leptoptilos javanicus*	**VU**	A large stork of coastal mudflats and mangroves, extending up large rivers. Known to nest colonially in tall trees deep within PSF in Malaysia. One bird was observed soaring over the KSM block. Virtually no significant tracts of PSF remain close to the Sg. Kampar along its southern bank. **The species may still breed on the north bank.**
Wallace's Hawk Eagle *Spizeatus nanus*	**VU**	An extreme lowland specialist (Wells, 1985). Widespread conversion of lowland forest has constricted the distribution of this species, and it is today most commonly recorded in PSF (Sebastian, 2002). Three birds were seen at three different locations in the FMU. **One bird had a nest with 1 chick, about 25m on an exposed bough of a *Parkia speciosa*.**
Short-toed Coucal *Centropus rectunguis*	**VU**	A seldom seen resident of pristine lowland dryland and peat swamp forest. Threatened by deforestation and habitat fragmentation. **One individual heard calling from the southern block (KS-2).**

Rationale for Boundary Delineation

- The HCV 1.3 boundary has been delineated according to the ecological and biological requirements of three species: White-winged Duck, Storm's Stork and Tomistoma. All three species overlap in ecological requirements, which result in their populations being concentrated within the riverine environments found within this boundary.
- The boundary has used a 2km extension from water's edge, and modified according to the



practicalities of management. The main area is the eastern portion where the boundary has been aligned to the route of a logging canal.

- The southwestern block has a triangle which has been excluded from this HCV boundary, on the grounds that beyond 2km of a riverine environment, the significant concentration of these three species is likely diminished.
- The corridor block (connecting the KSM block with the western strip of retained forest within the FMU) has been included as a result of the 2km extension from waterways, which in this area, extends outside the FMU.

4.1.4 HCV 1.4 Critical Temporal Concentrations

Definition
The Indonesia HCVF Toolkit states that a globally significant concentration of migratory species or a nationally significant temporary concentration or migration route is an HCV.

This HCV relates to values involving the temporal usage of specific locations or habitat types by significant numbers of species or individuals of a species, and which are critical to their continued survival. The objective is that areas which play a crucial role in the life-cycles (i.e., breeding, migration) of certain species are identified as HCVs.

Site Context
No such locations were identified within the FMU. There was no "Important Bird Areas" in or around the FMU. There were not any specific locations, or landscape features, identified within the FMU that would support breeding colonies.The floodplain habitats present outside the FMU, in the southwestern corner, and extending slightly into the FMU, may have such concentrations of resident and migratory waterbirds. However, this area has not been included under this HCV for the following reasons:

- Utilization of this habitat by migratory birds cannot be established from available information and ground investigations.
- The habitat occurs in a very limited extent within the FMU, compared to its area size outside the FMU.
- Other temporal concentrations such as mammal movement routes or bottlenecks may have been present in the past, but the current pattern of clearing within the FMU have all but eliminated any chance of these still be used, or being of critical importance to species.

Rationale for Boundary Delineation
HCV 1.4 not identified.

4.2 High Conservation Value 2

Forest areas containing globally, regionally, or nationally significant large landscape level forests, contained within, or containing the management unit, where viable population of most if not all naturally occurring species exist in natural patterns or distribution and abundance.

Three sub-categories (components) have been set to assess the presence of such forest areas, and these are treated separately below.

4.2.1 HCV 2.1 The FMU is a large, landscape-level forest

Definition
The Indonesian HCVF Toolkit states that a FMU which is a large landscape forest is considered an HCV.

For the island of Sumatra a large landscape level forest on its own would need to be greater than 50,000ha. The FMU includes three blocks of natural forest, each separated from the other by Acacia plantations, but all connected to the Kerumutan landscape on the western boundary. Each of these natural forest blocks is about 10,000ha in area.

Rationale for Boundary Delineation
HCV 2.1 not present because the FMU forests are smaller than the size threshold.

4.2.2 HCV 2.2 The FMU is an integral part of a large landscape-level forest

Definition
The Indonesian HCVF Toolkit states that a FMU which is an integral part of a large landscape forest is considered an HCV.

HCV2.2 relates to areas that critically enhance the conservation functions of a landscape-level forest that is outside, adjacent, or contains the FMU. The forests of the FMU must be contiguous with forests of this larger landscape so that dispersal is possible within the forested block.

In addition, the objective of this HCV should be that the forests of the FMU contribute to maintaining the conservation of one of a limited set of ecosystem replicates within the ecoregion, so that loss of this landscape forest or its decline in size and integrity would increase the risk of species extinction.

Site Context
Although the FMU is not itself a large landscape level forest, it is connected to one of a limited number of such landscapes remaining that represent the biodiversity of habitats and species of the East-Central Sumatran Peat Swamp ecoregion (Reiley & Ahmad-Shah 1996; Jarvie *et al.* 2003a).

The accompanying table 5 shows that the Kerumatan landscape forest, as we have termed it, is currently the second largest continuous block of this landscape type, and harbors the third largest protected area, the Kerumatan Wildlife Sanctuary. When severely degraded lands and those already designated for forest conversion are deducted from this current block of 439,000 ha, only 137,000 ha are left in officially designated protected forest.

If the approximately 35,000ha of primary and "lightly logged" natural forest (those unburned and not severely degraded) within the FMU were added to this total, an additional 21% of conservation area would be protected in this landscape block.

Table 5. Contribution of the Pulau Muda FMU to the Kerumutan Forest Landscape

I. Forest Blocks of East-Central Sumatra PSF Ecoregion		
Legal Designation	**Area (ha) (x 1000)**	**Protected Areas**
A. Tasik Serkap	511	(4 protected areas, totaling 37,000ha)
B. Kerumutan	**439**	(Kerumutan Wildlife Reserve = 96,000ha)
C. Berbak (Jambi/S. Sumatra)	355	(Berbak = 163k)
D. Giam Siak Kecil - Bukit Batu	314	(2 protected areas, totaling 108k)
E. Senepis	205	(proposed protection area of 50,000ha))
F. Libo	147	(3 separate patches, none protected)
II. Protected Forest of the Kerumutan Forest Landscape		
(not including the Pulau Muda FMU)		
Total Landscape Level Forest Block	**478**	
A. Severely Degraded or Converted	39	
1. Other	10	
2. Production Forests	22	
3. Protection Forest	7	
B. Forested (Primary and Logged)	**439**	
1. Other	36	
2. Production Forests (HTI & HPH)	181	
3. Protection Forest	**222**	
a. Allocated to HTI	51	
b. Allocated to Oil Palm	34	
Net Total Protected Forest	**137**	
III. Natural Forests of the Pulau Muda FMU	39.4	FMU Contribution to
A. Severely Degraded by Logging & Fire	3.9	Protected Forest Block =
B. Primary or Lightly Logged	**35.5**	**21%**
1. Mixed Peat Swamp Forest	6	
2. Tall Peat Swamp Forest	25	
3. Short Peat Swamp Forest	4.5	
Total FMU Forest + Protection Forest	**165**	

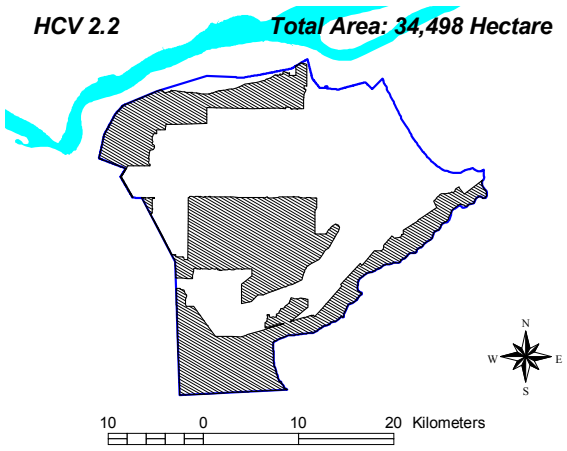
Source: SPOT 2A image, Timber_estate_2003_48n.shp, Palmoil_plantation_2002_48n.shp, Logging_concession_2002_48n.shp, Rtrwp_riau_1994_48n.shp, Rtrwp_riau_draft_2015_48n.shp

Rationale for Boundary Delineation

Most of the natural forest areas of the FMU that have been determined to be HCV2.2 are so because they are connected to and critically enhance the ecosystem functioning and biodiversity conservation value of the adjacent protection areas to the west of the FMU. These habitats occur within three important blocks of forest extending into the FMU from the larger landscape to the west. This continuity, and the contribution in habitat area these diverse habitats make to the value and integrity of the ecosystems of the overall landscape, makes these blocks HCV2.2.

- The forest that extends into the FMU on the north and northwest includes a rich mosaic of forest habitats, including the most important habitat for wildlife in the FMU. The Mixed PSF here must have a very limited distribution within Kerumatan landscape, because satellite images reveal most land in this belt near the river outside the FMU has been cleared for agriculture. This forest habitat has a limited natural distribution, and has rarely survived human logging and agricultural activities. Delineation of this block follows the margins of intact forest that has not been severely degraded.

- The block of forest in the center is delineated to include the Short PSF block, the contiguous block of Tall PSF on its south and east designated as Hutan Lindung, and all the connecting Tall PSF of the "corridor" connecting this to the larger landscape forest. The Short PSF on the dome is rare within the Kerumatan landscape because it occurs only in the central areas isolated from rivers that drain peat formations. For instance, we did not observe other Short PSF when flying west and then NW from the FMU into Kerumatan Reserve. Delineation of this block of the two habitats is to maximize its size and continuity to best contribute to the ecosystem integrity of the landscape.



- The block of forest on the southwest and running to the northeast is a mixture of Tall PSF, Flooded Short PSF and Riparian forest, rare in the landscape. While larger areas of this habitat occur within the Kerumutan Reserve, the area within the FMU form an integral part of this landscape, and therefore have been included within the boundary of this HCV.

4.2.3 HCV 2.3 The FMU maintains viable populations of most naturally occurring species

Definition

The Indonesian HCVF Toolkit states that a FMU which contains viable populations of most naturally occurring species is an HCV.

HCV2.3 relates to the importance of FMU areas in maintaining viable populations. To be HCVs, the area must critically contribute habitat or resources that lower the risk of extinction. The distribution of species among habitats and total area of each habitat within the larger forested landscape must be considered in determining whether areas within the FMU are HCV because they are needed to maintain viable populations.

In this situation, following guidance from the Toolkit, consideration of HCV2.3 is irrelevant because HCV2.2 already has been identified. As the remaining forest patches in the FMU are typically below 10,000 ha they would not on their own be able to maintain viable populations of most naturally occurring species and achieve significance with respects to HCV2 as part of the large landscape level forest.

