Government of Central Kalimantan

Government of Indonesia

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# Master Plan for the Rehabilitation and Revitalisation of the Ex-Mega Rice Project Area in Central Kalimantan






## BIODIVERSITY AND THE EX-MEGA RICE PROJECT AREA IN CENTRAL KALIMANTAN

**Technical Report No. 8**

**OCTOBER 2008**

Euroconsult Mott MacDonald and Deltares | Delft Hydraulics
in association with
DHV, Wageningen UR, Witteveen+Bos, PT MLD and PT INDEC

**Master Plan for the Rehabilitation and Rehabilitation of the Ex-Mega Rice Project Area in Central Kalimantan**

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# Biodiversity and the Ex-Mega Rice Project Area in Central Kalimantan

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| | |
|---|---|
| BKSDA | Balai Konservasi Sumber Daya Alam |
| BPDAS | Balai Pengelolaan Daerah Aliran Sungai |
| BPP | Balai Penyuluhan Pertanian |
| CA | Cagar Alam (Strict Nature Reserve) |
| CDM | Clean Development Mechanism |
| CIMTROP | Centre for International Co-operation in Management of Tropical Peatland; associated with the University of Palangka Raya |
| dbh | diameter at breast height |
| EMRP | Ex Mega Rice Project |
| FMU | Forest Management Unit |
| HL | Hutan Lindung (Protection Forest) |
| KPH | Kesatuan Pengelolaan Hutan (Indonsian for FMU) |
| LULC | Land Use Land Cover |
| MRP | Mega Rice Project |
| NLPSF | Natural Laboratory of Peat Swamp Forest |
| NP | National Park |
| PA | Protected Area |
| PLG | Proyek Lahan Gambut (Indonesian acronym for MRP) |
| SM | Suaka Margasatwa (Wildlife Reserve) |
| TN | Taman Nasional (National Park) |
| REDD | Reduced Emissions from Deforestation and Degradation |
| RESTORPEAT | Restoration of tropical peatland to promote sustainable use of renewable natural resources |
| STRAPEAT | Strategies for implementing sustainable management of peatlands in Borneo |
| UNPAR | University of Palangka Raya |

# Summary


**Key areas for biodiversity**

Much of the biodiversity value of the EMRP area has been lost due to conversion activities. Limited areas that have retained most of their biodiversity values, however, require targeted conservation activities to prevent further loss. These areas are:

- Mangroves: The southern tip of Block D near Desa Pantai Kiapak (aka Kapuk or Kapak), an with mixed, diverse mangroves abundant in wildlife (e.g. proboscis monkey, silvered langur) and mangroves south of the mouth of the Sebangau River, which are disturbed but rapidly regenerating and important for migratory wader and other birdlife.
- Peat swamp forest: Selectively logged areas have retained much if not most of their biodiversity value, and apart from sensitive or selectively removed species, appear to be well on the way to recovery. This is particularly the case in the eastern part of Block E (Mawas) and in the northern (CIMTROP-managed) part of Block C, and to a lesser extent in the northern part of Block A and the western half of Block E. The latter two areas are currently most threatened, mainly by illegal logging.

Biodiversity value of remaining swamp forests is low, as only secondary fire sere vegetation remains, dominated by gelam *Melaleuca cajuputi* or belangiran *Shorea balangeran*, which has lost most species associated with mixed freshwater swamps. Riparian habitats along some rivers are of limited value to biodiversity; they still harbour most plant species and many wildlife species, but those requiring a larger range (e.g. into adjacent freshwater swamp forest and PSF) have disappeared. Populations of primates and typical forest birds have significantly declined, and are very low compared to pre-EMRP conditions. Small to medium-sized streams located in degraded freshwater swamp and PSF areas are impoverished in terms of biodiversity due to declined water quality and quantity.