Rationale for Boundary Delineation
HCV2.3 is not-applicable as HCV2.2 is already identified.

4.3 High Conservation Value 3

Forest areas that are in or contain rare, threatened or endangered ecosystems

4.3.1 HCV 3.1 Forest areas that are in, or contain rare, threatened or endangered ecosystems

Definition
The Indonesian HCVF Toolkit states that where a FMU contains significant size of these rare, threatened, and endangered forest types and has been identified as a conservation priority area by an independent organization, then the forest types is an HCV. Rare, threatened or endangered ecosystems that are located outside the FMU that are impacted heavily by FMU activities is also an HCV.

The Indonesian HCVF Toolkit guidance relates HCV3.1 to rare, threatened or endangered ecosystems that have been identified within national conservation plans. The Toolkit provides further guidance as "there may be cases where conservation plans do not reflect current forest condition, threats, and trends. Experts should be consulted to identify if there are gaps in these plans and if the FMU should be considered critical to the protection of the ecosystem type." Thus, the present assessment would consider as HCV areas within the FMU that are rare, threatened, or endangered ecosystems for the ecoregion or nation based on expert judgment, especially if the available national conservation plans had overlooked ecosystems that were poorly represented in protected areas in the ecoregion.

Site Context
Within the 1995 update and revision of the 1982 National Conservation Plan for Indonesia (MoF 1995), maps indicate a portion of the northeastern Mixed PSF (approximately 10km from the village of Teluk Meranti) identified as a conservation priority area. The objective was to extend the boundary of Kerumutan Wildlife Reserve both east and west. The plan establishes the conservation importance of Wet Lowland Forest on Alluvium, comparable to area identified as Mixed PSF herein. The remaining area of this habitat type in Riau was calculated, in 1995, at 10,000 ha (10% of the original) with only 5,000 ha in protected areas (MoF 1995). This particular occurrence of the habitat was not mentioned in the Indonesian Biodiversity Strategy and Action Plan 2003 – 2020 (IBSAP).

The professional opinion of the team ecologist is that the northern belt of Mixed PSF is most important ecosystem type in the FMU for birds and mammals and overall plant diversity. Mixed PSF is the most diverse forest type in tree, woody climber and fig species, and the most productive. It is a rare and endangered habitat regionally and within this landscape.

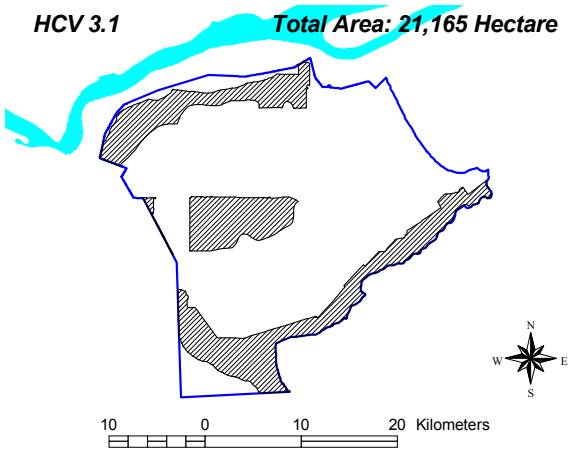
The peat dome within the FMU is not mentioned in the NCPI or IBSAP. This would appear to be a weakness as the short PSF on the dome is rare within the Kerumutan landscape because it occurs only in the center areas of the large forests, isolated from rivers that drain peat formations. One other dome was ascertained within the Kerumutan Reserve during helicopter overflight.

The specific rivers within the FMU are not mentioned in the NCPI or IBSAP. However, riverine habitats have suffered loss and degradation throughout Sumatra and few high quality representations can be found outside protected areas today.

Rationale for Boundary Delineation
The entire belt of Mixed PSF is the most endangered habitat, highest in species diversity, and most important for maintaining wildlife populations. The Mixed PSF and its associated minor habitats can be presumed to constitute an endangered habitat in this ecoregion and probably throughout Southeast Asia for the following reasons:

- It is limited to areas adjacent to larger sediment-bearing rivers;
- The relatively productive alluvial soils along rivers are commonly cleared and drained for agriculture wherever they occur; and,
- Such habitats support high volumes of commercial timber trees and because they can be accessed easily from large rivers, they are often logged.

Protection of this northern block of Mixed PSF within the FMU is estimated to contribute between 30-50% of this habitat known to exist within the entire Kerumutan landscape forest. The boundaries follow as nearly as possible the boundaries of this habitat as observed in the overflights, photographic analysis of this forest belt, and in consideration of the map from the NCPI.



The Short PSF of the peat dome is a rare habitat within this landscape and given its limited ecological setting occurs as just a few patches within the Kerumutan landscape. It plays an important role in maintaining the hydrologic cycle for downslope natural and plantation forest (see HCV4.2). The boundaries were defined by aerial surveys. Note that the block of Short PSF within the rectangular block apparently continued to the west through the recently logged plantation area, and is also delineated along the western strip of the concession.

An argument can be made that the riverine ecosystem is rare and threatened in Sumatra. This habitat plays a key role in maintenance of forest biological diversity and harbors threatened species. The boundaries of the HCV in the southern portion of the FMU have followed the courses of the Sg. Simpang Kanan and Sg. Gaung Kiri. A 2km buffer has been applied to delineate the area.

4.4 High Conservation Value 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection and erosion control)

Four sub-categories (components) have been set to assess the presence of such forest areas, and each are treated separately below.

4.4.1 HCV 4.1 Unique sources of water for daily use

Definition
The Indonesian HCVF Toolkit states that where forests provide the only source of water for daily use to a community, this will be an HCV.

Site Context
Through detailed interviews within the villages of Pulau Muda and Teluk Meranti the team assembled tables on basic needs that included the sources of water for the communities.

The FMU does not provide unique sources of water for daily use. Fewer than 5% of people from Pulau Muda village and Teluk Meranti village and typically less than 1% of the people obtain drinking water from any of the rivers originating in the FMU natural forests.

Rationale for Boundary Delineation
HCV 4.1 was not identified.

4.4.2 HCV 4.2 & 4.4 Forests with critical impact on water catchments, erosion control as well as agriculture, aquaculture & fisheries

4.2 & 4.4 are presented together for the purposes of this HCVF report. They have similar natural forest buffer and management consequences.

Definition
The Indonesian HCVF Toolkit states that forests that are protected, DAS Super-Prioritas and Prioritas, other significant DAS and Sub-DAS areas designated by relevant experts, as well as cloud forests, will be HCV4.2. This HCV relates to the critical role forest areas may play in protecting water catchments, downstream water quality, and preventing erosion.

The Indonesian HCVF Toolkit states that any forest that has a critical impact on the forest services that agriculture or aquaculture is dependent upon are an HCV4.4. Similar to HCV4.2, the assessment is whether any forest areas are critically responsible for water quality and supply, albeit focused on agriculture or acquaculture.

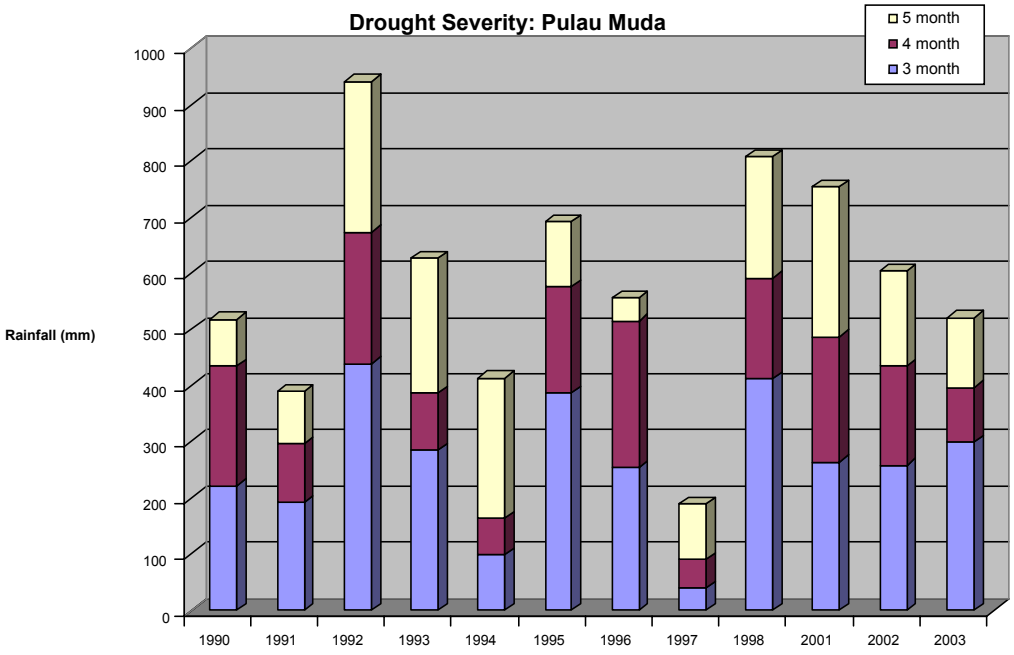
Site Context
The Kampar river basin begins on the eastern slope of the Bukit Barisan mountain range in West Sumatra and extends to the mouth of the Kampar river in Riau. About 10% (2,530 km^2) is located in West Sumatra province and 90% (22,086 km^2) is in Riau province. According to sources checked with balai PDAS (Pengelolaan Daerah Aliran Sungai/Watershed Management Authority) the Kampar River Basin is identified as a DAS prioritas area. However, only a narrow strip (approximately 5 to 10km wide) of the northern portion of the FMU falls within the DAS prioritas. The management classification for this area is production forest, as it is currently zoned.

Located in the center of the FMU is a peat dome where the peat is deepest. This was initially indicated by APP topographic maps and soil maps. The observed presence of Short PSF on the dome confirms its presence. The peat dome provides water storage and discharge functions, absorbing rainfall and releasing it laterally through the peat profile. The topographic gradient from peat dome to natural water channels is very low, and so sub-surface flow is slow and constant, mitigating flooding during high-rainfall periods, and drought during low-rainfall periods (Rieley, Ahmad-Shah & Brady 1996; Silvius & Giesen 1996). Downslope forests receive relief from drought conditions because the

higher water table of the dome can supply water laterally to these forests, mitigating the period of water deficits.

Although the concessionaire attempts to manage the water table at roughly 80cm below ground surface, the canals nearest the dome had water levels 1.5m or so below the surface, during the team's relatively rainy visit. In contrast, as one moved down the canal systems to lower elevations 6-10m below the dome, canals on the far north and south were overflowing their banks, drowning and killing natural forest not adapted to this frequency of flooding. Under natural conditions, subsurface water percolates laterally through peat, as higher areas supply water towards lower ones. The result is that the deepest, highest peats are most prone to drying out during extreme drought conditions.

A drought analysis of the type performed on Bornean rainfall data (Leighton & Wirawan 1986) was performed on 13 years of monthly rainfall data from Japura[13].



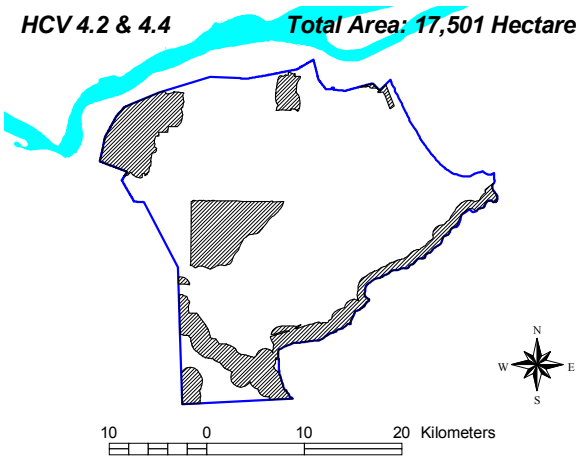
For each calendar year, the 3, 4 or 5 consecutive months with the lowest cumulative rainfall are plotted. The important point is that the distribution of drought intensities shows very high annual variation, and that occasional years such as 1997 are exteme drought "outliers," of unexpected severity. These years correspond to the El Nino-Southern Oscillation (ENSO) events that mark severe drought years over much of Borneo, South Sumatra and Java. In 1997, the July-September total was only 40mm, with only a cumulative 189mm falling during the five months of June-October. 1997 was marked by extensive forest fires throughout this region (Shen, Liew & Kwoh 2001). It is these infrequent years that seem to occur with increasing frequency that test the adaptations of Short PSF trees. Because intensive canal and plantation development began in earnest in 1998, the concessionaire has yet to experience the exacerbated drought and fire risks associated with these extraordinary drought years.

[13] The spreadsheet of raw data is attached in the Technical Annex.

Some forested river systems connected with the FMU (e.g., demarcating the FMU boundary or originating from within the FMU) are important to riverine fisheries, and in the case of the southern Gaung Kiri and Simpang Kanan may lead to important agricultural areas downstream. The protective function of riverine forests is to buffer against reduced water quality to downstream users and the aquatic biota, and to regulate flow rates, is a recognized consideration of forestry management in Indonesia.

Rationale for Boundary Delineation
The peat dome is critical for the maintenance of hydrological functions in the water catchments it services. Riverine forests along existing natural water channels are critical for downstream agriculture and aquaculture, and both are classified as HCV.

- The remaining natural forest at the peat dome at the 28m elevation contour line has been designated HCV because it moderates the hydrologic cycle for downslope peat forests on the east and south sides of the dome. The ability of the dome to perform this function has already been compromised by the plantation canal system. The remaining area of un-drained peat dome and forest must be maintained. The 28m contour roughly corresponds to the Short PSF area, but not exactly, as tall PSF apparently intrudes in a few places. This area is mostly within the KSM area, though the dome extends into the bordering forest on the west as it continues outside the FMU.



- To protect the external ecological and agricultural value of rivers intimately connected with the FMU, especially those that would enter into the Kampar river water catchment, a one kilometer buffer is proposed for each of the main river systems. The team was not able to ascertain what the specific management recommendations of balai PDAS should be for the downstream stretch of the Kampar River, and take a precautionary stance that the protection of the peat dome and river systems would be of priority.

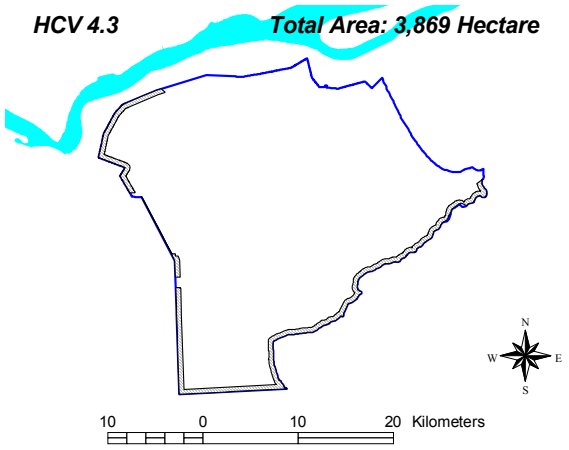
4.4.3 HCV 4.3 Forest providing a barrier to the spread of fire

Definition
The Indonesian HCVF Toolkit states that any forest boundary that protects against large scale fire is an HCV.

HCV4.3 relates to the critical role forest areas may play as a buffer to the spread of forest fires especially in PSFs where the consequences of fire can cause irreversible damage.

Site Context
According to company data, the FMU has not suffered any significant fire events. However, serious fire threat could potentially occur, particularly in drought periods as

described above. First, fire could come into the FMU from the agricultural area of Pulau Muda or the areas to the south where illegal logging and river disturbance has caused forest degradation. Second, from the FMU outwards into surrounding forest, especially the western forest that connects with the Kerumutan Wildlife Reserve. In future severe drought periods, the conditions for wildfires may be present and the protective function of natural forest could be critical.



Rationale for Boundary Delineation

A 500m buffer is proposed inside the FMU border wherever there is natural forest. The science on an acceptable fire buffer in PSF, based upon limited information, is inexact, and a precautionary buffer is suggested in the absence of further company monitoring and research, particularly during serious drought periods.

4.5 High Conservation Value 5
Meeting Basic Needs of Local Communities

Definition

The Indonesian HCVF Toolkit states that if local communities obtain essential fuel, fodder, medicines, or building materials from the forest, without readily available alternatives, then the forest is an HCV. HCV5 applies only to basic needs.

In this HCVF assessment, more than a quarter (25%) of households must be dependent on FMU forests in this way. Local communities may include sub-groups within village areas that form a distinct community of their own.

Site Context

Over 95% of the two main northern villages along the Kampar River, Pulau Muda and Teluk Meranti, are Melayu. Other cultural groups such as Javanese, Maduran, Buginese, Banjar, Minang, Batak *inter alia*, generally do not live in distinct sub-settlements nor do they follow agricultural and forestry practices that differ markedly from the local norm. Therefore, for the purposes of this HCVF assessment, data gathered on forest utilization was for two local communities corresponding to the two villages.

Increasingly, local communities consider forest areas as sources of timber (unsustainably harvested) or as land for conversion to agricultural use. Such forest conversion pressures have risen in recent years with the oil palm cultivation boom. There is already one CPO (crude palm oil) mill where smallholders can sell palm bunches, and more mills are anticipated which should encourage higher farmgate prices. Demand for illegal timber shows no signs of abating.

Forest areas appear to be declining in importance as sources of non-timber forest products (NTFPs). Data on sources of basic needs' components of HCV 5 (see Tables 1 – 4, Technical Annex), indicated that forests are now a minor source of protein, carbohydrates, fuelwood as well as cash NTFPs such as dammar and rattan. Local cultivated agroforestry systems containing fruit trees, coconuts, shrubs and herbs as well

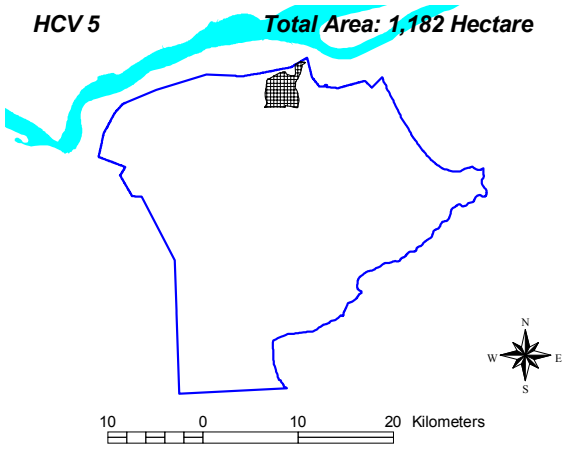
as food crop areas, in particular rice, yield a far greater quantity of basic needs than NTFPs. As incomes have increased over time, so too has the amount of vegetables from outside village areas. Market days reveal a far greater volume of village products from the highlands (potatoes, cabbages, onions, garlic, egg plant, cucumbers, capsicum etc.) than from village farm plots.

Not only are NTFPs playing a smaller role than in the past in the provision of basic needs, but most of the forest areas accessed by local communities in search of these goods are in forests *outside* the FMU and within village boundaries to the south of riverside settlements.

The FMU's northern Tanjung Bebayang (*Konservasi*) and Merawang River (*Unggulan*) are accessed by only a handful of hunters and fishermen from both villages. Some fishermen from Pulau Muda also use the Simpang Kanan River, reached by traveling on the FMU's canals. River fishing within the FMU has been replaced by canal fishing for a smaller range of species but with less seasonal variation in output.

HCV 5 was, however, identified for one kind of basic need -- medicinal plants. Initially, village leaders and senior figures in both villages dismissed the natural forest as a source of NTFPs. Careful questioning resulted in lists of useful NTFPs, many items said to be disregarded today but what parents and grandparents used to gather. Discussions with traditional mid-wives and healers revealed a different picture (and cautioned against over reliance on senior village figures as sources of information about other social sub-groups). In Pulau Muda village, most childbirths are assisted by traditional midwives who begin applying medicinals during pregnancy and up to a couple of months after birth. Only if there are birthing complications will villagers consider going to the AA camp doctor, who will then prescribe modern medicines. Forest surrounding the Merawang River in the FMU's northern *Unggulan* area is the most valued source of childbirth medicinal plants.[14]

The question of whether or not the medicinal plants represent a basic need, something that is highly-valued rather than simply valued by an insignificant minority, is not as easy to answer as it may appear. Few children, if any, are born in the village without them or their mothers being tended by midwives who use the wild medicinals. But not all women, and probably only a few men realize this or would be concerned about the loss of natural forest sources of medicinals unless this were brought to their attention.



On the issue of substitutes for the medicinals, two reasons were given for not substituting: higher cost and uncertainty that the pharmaceuticals would be as effective for childbirth care. Certainly, there are pharmaceutical substitutes, and perhaps low cost but a cost nonetheless that is not easy for the midwives and healers to bear and pass on to patients. The important point is the perception of the group applying and receiving them, together

[14] The Merawang river was the site of the first village settlement in the Pulau Muda area. Abandoned some 70 years ago, the area's value as a source of medicinal plants probably has a long history.

making up most of the village's women. The present assessment found that more than 25% of birthing medicinal needs come from wild sources which are certainly more than the Toolkit's threshold of 15%.