**Proposed approach to biodiversity management**

The six key biodiversity areas should receive an official protection status that builds upon existing management. Proposed are:

- The Kiapuk (7,500 ha) and Sebangau South (15,500 ha) mangrove areas; this should be managed as a Cagar Alam or Suaka Alam by BKSDA, perhaps in partnership with Wetlands International as the latter have significant mangrove management experience and have a presence in Central Kalimantan. Both will function as conservation areas embedded in a larger Protection function Forest Management Unit (FMU/KPH).
- Sebangau-Kahayan peat swamp forest (57,000 ha) at the northern end of Block C and currently actively managed by CIMTROP. Should be granted a *Kwasan Lindung* protection status that allows continuation of CIMTROP management, and does not prevent low-impact utilisation of resources by local communities.
- Mawas peat swamp forest (288,000 ha), which comprises the eastern half of Block E and the northern tip of Block A. It is currently actively managed by the BOS Foundation, together with BKSDA. It should be given special conservation status that allows low-

level utilisation (e.g. fishing, rattan & jelutung exploitation), but protects key biodiversity elements and prevents (small- and large-scale) commercial logging.

- Kapuas-Kahayan peat swamp forest (250,000 ha), which comprises the western half of Block E and the northern tip of Block B. It is currently not actively managed for conservation and is being subjected to widespread illegal logging (Block E) and conversion to plantations (Block B). Proposed is special conservation status, and management by BKSDA.
- Sebangau NP Bufferzone (East) (42,000 ha), which runs along the eastern banks of the Sebangau River and still has a sizeable population of key wildlife such as sun bear and orang-utan. This area still largely consists of (semi-)natural habitats and can serve as a natural bufferzone for the Sebangau NP located to the west.

**Main challenges to biodiversity**

The main challenges to biodiversity are challenges that target the six key areas. These challenges are: illegal logging and fires (threaten PSF in Block E and northern Blocks A & C), plantation development (threaten PSF in Blocks A & B), and tambak development (threat to remaining mangroves).

- Illegal logging occurs on a wide scale, but especially in the western half of Block E and northern Block A, but also in the Mawas (eastern Block E). Log rafts are common on the main canals, as are small sawmills and camps. All logs taken are small (diameter maximum 30-35 cm), and most is transported via the Kapuas River and Kuala Kapuas (half), Barito River (1/3), and Kahayan (the balance). Illegal logging is rarely challenged by enforcement agencies, who generally do not respond to reports.
- Fires are linked to conversion activities and illegal logging. Logging activity generates fuel, and canals excavated to extract logs add to forest desiccation and further increases the fire hazard. The use of fire for clearing land is prohibited, and many now use herbicides instead. However, fires occurrence is still widespread and are often associated with agricultural development in peat land.
- Plantation development is proposed for almost 400,000 ha, of which approximately 1/3 on deep peat (>3m), 1/3 on moderately deep peat (0.5-3 m) and 1/3 on shallow peat and mineral soil (<0.5 m). Those planned for deep peat and on moderately deep peat on the edges of domes will affect the peat domes and remaining PSF biodiversity.
- Tambak (brackish-water fishponds) have been developed in mangrove areas between the Sebangau and Kahayan rivers and are expected to expand further. Most development occurs without prior plans or studies, and is carried out on the basis of trial and error. Tambak development forms the key threat to remaining mangrove biodiversity.

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# 1 Former (pre-MRP) biodiversity values in the area

## 1.1 Key habitats

### 1.1.1 Introduction

The main natural habitats of the EMRP area are mangrove, beach swales and (low) dunes, freshwater swamps, riparian vegetation, peat swamps, lakes, rivers and streams. Originally, all these habitats – except the aquatic ones – were largely forested, and most of the freshwater swamps and riparian habitats, for example, were freshwater swamp forests or riparian forests. Human influence has been present for a long time, and accessible and easily converted habitats such as riparian habitats and (shallowly flooded) freshwater swamps were probably put to agricultural use centuries ago.

By the onset of the MRP six main habitats could be identified (Table 1), of which the main one was peat swamp, originally extending over two-thirds of the area, and in 1994 still covering more than 50 % of Ex-PLG area (see Table 3 and Figure 1). Each of these types is described briefly in 1.1.2, along with the sub-types.