Rationale for Boundary Delineation

The HCV 5 boundary was set to provide a protected harvesting zone 1.5km wide on either side of the Merawang River, based upon information from midwives regarding the distance required for adequate collection. Over the years, illegal logging along the Merawang has destroyed some tree sources of medicinals. Whereas most medicinals were found within 200m of the river, now gatherers must walk up to a kilometer to obtain all that they rely upon.

4.6 High Conservation Value 6
Forest Areas of Critical Value to Traditional Culture

Definition

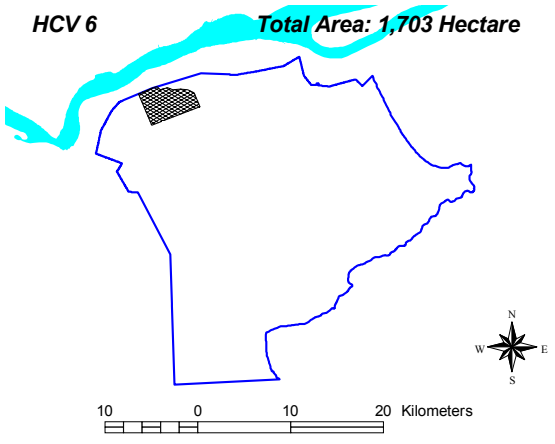
The Indonesian HCVF Toolkit states that if forest areas are critical to the traditional cultural identity of local communities, e.g., restricted-use and reserve forest, ancestral burial, spiritual, religious, and taboo sites, then the forest area will be HCV.

Site Context

The FMU's northwestern conservation area contains part of a riverine marshland and inland forest area known in the villages of Pulau Muda and Teluk Meranti as Tanjung Bebayang. *Tanjung* refers to a point on the river bank where the tidal bore or *bono* is particularly treacherous at the interface between shallows and deeper water. The marshland is renowned form its dangers. *Bebayang* is derived from *bayangan* or imagined features. Tj. Bebayang is imbued with mystical properties. Although not strictly taboo, the area is said to be deadly for those who misbehave.

Tj. Bebayang related spiritual and taboo beliefs are held by over half of the population in each village, but handled in different ways by different groups, from traditionalists to modernists, from the young to the old, such that it becomes unclear whether "critical" is the right descriptor. Yet undeniably, the beliefs in question are deeply embedded in local folklore and have influenced the behaviour of most villagers who venture to the area.

Everyone asked about Tj. Bebayang had a tale of mysterious occurrences, ranging from the death of loggers and failure to set up logging camps to company staff explaining that it had never been possible to complete a boundary demarcation exercise in the area. One sign of discretionary use of the forest area is the low level of human disturbance in the area. Aerial observations revealed a relatively intact forest area and no active illegal logging.



Offerings are left in Tj. Bebayang by those who have experienced good fortune such as the birth of a healthy child, and others who seek good fortune. A small number of visitors with similar motives come from as far afield as Bandung and Medan.

The few who deride the spiritual beliefs or feel awkward about their un-Islamic nature, are careful to give explanations that imply respect. For example, "Tj. Bebayang has no spiritual value … because the spirits have left", or "It is not true that you are in danger from spirits in Tj. Bebeyang …as long as you behave", and "only the old people believe". Interestingly, such statements are usually keenly-followed by stories of what can happen to you there.

In sum, Tj. Bebayang is widely feared (visited by few), revered (fruit and animal offerings for good fortune) or reviled (as a place of primitive and animistic spiritual power). Though arguably declining as a cultural feature of the socio-economic landscape, its "use" is associated with minimal wood extraction in comparison with similar areas along the Kampar River, and disturbance in general. It represents a conservation asset that is likely to enhance FMU's conservation efforts.

Rationale for Boundary Delineation
Pulau Muda healers and other elders interviewed in the assessment demonstrated the extent of the upstream and downstream limits of Tj. Bebayang along the Kampar river bank. From further discussions with these local sources of knowledge, it was estimated that the boundaries extended inland about 5 km inland across the marshland and into eastern half of the FMU's northwestern conservation area. This represents a rough estimate of the respondents and probably will not be known definitively until further boundary demarcation takes place with the communities. Inland extents of forest areas across Indonesia are generally less strictly defined than boundaries along rivers or with villages on either side, (e.g., 'day's walk there and back after gathering products', is a typical measure from Aceh to Papua.) It the case of Tanuing Bebayang, there was never any reason to strictly define the inner inland boundary.

4.7 Additional Boundary Delineation Considerations

In addition to what has been discussed above, certain decisions have been made by the assessment team in setting HCV boundaries. These are explained below in some detail.

(1) The rationale for adopting a 2km extension of habitat on either bank of river channels:

- The current constriction of the hydrological regime of these rivers has resulted in backing up of water during periods of high precipitation. The resulting flooding is exacerbated in inundation effects to the riverine vegetation communities, causing tree death along certain stretches. Successional effects cannot be predicted at the present, but some of these areas are expected to form herbaceous marshes in time. The extent of this habitat change is expected to be confined within a 2km strip of forest.
- The storm's stork is known to utilise tall forest along such riverine environments for nesting, often considerable distances from rivers. Providing a sufficiently large forest tract along these river systems will reduce the disturbance effects of surrounding land use, securing these tracts as breeding habitat for the species, thus ensuring their continued utilisation of the area, and the maintenance of viable populations.
- The Tomistoma uses riverine forest above the flooding limit as nesting habitat. The result of extended flooding along these rivers is the extension of the flood-limit fringe into the forest, thus requiring these crocodilians to move deeper into the flooded forests to access nesting habitat. The 2km strip will ensure the continued availability of nesting habitat for

Tomistoma, as well as provide sufficient buffering from landward intrusions and disturbance.

- The maintenance of large tracts of forests surrounding these rivers preserves the physical functioning of such peat swamp channels and the species that are either entirely dependent on aquatic and riverine habitats, or closely associated with such habitats. Examples of such species (which are listed in the RDB under one category or other) are Otters *Lutra* sp., the two fish eagles *Ichthyaetus* spp., Malaysian Blue Flycatcher *Cyornis turcosus*, etc

(2) Rationale for exclusion of northeastern block of forest from HCV1.2, HCV1.3, and HCV2.2:

- While all tracts of forest have conservation value, the northeast tract of forest has limited value to the White-winged Duck population. While the species may use this forest, usage is expected to be confined to the southern portion (areas which have been included in the HCV boundary), where the riverine habitats extend into the block.
- The strongest argument against the viability of the northeastern forest block is its isolation. Roughly triangular in shape, its eastern boundary abuts oil palm plantations for its entire length. Its western boundary is adjacent to Acacia plantations and recently cleared land, eventually to be planted. The block is therefore a fragmented forest block.
- The edge-effects are expected to be adverse due to the shape of its northern boundary.
- For HCV1.3, there are no known concentrations of threatened species which would be dependent on the northeastern forest block.
- For HCV2.2, the northeastern it is poorly connected to the landscape level forest, and interrupted by severely degraded and dead forest patches and likely to become isolated.

(3) Demarcation of boundaries has been aligned, wherever possible, following these guidelines:

- Following natural and existing physical boundaries where they exist. These may include river channels, forest edge, canals, roads and other on-the-ground features which act as a physical separation between land-uses and/or habitats.
- Remaining forest areas do not follow boundaries as drawn on planning maps. Wherever there are tracts of forest which extend beyond delineated boundaries, these have been included in the HCV boundaries.
- These boundary lines have been demarcated from GIS mapping. Ground-truthing will be required for the company to delineate the actual real-world boundaries.

4.8 HCV areas identified in the FMU

HCV area identification is summarized in Table 6. HCVs 1, 2 and 3 account for the largest area of forest within the FMU. The HCV 2 sub-components exceed either HCV 1 or 3. The social HCVs are in general an order of magnitude smaller than HCVs 1, 2 and 3. HCV 4 areas essentially represent buffer areas around the FMU perimeter and its main river systems.

There is a high degree of overlap among all HCVs, which is to be expected from ecological values where biophysical connectivity plays such a large role.

Table 6. HCV Areas identified in the FMU

HCV	Area (ha)			
	Total	**% of FMU Natural Forest**	**% of HCVF Area**	**% of overlap with other HCVs**
HCV 1				
1.1	20,888	52.97%	61.16%	100%
1.2	20,458	51.88%	59.90%	100%
1.3	11,835	30.02%	34.65%	99%
1.4	-			
Total 1	25,427	64.49%	74.45%	98%
HCV 2				
2.1	-			
2.2	33,498	84.96%	98.08%	98%
2.3	26,296	66.69%	76.99%	99.8%
Total 2	33,538	85.06%	98.19%	98%
HCV 3	21,165	53.68%	61.97%	100%
HCV 4				
4.1	-			
4.2 & 4.4	17,501	44.38%	51.24%	100%
4.3	3,869	9.81%	11.33%	100%
Total 3	18,336	46.50%	53.68%	100%
HCV 5	1,182	2.99%	3.46%	100%
HCV 6	1,703	4.32%	4.99%	100%

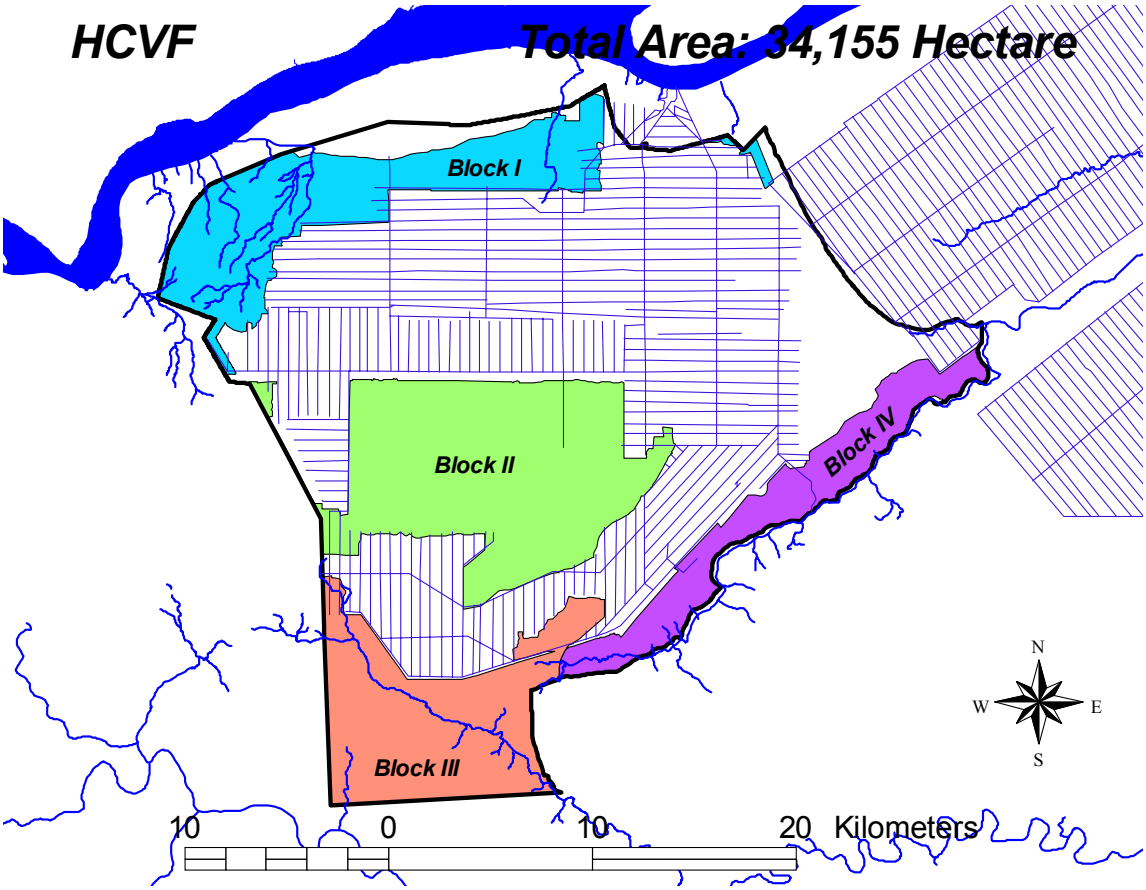
5. Indicative HCVF Boundary for Pulau Muda District

This section takes forward the process of identifying and delineating HCV areas in the previous section to demonstration of where the indicative HCVF boundary and area that it encompasses should be for the Pulau Muda District.

Following the delineation of HCV boundaries through the GIS mapping process, a composite overlay of all identified HCVs and components was produced. The overlays permitted a single HCVF layer with defined areas indicated on a map of the FMU. The HCVF boundary is best represented according to the dominant forest blocks that are described below.

Figure 5 is to be considered the indicative HCVF map for the Pulau Muda District, as of August 23, 2004, and depicts the four forest blocks.

Figure 5. Indicative HCVF Boundary for Pulau Muda District



The HCVFs defined within the FMU can be broadly divided into the following blocks:

Tanjung Bebayang – Sungai Merawang Block I
This block contains almost the entire remaining forest along the northern boundary of the FMU, from the northwestern corner, along the boundary parallel to the Kampar river to the eastern edge of the Sungai Merawang area.

This block has an overlap of seven HCVs or their components, detailed below:

HCV2.2 – Its boundary covers the entire remaining natural forest within this block, excluding an area of secondary forest along the northern FMU boundary. It includes areas of natural forest that have been degraded either by flooding or logging, but which have been determined to retain their value in contributing to the Kerumutan large landscape level forest.

HCV3.1 – Its boundary follows the current limits of natural forests which have been determined to be in good condition, and consist of mixed PSF, which has been identified as a rare and threatened habitat type within the FMU, within Kerumutan, and regionally as well.

HCV 4.2/4.4 – Its boundary includes the riverine forest systems within this block.

HCV 4.3 – A strip of forest aligned with the western boundary of the FMU.

HCV5 – Its boundary follows the current delineated boundary of the Hutan Konservasi Merawang, which has been ascertained to be of high value to the community of Pulau Muda, as a source of medicinals.

HCV6 – Its boundary follows the accepted boundary of a spiritual forest called Tanjung Bebayang.

Tanjung Bebayang – Sungai Merawang Block I is identified as an HCVF on the basis of the following:

- It contains seven different components of high conservation values identified within the FMU.
- It supports 5 of the 6 HCVs as defined by the FSC under Principle 9 of the FSC Principles and Criteria.
- Two of these attributes occur entirely within this HCVF.

KSM Block - II

This is the rectangular block in the centre of the FMU, and includes the larger of the two Kawasan Lindung (i.e., KL-1) with which it is contiguous. The KSM block has two distinct habitats or ecosystems within its boundaries: Tall PSF and Short PSF.

This block has an overlap of seven HCVs or their components, detailed below:

HCV1.1 – Its boundary extends across this entire block, the rationale being its contiguity with KL-1, a legally protected area within the FMU. The application of the contiguity principle and the addition of Short PSF to the KL-1 forest type are the justification for the inclusion of the entire KSM block under HCV1.1.

HCV1.2 – Its boundary follows the rough limits of the Tall PSF habitat within the block, excluding the Short PSF. The rationale for this is that the White-winged Duck is known to utilize the Tall PSF within the block as a refuge, but it is not expected to utilize regularly, or depend upon, the Short PSF for its survival.

HCV1.3 – Although the block is excluded from this HCV, there is a small amount of this forest that applies due to the 2km extension from all waterways and water channels.

HCV2.2 – Its boundary is similar to HCV1.1, but includes the remaining triangle of uncleared forest between the western edge of the block and the western boundary of the FMU. The rationale for this inclusion is that this forest is still quite contiguous with the larger landscape level forest of Kerumutan.

HCV3.1 – Its boundary follows the limit of the Short PSF, determined to be a rare and threatened habitat type both within the FMU, landscape, and regionally.

HCV 4.2/4.4 – its boundary follows the extent of short PSF within the block, which provides critical hydrologic services to surrounding forests.

The KSM Block II has been identified as an HCVF on the basis of the following:

- It contains seven different components of high conservation values identified within the FMU.
- It supports 4 of the 6 HCVs as defined by the FSC under Principle 9 of the FSC Principles and Criteria.
- Under HCV1.1, the long term ecological functioning and viability of KL-1 is dependent on this block.

Sungai Gaung Kiri Block - III

This block is the southwestern corner portion of the FMU, consisting of the largest tract of tall PSF within the FMU. It is delineated in its northeastern corner to include the KL-2 block of protected forest, but excludes the more open channel of the Sg. Simpang Kanan as its flows eastwards along the FMU's southern boundary.

This block has an overlap of seven HCVs or their components, detailed below:

HCV1.1 – Its boundary includes this block in its entirety. The rationale is similar to that for KL-1, which is to support the existing protected area (KL-2) in terms of habitat contiguity and long term viability.

HCV1.2 – As with HCV1.1, its boundary includes this entire block. The rationale is that the primary habitat for the White-winged Duck is tall riverine forests with open water bodies, and this block has two river systems within its boundary: Sg. Simpang Kanan and Sg. Gaung Kiri. It also adds a small representation of floodplain wetlands, which is also likely to be habitat for the duck. The inclusion of forests between these two river systems is based on contiguity.

HCV1.3 – Its boundary follows the 2km extension applied to all water channels within the FMU. The rationale for this is the three endangered species identified within the FMU are all associated with riverine ecosystems.

HCV2.2 – Its boundary includes this entire block, for its contribution to the large landscape level forest of Kerumutan, and strengthened by its being the largest remaining block of forest within the FMU which is contiguous with the Kerumutan landscape to the west.

HCV3.1 – Its boundary includes the riverine habitats within this block, excluding the southwestern corner which is beyond the 2km extension applied to rivers. The rationale is that riverine ecosystems are under threat.

HCV 4.2/4.4 – Its boundary follows the 2km extension away from river courses, aligned with the Sg. Gaung Kiri. The southwestern corner is included following the floodplain habitats.

HCV 4.3 – its boundary is aligned with the FMU boundary along its entire length.

The Sg. Gaung Kiri Block III has been identified as an HCVF on the basis of the following:

- It contains seven different components of high conservation values identified within the FMU.
- It supports 4 of the 6 attributes of HCVFs as defined by the FSC under Principle 9 of the FSC Principles and Criteria.
- Under HCV1.1, the long term ecological functioning and viability of KL-2 is dependent on this block.

Sungai Simpang Kanan Block - IV
This block follows the alignment of the Sg. Simpang Kanan from the boundary of the Sg. Gaung Kiri block (an arbitrary boundary) to the eastern corner of the FMU where it adjoins the oil palm plantations. South of the Sg. Simpang Kanan, it follows the FMU boundary, and to its north, it follows the existing forest – Acacia plantation interface.In the eastern corner, it follows the 2km extension away from the river, excluding the larger forest block to its north.

This block has an overlap of seven HCVs or their components, detailed below:

HCV1.2 – Its boundary includes this block in its entirety, and represents the most important representation of primary breeding habitat for the White-winged Duck within the FMU.

HCV1.3 – Its boundary includes the entire block. The riverine habitats are best represented within this block, and support a concentration of endangered species, represented by the White-winged Duck, Storm's Stork and Tomistoma.

HCV2.2 – Its boundary includes the entire block, as a part of the larger landscape forests of Kerumutan.

HCV3.1 – Its boundary includes the entire block, as the primary representation of PSF riverine habitats, a threatened habitat regionally.

HCV 4.2/4.4 – Its boundary follows the course of the Sg. Simpang Kanan along its entire length within the FMU.

HCV 4.3 – Its boundary follows the FMU boundary along its entire length.

The Sg. Simpang Kanan Block IV has been identified as an HCVF on the basis of the following:
- It contains seven different components of high conservation values identified within the FMU.
- It supports 4 of the 6 attributes of HCVFs as defined by the FSC under Principle 9 of the FSC Principles and Criteria.
- This block is the highest conservation significance for the preservation of HCV1.3, within which the Tomistoma population (although not observed) would be confined to.

Table 7 represents the area delineated as HCVF corresponding to each of the current FMU land use classifications. It can be seen that 85% (34,156 ha) of the remaining natural forest at the time of the assessment was delineated as HCVF. Almost 94% of the FMU conservation (*konservasi*) area is delineated as HCVF, 83% of the *Unggulan* natural forest, and only 10% of the *Kehidupan* forest is HCVF. Of the remaining 14,062ha allocated for establishment of plantations, about 87.5% was determined to be HCVF by the assessment team.

Table 7. HCVF area compared to FMU land use

FMU Land Use	HCVF (Ha)	% of FMU land use	Remaining Natural Forest (Ha)	Total Area (Ha)
Kehidupan	353	10.0%	3,050	**3,525**
Konservasi	13,508	93.5%	14,100	**14,447**
Produksi	12,317	23.9%	14,062	**51,442**
Unggulan	7,974	83.3%	8,588	**9,567**
Overlap with MGI	4	0.5%	4	**773**
Totals	**34,156**	**42.8%**	**39,805**	**79,754**

6. *HCVF Management, Monitoring and Research Implications*

The scope of the SmartWood HCVF assessment of Pulau Muda was to identify HCVs and delineate the HCVF areas. Detailed management and monitoring guidelines will have to be developed by the company, in consultation with stakeholders, on the basis of the identified HCVs and preliminary delineation of HCVF.

This section describes some of the general management and monitoring considerations for HCVFs within and directly surrounding the FMU that the company would have to deal with.

6.1 Management Implications

Following an HCVF assessment and indicative delineation of the HCVF boundary within the FMU, the challenge forest managers will face is what to do next? Current and future plantation operations, and outside forces, will have an impact on these HCVFs. The nature and extent of these impacts must be determined by the plantation managers, and steps taken to mitigate these impacts. These measures will need to be developed within the forest management plan (FMP) or addressed in future revisions of the existing FMP.

On the assumption that the HCVF boundary delineation as recommended is adhered to, and company commitment is made to develop its management planning so that HCVFs are managed as part of the FMU, there are a number of issues to be considered.

Boundaries
The first management implication arising from this assessment will be for the company to accept the findings and then undertake a process to transfer the 'indicative' HCVF boundary to company maps, plans, and GIS. The objective is to ensure that an actual boundary delineation process takes place at Pulau Muda. The delineation of the HCVF boundary will need to be implemented on the ground, and particularly for those HCVs that are social, the boundary process will need to involve the local communities.

Supervision, Guidelines, and Training
The company will need to develop procedures to inform staff of the exact locations of HCVFs and state all conditions/prohibitions for staff to protect HCVFs.

- Supervisors must maintain strict oversight of operations to enforce no-cut policies. (There should be a strict no-cutting policy in the HCVF areas.)
- Guidelines for operations will need to be developed, in association with the FMP, to reduce or eliminate the impact of plantation management on the HCVFs.
- Monitoring to ensure compliance with these guidelines by staff and contractors will need to be undertaken.
- Training must be considered to build in-house capacity to manage HCVFs.

External Protection
An important and direct implication of designating areas as HCVF is to protect these from the most damaging human disturbances. Forests designated as HCVF would need to be protected from illegal logging, hunting, and trapping (although some of these forests can continue to supply minor forest products sustainably collected), and wildfire. Through the FMP, strategies need to be developed which might depend on partnerships and covenants being formed.

- The company will need to communicate the reasons for HCVF designations to staff and surrounding communities. (Informational brochures and maps of HCVF could be used to socialize staff, workers, and surrounding communities about the locations of HCVFs.
- To ensure that boundaries are well understood, it may be necessary to signpost HCVF borders. If signs are used, they should explicitly mention which activities are forbidden.

- FMU security personnel, working with conservation staff, should be assigned to the task of monitoring HCVFs.
- Wildlife hunting and trapping should be completely banned in HCVFs (and probably throughout the concession).
- Banning firearms within the FMU, except those carried by security personnel, should be undertaken to control hunting.

Canals

In the FMU, canal systems have created some conservation problems that should be considered in managing HCVFs:

- Like roads, canals provide entry for illegal hunting and logging activities.
- Canals form barriers to wildlife travel, both for terrestrial species that will not cross water and for arboreal species whose canopy travel routes have been interrupted by a canal corridor.
- In many areas, canals within designated HCVFs may need to be blocked and filled to re-establish continuous land connections for such species. This problem is especially important in the forested corridor of the west-central block, which is completely intersected by north-south running canals.
- As canals transport water from the uphill peat areas of the dome and surrounding areas to the lower peripheral areas, there is the problem of forest (such as the Mixed PSF in the northwestern corner of the FMU) being unnaturally flooded and dying.
- Canals spilling water directly into HCVFs may need to be blocked and filled.
- In some areas, to preserve hydrology, the canals to be blocked may not even be near the HCVFs.

Roads

The potential for construction of a proposed road running along or through the northern portion of the FMU would be a clear threat to the HCVF there. Such a road would carry many risks, both ecological damage from engineering that interrupts drainage, but most importantly from uncontrolled agricultural development, logging and colonization drawn by road transport.

- Roads should not be constructed through any of the delineated HCVF areas

Community uses

The management of the HCVFs related to medicinal collection and cultural/taboo beliefs will require the willing and active participation of the Teluk Meranti and Pulau Muda village communities.

- The definitive HCVF boundary delineation should involve participative mapping involving both the village leadership and the sub-groups most familiar with the values, e.g., healers and mid-wives who gather medicinals related to HCV 5 and elders familiar with the HCV 6 area.
- Conventional reliance on input from village leaders alone should be avoided, because of importance to sub-groups of certain HCVs.

6.2 Monitoring Regime

Monitoring is clearly an essential component of HCVF management, both for internal management reasons and to ensure national and international credibility. HCVF should be monitored both for their protection and to evaluate status of their conservation values. In the present circumstances of wide skepticism about company motives, credibility may only be achieved if there is also an independent and transparent monitoring system, at least annually implemented, to assure that HCVF areas are being respected and maintained. The company may want to develop an HCVF monitoring unit.

Monitoring for purposes of evaluating the status of HCVF protection should incorporate a combination of techniques.

- Satellite images and aerial over-flights can provide less frequent monitoring from above.
- On-the-ground monitoring along canals, rivers and terrestrial borders where monitoring by boat is not possible.
- Monitoring should be preemptive to the extent that is possible. The company should detect and attempt to prevent illegal logging, agricultural or hunting activities at their initial stages of encroachment.
- Monitoring of illegal logging may need posts established at the borders of the FMU along the main rivers.

Monitoring for purposes evaluating the status of HCVF conservation values would require a carefully thought out sampling design beyond the scope of this report. A main purpose of this set of monitoring objectives should be to characterize the HCVF forests far more rigorously than has been done so far. The main elements of such conservation monitoring should be:

- Measurement of biological variables that are clearly connected to the objectives of maintaining and managing HCVs 1, 2 & 3. This means census of the key populations of wildlife. These include both endangered species, and umbrella and keystone species (e.g., large seed dispersing birds and mammals), as indicators of ecosystem integrity and health.
- Measurement of tree biodiversity and enumeration of rare plant species.
- Improved definition of sub-habitats and comparison of these with areas of the greater Kerumutan landscape.
- Wildlife and vegetation should be sampled in strata across the HCVFs of the FMU.
- Wildlife samples (transects) should cover all habitat types present.
- Vegetation stucture and floristic samples should be nested plots in which areas sampled for large trees are larger than the nested plot areas sampled for small diameter trees.
- Plot and transect samples should be stratified across the blocks of the different habitats.
- Once established, a baseline set of values needs to be compared periodically with collected samples to monitor ecological health.
- Such baseline studies and ongoing monitoring data will form the basis for independent third party monitoring or assessments.

6.3 Research and Development

The monitoring objectives for maintaining HCVF conservation values implies some research needs. These would include better scientific characterization of the natural forests that have been designated as HCVF in terms of species, habitats and ecosystem values.

One research topic would be to evaluate the importance of the HCVFs of the FMUs in relation to the Kerumutan landscape-level forest. What are the important species and habitats within the large landscape and how do those of the FMU complement these as part of an ecosystem, or compare to their counterparts in the landscape forest?

The Sg. Gaung Kiri and Sg. Simpang Kanan HCVFs support White-winged Duck, a conservation flagship species with a high media profile. Management of the HCVF specifically for this species is not expected to be resource intensive. However, given its status, management will need to address issues beyond the protection of its prime habitat. Development of a species action plan may be required, in order that the management of this resident population is effective. Understanding how best to manage a critically endangered population of white-winged ducks in a forestry plantation will depend on how much managers can learn about the species in relation to its use of the FMU.

The Sg. Simpang Kanan HCVF block supports a concentration of globally threatened species. Management of this HCVF will require in-depth ecological knowledge of the species concerned, their spatial and temporal use of habitats within, and without, the HCVF, and the control of operative factors which impact upon the long term survival of these populations.

The KSM HCVF block contiguous with the Kerumutan landscape forest to the west is compromised by the clearing of much of the connecting forests. The remaining connection is a narrow 750m "corridor" which is something of a bottleneck currently. However, from an ecological standpoint, this connection area still has potential through management. One research topic would be to study how restoration strategies of the cleared areas adjacent to the corridor could enhance the corridor value.

There is a broad scope for the concessionaire to play a wider conservation role in this entire landscape. Clearly the HCVFs identified are most important if the landscape-level forest is protected. How can the company contribute to this? Cost-effective contributions that might be made towards this broader context would be especially valuable and laudatory as good stewardship.

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Appendix 1. List of Spatial Data & Imagery Sources

Asia Pulp and Paper Co. Ltd

IMAGES

1. Spot image of Pulau Muda and surrounding areas. Dated May 2004. Acquired by SmartWood for APP. Electronic file *SPOT2A.tiff.*

GIS Data

2. Pulau Muda Baseline Information in Arc View Shapefile and AutoCAD format. Reference files:
    a. Bagunan_air.shp
    b. Konturpm.dxf
    c. Mgpp260504.shp
    d. Mgsm260504.shp
    e. Pmkl260504.shp
    f. Pmls260504.shp
    g. Pmsg260504.shp
    h. Pmsl260504.shp
    i. Pmhp260504.shp
    j. Skpp260504.shp
    k. Sksm260504.shp

Ministry of Forestry

3. Table of conservation sites in Riau. Undated. Ministry of Forestry website: *http://www.dephut.go.id*, downloaded on 15 July 2004.

IMAGES

4. Peta Penutupan Lahan pada Area hutan Lindung dan Kawasan Konservasi, Propinsi Riau, Skala 1:4000,000. Undated. Ministry of Forestry website: *http://www.dephut.go.id/*, downloaded on 16 July 2004.

SarVision, Wageningan University

IMAGES

5. Spot image of South East Asia1. Dated 15 February 2002. To Chris Bennett from Dirk Hoekman. Electronic file *1998_VVY_FullResolution*.
6. Spot image of South East Asia2. Dated 15 February 2002. To Chris Bennett from Dirk Hoekman. Electronic file *1998_VVY_FullResolution*.

WWF Indonesia

IMAGES

7. Landsat MSS. Dated 14 May 1973.
8. Landsat MSS. Dated 15 July 1985.
9. Landsat MSS. Dated 17 July 1985
10. Landsat TM. Dated 15 September 1993
11. Landsat ETM 7. Dated 5 March, 2001
12. Landsat ETM 7. Dated 15 August, 2002

GIS Data

13. Various data on Riau in ArcView Shapefile and ArcView grid files. Reference files:
    a. Protectedareas_dinhut_poly_48n.shp
    b. Timber_estate_2003_48n.shp
    c. Palmoil_plantation_2002_48n.shp
    d. Logging_concession_2002_48n.shp
    e. Rtrwp_riau_1994_48n.shp
    f. Rtrwp_riau_draft_2015_48n.shp
    g. Riau_90 (digital elevation model)
    h. Administrative_boundary_2001_poly_48n.shp
    i. Base_poly_48n.shp
    j. Landcover_riau_2002_48n.shp

Appendix 2. APP / SMG Contact List

	Name	Organization	Contact Details	Remarks
1	Alias Abdul Jalil	Forest Environment Division	PT AA, Perawang	APP Team, in July 21 meeting, Motivated new staff member, so programs not yet in place.
2	Faizal Toh	FIM Dept	PT AA, Perawang	APP Team, in July 21 meeting
3	Balan Nair	Head of Forestry	PT AA, Perawang	APP Team, in July 21 meeting
4	Pang Tak Kai	Head, Water Management	PT AA, Perawang	APP Team, in July 21 meeting, future research plans for canal systems and objectives
5	Soekrisno	Water Management	PT AA, Perawang	APP Team, in July 21 meeting
6	Jim Leitch	Forestry Planning	PT AA, Perawang	APP Team, in July 21 meeting
7	Amir Sabri	RS-GIS	PT AA, Perawang	APP Team, in July 21 meeting
8	Agus Pratomo	Fire Protection Section	PT AA, Perawang	APP Team, in July 21 meeting
9	Sugiyono	Social Forestry Manager	PT AA, Perawang	APP Team, in July 21 meeting
10	Liberty	Soil Science/R&D	PT AA, Perawang	APP Team, in July 21 meeting
11	Kho Tjin Ho	Senior District Manager	Pulau Muda District	PMD team, in July 23 meeting
12	Roy Adam	Ka. Sub District Merawang	Pulau Muda District	PMD team, in July 23 meeting
13	Giyaini	Resort Merawang	Pulau Muda District	PMD team, in July 23 meeting
14	Irzal	ADM	Pulau Muda District	PMD team, in July 23 meeting
15	Rudolf Gutton	ISO District Coordinator	Pulau Muda District	PMD team, in July 23 meeting
16	Wahyudin	ADM ISO	Pulau Muda District	PMD team, in July 23 meeting
17	Ali	Ka. District Office	Pulau Muda District	PMD team, in July 23 meeting
18	N…oto	… Resort Simpang Kanan	Pulau Muda District	PMD team, in July 23 meeting
19	Hermowan	Ka Sub District Sg. Kanan	Pulau Muda District	PMD team, in July 23 meeting
20	Diding K	KaWaSic FAM, Perawang	Pulau Muda District	PMD team, in July 23 meeting
21	Julian Herry	Technical Support	Pulau Muda District	PMD team, in July 23 meeting
22	Eri Tandra	Technical Support	Pulau Muda District	PMD team, in July 23 meeting
23	M. Taufiq H.	Security and Social Section	Pulau Muda District	PMD team, in July 23 meeting
24	Sugianto	Asst. Manager, Merawan Resort	Pulau Muda District	Field identification of trees; inconsistent in identification
25	Yusman	Head, Cruising Team	Pulau Muda District	Field identifications of trees; methodology, reliable in definition and use of vernacular names; motivated to improve skills.
26	Rohadi	Security Guard	Pulau Muda District	Info on species seen and locations
27	Resno	Security Guard	Pulau Muda District	Ex-logger from 1986
28	Pasau Anggoro	Planning & Survey Staff	Pulau Muda District	Person conducting biodiversity monitoring
29	Raffles	Komandant Sekuriti	Pulau Muda District	Info on species seen and locations
30	Sahat Manalu	Operator & boat driver	Pulau Muda District	Info on species seen and locations
31	Contract workers	Kem Kontrak PKJ	Pulau Muda District	Interviewed 11 people for info on species
32	Contract workers	Kem Kontrak [?]	Pulau Muda District	Interviewed 5 people for info on species

Appendix 3. Contact List of Interviewed Stakeholders & Resource Persons

	Name	Title	Remarks
1	Alias	Desa Pulau Muda	26 July
2	Anasruddin	Village Head, Pulau Muda	26 July
3	Kamaruddin	Hunter, Pulau Muda	26 July
4	Sulaimi	Penyuluh Pertanian Lapanagan, Desa Teluk Meranti	26 July
5	Ali Azar	Desa Teluk Meranti	26 July
6	Abdul Azis	Desa Teluk Meranti, Independence Veteran	26 July
7	Lubis	BKSDA	26 July
8	H. Hasan E.	Kepala Desa, Teluk Meranti	27 July, village meeting, chaired by H. Hasan E.
9	Ramodhin	Sekretaris Desa	27 July, village meeting
10	Jasri	Ketua Pemuda	27 July, village meeting
11	M. Yazio	RT	27 July, village meeting
12	Ali Asar	Ketua BPD	27 July, village meeting
13	Abdul Gafar	Anggota BPD	27 July, village meeting
14	Ahmad Bakrie (Ojong)	Dukun Obat	27 July, village meeting
15	Sofian	Babinsa	27 July, village meeting
16	Adnan	Anggota BPD	27 July, village meeting
17	Hazairin	Anggota BPD	27 July, village meeting
18	Wali		27 July
19	Ahmad Bakrie (Ojong)	Healer (dukun obat), Teluk Meranti	27 July
20	Sinun	Midwife (bidan), Teluk Meranti	27 July, meeting with midwife & other women
21	Salama		27 July, meeting with midwife & other women
22	Ati		27 July, meeting with midwife & other women
23	Intan		27 July, meeting with midwife & other women
24	Lja		27 July, meeting with midwife & other women
25	Samsar	Midwife (bidan), Pulau Muda	28 July
26	Pesa	Midwife (bidan)	28 July
27	Makmur	Healer	28 July
28	Imam Jantan	Healer & funeral preparer	28 July
29	A. Rachman	Jabatan P3N, Pulau Muda	28 July, village meeting for questioning
30	Darwis	Staf Desa	28 July, village meeting for questioning
31	R.Sitomorang	BPD	28 July, village meeting for questioning
32	Muchtor		28 July, village meeting for questioning
33	Nasir YS		28 July, village meeting for questioning
34	A. Rachman		28 July, village meeting for questioning
35	Kamarudin		28 July, village meeting for questioning
36	A. Bahtiar		28 July, village meeting for questioning

37	Mr. Yus Rusila Noor	Project Coordinator Climate Change, Forests and Peatlands in Indonesia, Wetlands International	Email, phone, and provision of data.
38	Rudyanto	BirdLife International	Email, phone, and provision of data.
39	Pete Wood	BirdLife International	Email, phone, and provision of data.
40	Chip Fay	ICRAF	Phone communication
41	Willem van Diest	Northern Sumatra Irrigated Agriculture Sector Project	Email, meeting, and provision of data
42	Judith Kaspersma	Northern Sumatra Irrigated Agriculture Sector Project	Email, meeting, and provision of data
43	Meine van Noordwijk	ICRAF	Email and provision of data

Appendix 4. Itinerary

Date	Location /Sites visited	Main activities /1/
July 20	APP/SMG offices in Jakarta	Initial SW team briefing with senior management
July 21	PT Arara Abadi offices in Perawang	Initial SW team briefing with mid-level management
July 22	PT Arara Abadi offices in Perawang	SW team interviews staff in research & development, survey and planning, community development, and legal. SW team examination of reports and other data sources to establish background to the site
July 23	Pulau Muda District Base Camp Office	SW team introductory meeting and questions with staff. SW team preparations for field work
July 24	Log pond port to Western concession boundary	SW team travels by boat through canals alongside 5 – 6 year old plantations, along newly planted sites, and blocks being clear-felled at the moment.
	Buffer zone strip at end of Kanal Primer XII	Recording of species along canal along forest edge Interview with APP staff
	Kanal Primer XIII into southwestern corner of KSM	Recording of species along canal (forest edge) Interview of construction crews working on site, and APP staff
	Junction of *Kanal Primer XII* and *IV*, into KSM	Brief recce along bund to forest edge Interview with APP staff
July 24	Petak 897	Recce within existing natural forest along boundary.
	Western edge of KTH block	Observing forest structure and vegetation type in natural forest (with poles and pandanas).
	Southern edge of KTH block ("Corridor Area")	Recce within existing natural forest at southern most canal; observed large areas of the "Corridor that was felled."
July 25	Canal at southeastern corner of FMU (SK03)	Recording of species Examination of forest edge and flooding
	Canal at southeastern corner of FMU (SK01)	Recording of species Examination of forest edge and flooding
	KL-1	Recording of species Examination of forest
	End of kanal primer XV	Recording of species
	End of kanal primer XIV	Recording of species Attempt to reach tributary of Sg. Gaung Examination of forest
	Northwestern corner of KL-1 (southern end of Kanal primer I)	Brief examination of forest from boat
July 26	Visit KSM Block NW	Ecosystem and habitat typing, forest species identification
	Introductory Meeting in Teluk Meranti	Collecting social data
	Soil sample taken in riverbank	Establishing peat profile
	Exploration Kanal KSM NE Corner	Recording species; Spotlighting 2.7km transect along canal from 1902 to 2033
July 27	KL NW Block	Ecosystem and habitat typing
	Edge of Unggulan and river block	Evaluating forest condition
	Western end of kanal primer XI (into Kawasan Lindung)	Recording of species, Examination of forest, Interview with construction gangs
July 28	KL-2	Recording species along bund, examination of forest
July 29	Aerial survey of FMU	Vegetation and habitat mapping
July 30	Aerial survey of FMU and kerumutan	Vegetation and habitat mapping

Appendix 5. Glossary of Terms

***Areal Kehidupan* / Livelihoods Area**
According to Minister of Forestry Decree No.70 of 1995, around 5% of the HTI FMU area with non-timber yields of value for local communities.

***Areal Konservasi* / Conservation Area**
According to Minister of Forestry Decree No.70 of 1995, conservation areas are where there is peat, water absorption area, riparian zone, beach zone, next to lake or reservoir, around spring and around mangrove areas.

***Areal Produksi* / Production Area**
According to Minister of Forestry Decree No.70 of 1995, production areas that can be cleared for the establishment of industrial timber plantations.

***Areal Unggulan* / High-quality Local Species Area**
According to Minister of Forestry Decree No.70 of 1995, around 10% of the HTI FMU area is mandated for management of local species of high market value.

Alternatives
In the context of livelihood sources, refers to alternatives that are readily available at a low marginal cost, e.g., market beef instead of deer meat.

Baseline Mapping
Mapping parameters that include: topography, vegetation types and their distribution, and land use and vegetation cover of the surrounding areas. Graphical presentation of all available baseline information forms the basis for planning of surveys, plotting of HCVs, creation of overlays and delineation of HCVFs. Pre-requisite for conducting an HCVF assessment.

Baseline Inventory and Mapping
An inventory of the habitat and species in the FMU. It should cover the following parameters:
- Inventory of species occurring within the FMU: plants, mammals, birds, herpetofauna (reptiles & amphibians) and fish;
- Reports & other literature on gazetted protected areas in the immediate vicinity;
- Ecological literature on species of conservation significance locally, nationally, regionally and globally;
- Reports and other literature on the status of habitats, forest types and vegetation communities of conservation significance locally, nationally, regionally and globally;
- Mapping of: topography, soils, vegetation types and their distribution, and land use and vegetation cover of the surrounding areas.

A baseline inventory and mapping is a pre-requisite for conducting an HCVF assessment.

Contiguity Principle
The application of this principle to HCVF delineation endeavours to minimize boundary lengths, keeping forest blocks as compact as possible. Small tracts of forest should be avoided, reducing fragmentation and edge effects to HCVFs. Where gazetted protected areas occur adjacent to, or close to the FMU, HCVFs should maintain contiguity with these protected areas. Wherever possible, forest corridors should be maintained between HCVFs, their size and shape reflecting the needs of the animal and plant species which use them. Contiguity should also be maximized with other protection forests within forest estates, such as riverine buffers, catchments, steep slopes and buffer strips.

Critical temporal concentrations

Defined by the Indonesian HCVF Toolkit as habitats or locations which have important concentrations of species only at certain times or at certain phases of their life-history, including critical breeding sites and migratory routes or bottlenecks (latitudinal as well as altitudinal). These may be represented by:

- Concentrations of migratory birds;
- Animals such as bearded pig following Dipterocarp masting events;
- Fruit bats, bees and pigeons follow flowering and fruiting patterns of trees;
- Elephant migration between different forest blocks;
- Fish migrating to spawning grounds.

Critically Endangered Species

According to IUCN, a taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥80% over the last 10 years or three generations, whichever is the longer**,** where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible**,** based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
a. Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 50 mature individuals, OR
(ii) at least 90% of mature individuals in one subpopulation.
b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

Data Deficient (DD) Species

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Degraded forest

Forest no longer in its natural state, its structure being modified by human activity or natural conditions*, either directly, e.g., high-impact logging, or indirectly, e.g., flooding of forests caused by downstream obstruction to rivers by infrastructure development.* The majority of its floristic composition is retained, but opening of the canopy has resulted in colonization, or regeneration, of light-loving species. Depending on proximity to sources of colonization, scrub species (mammals and birds) may or may not occur.

> Also considered is the AMEC definition derived from World Bank, "This is a forest that has been essentially modified by human activity and has reduced the habitat's ability to maintain viable populations of native species. These forests may also be under current threat from local people involved in illegal activities which will continue to degrade the forest structure and its associated hydrology and thereby its habitat values for the conservation of fauna and flora and sustainable livelihood of local people. Degraded forests have been essentially modified through previous logging, indicated by evidence of railway lines and large openings, fires, or extensive networks of canals in peat areas."

Ecoregion

A geographically disctinct area of land that is characterized by a disctinctive climate, ecological, features, and plant and animal communities.

Endangered Species

According to the IUCN, a taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer**,** where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
   a. Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 250 mature individuals, OR
      (ii) at least 95% of mature individuals in one subpopulation.
   b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

Forest
Unless otherwise indicated all references to "forest" in the report assume natural forest (regardless of its quality). Plantation forest areas are specified as such.

FMU
The Forest Management Unit of Pulau Muda District I located south of the Kampar river in Kabupatens Pelalawang, Indragiri Hilir and Indragiri Hulu. It does not include the Serapung forest management area.

Forest Fragmentation
In the context of forests, refers to discontinuity in the forest landscape compromising functioning of the corridor affect, resulting in forest landscape dysfunction and related threats to habitat integrity and species survival. The usage of this term here is not applied to canopy fragmentation.

HCV
High Conservation Value as determined by identifiable biodiversity components. HCVs are distinct from lower conservation values which may still be worthy of protection as well as other site aspects of no significant conservation value.

HCV 1
Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).

HCV2
Forest areas containing globally, regionally, or nationally significant large landscape level forests, contained within, or containing the management unit, where viable population of most if not all naturally occurring species exist in natural patterns or distribution and abundance.

HCV3
Forest areas that are in or contain rare, threatened or endangered ecosystems.

HCV4
Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).

HCV5
Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).

HCV6
Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance in cooperation with such local communities).

HCVF
High Conservation Value Forest area determined according to the presence of one or more high conservation values within areas of conservation value.

***Kawasan Lindung / Protection* Area**
According to Presidential Decree No.32 of 1990, Protection Areas.

Keystone species
Species providing ecological functions (e.g., seed dispersal, pollination, key food resources) necessary for preventing the local extinction of other species in the community.

Landscape Forest
Large blocks of forest covering more than 50,000 ha that are (a) continuous enough to allow dispersal of plant and animal populations and (b) are mostly in primary or lightly disturbed condition.

Local Community
A village (*Desa*), sub-village (*Dusun*) or other social sub-group unit within the village or from another village (e.g, fishermen, rattan gatherers), whose area of livelihood development overlaps partly or entirely the FMU's natural forest area or is adjacent to it. Local communities may be recently or long-established. The social unit of community may apply to settlements downstream that are impacted by human forest disturbance, e.g., canal digging, or settlements close to smoke sources from fire mismanagement.

Lightly degraded forest
In the Pulau Muda FMU this term is applied to lightly selectively logged forest which has increased the frequency of gaps, but retains high biodiversity conservation value. If protected from fire, natural processes of ecological succession and regrowth will return this forest towards primary forest conservation value.

Lower Risk (LR) Species
A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

- **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
- **Near Threatened (nt).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
- **Least Concern (lc).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

Non-forested land
Land that has been entirely cleared of its former vegetation, or has been colonized by secondary forest species, e.g. monotypic stands of *Macaranga* and other pioneer species. Faunal composition entirely open country scrub species.

Overlap
Refers to ecological as well as physical characteristics. For species, this would apply to those whose ranges extend across the Protected Area (PA) and the FMU. For habitats, this applies to vegetation communities which occur in both the PA and the FMU, and are of significant conservation concern or priority on national, regional or global scales.

Peat Swamp Forest (PSF)

Forests growing on surface peat, of variable structure and floristic composition depending on edaphic (soil) and drainage factors. Those at the Pulau Muda FMU are coastal peat swamp forests on peat deposits that have accumulated over marine sediments. The peat layer comprised of partially or nearly undecomposed plant litter, including fallen leaves, twigs, limbs and roots, may be a surface layer or many meters deep. Peat is highly acidic (pH 3.5-4.5), which inhibits its decomposition by microorganisms and inhibits essential mineral nutrient availability for plants. Peat swamp plant species are mostly endemic to this nutrient-poor, drought-prone habitat. Three major types of PSF occur in the Pulau Muda FMU, namely, Short PSF, Tall PSF and Mixed PSF.

Precautionary Principle
Ethical principle that if the consequences of an action, especially the use of technology, are unknown but are judged by some scientists to have a high risk of being negative from an ethical point of view, then it is better *not to carry out the action* rather than risk the uncertain, but possibly very negative, consequences (Wikipedia 2004, *http://en.wikipedia.org/wiki/Precautionary_principle,* 18 July 2004).

Primary forest
Forest in its natural state, unmodified by human activity (i.e., with negligible impact from human gathering activities, including the rare cutting of isolated timber trees). This refers to forest structure, and not to its fauna, or its size. Hunting may have removed certain species (e.g. large mammals), but the forest stand remain undisturbed.

> Also considered is the AMEC definition derived from World Bank, "This forest is relatively intact 'natural forest' and essentially unmodified by human activity. The forest shows no signs of fire, logging in the form of infrastructure such as railways or canals. Local people may be present in sufficient low numbers or under take activities that leave the forest in near-natural condition. The forest does not have adjacent activities that in the near future might essentially modify the natural forest cover, or leave the forest in other than near-natural condition. Some of these primary forest areas are critical habitats if they occur in existing 'protected areas' and or in areas that are being proposed for Protection Forest status under provincial land use planning legislation."

Severely degraded forest
Forest drastically altered in composition and structure, as a result of human activity or natural events, e.g. fire. The forest no longer retains natural structure and most of its fauna has been reduced to pioneer and secondary forest species. In the Pulau Muda FMU this is heavily logged forest that often has also burned, or forest that has established after agricultural clearing. It has negligible conservation of biodiversity value, but if protected from further disturbance, could help serve as a forested corridor lending continuity between forested block, or serve as a buffer zone forest helping to protect HCVF.

> Also considered is the AMEC definition derived from World Bank, "This is a forest that has been irreversibly modified by human activity and has reduced the habitat's ability to maintain viable populations of native species. These forests are also under current and increased threat from local people and their associated illegal activities that will continue to degrade the forest structure to a point where it loses habitat values for the conservation of fauna and flora and sustainable livelihood of local people. Severely degraded forests have been impacted by previous repeated logging activities which are indicated by the presence of railway lines or canals, repeated fires as evidenced by fire scars, vines, shrubs and grasslands."

Traditional
Of long-established social or economic practices reflected in social norms and institutions. In the context of HCV, taken to apply to practices that have been established for at least one generation or approximately 25 years.

Umbrella Species
Species occurring at low density whose habitat needs in terms of area and diversity encompass areas sufficient to maintain viable populations of other species.

Vulnerable Species

According to the IUCN, a taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥30% over the last 10 years or three generations, whichever is the longer**,** where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible**,** based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than 10 locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2000 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than 10 locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
   a. Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 1000 mature individuals, OR
      (ii) all mature individuals are in one subpopulation.
   b. Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:
1. Population size estimated to number fewer than 1000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.