**Table 1 Main habitats Pre-MRP**

| No | Main habitat type | Sub-types | Note |
|---|---|---|---|
| 1 | Mangrove | • *Nypa* dominated<br>• Mixed mangroves<br>• *Sonneratia-Avicennia* dominated | Few studies available from EMRP area. |
| 2 | Beach & low dune | • *Casuarina* zone<br>• *Barringtonia asiatica – Terminalia catappa* formation<br>• *Ipomoea pes-capre* formation | Very limited in area, and scarcely mappable. |
| 3 | Freshwater swamps | • Herbaceous freshwater swamps<br>• Shrub-dominated freshwater swamps<br>• Freshwater swamp forest | Large areas converted; merges into riparian habitats. |
| 4 | Riparian habitat | • Riparian forest | Non-forest is agricultural or used for habitation |
| 5 | Peat swamps | • Herbaceous peat swamps<br>• Shrub-dominated peat swamps<br>• Peat swamp forest<br>• Pole-dominated peat swamp forest | Pole forests are located in central parts of peat domes, where nutrient availability is extremely limited. |
| 6 | Aquatic habitats | • Lakes & ponds<br>• Rivers<br>• Streams | Mainly 'black water' habitats associated with peat. |

### 1.1.2 Main habitat types

**Mangrove**

Exposed mangroves such as directly along the coast south of the mouth of the Sebangau River, and along the coast east of the mouth of the Kahayan River, would originally have been much like those present there today – i.e. dominated by *Avicennia alba,* together with *Sonneratia caseolaris* near the mouths of streams and inlets. The areas behind this exposed zone would appear much like the mixed mangroves directly behind Pantai Kiapak, east of the mouth of the Kahayan – i.e. central mangroves, with *Rhizophora mucronata, Avicennia marina, Avicennia alba, Bruguiera parviflora, Sonneratia ovata* and *Xylocarpus granatum* trees, along with mangrove fern *Acrostichum* and *Acanthus ilicifolius.* Behind these central mangroves there would originally have been a zone of rear mangrove, and *species commonly found in this zone include Excoecaria agallocha, Ficus microcarpa, Intsia bijuga, Nypa fruticans, Lumnitzera racemosa, Pandanus tectorius* and *Xylocarpus moluccensis.* Along the brackish water streams and rivers there would have been a dense vegetation of *Nypa fruticans, Cerbera odollam, C. manghas* and *Sonneratia caseolaris,* backed in places further upstream by nibung *Oncosperma tigillaria* (Giesen *et al.,* 2007). Proboscis monkey would be common along the rivers, while long-tailed macaque and silvered leaf monkey would be common in mixed mangroves, along with a host of waders and mangrove forest associated birds.

**Beach & dune**

Beach and dune vegetation consists of a number of main types: i) the pes-capre formation, dominated by the straggling vine *Ipomoea pes-capre*, along with other vine species such as *Canavalia maritima, Ipomoea gracilis* and *Vigna marina,* and various sedges such as *Cyperus stoloniferus, Fimbristylis cymosa* and *F. sericea;* ii) stands of coastal she-oak (cemara laut) *Casuarina equisetifolia,* which form almost pure stands on sandy coastal ridges; and iii) the *Barringtonia* formation, with *Barringtonia asiatica, Calophyllum inophyllum, Erythrina orientalis, Guettarda speciosa, Hibiscus tiliaceus, Pongamia pinnata, Terminalia catappa, Thespesia populnea* and *Ximenia americana* (MacKinnon *et al.,* 1996). Originally, these types would have dominated beaches and along beach swales, such as the area west of the mouth of the Kahayan River, and near the mouth of the Kahayan.

**Riparian habitats**

Riparian habitats vary, depending on factors such as water types and quality, stream size and flow. Typical riparian tree and shrub species along main rivers in Central Kalimantan are rengas *Gluta renghas, Dillenia excelsa, Ficus microcarpa, Kleinhovia hospita, Hibiscus tiliaceus, Mallotus borneensis, Barringtonia acutangula, Lagerstroemia speciosa, Flacourtia rukam* and *Pandanus helicopus.* In open sections, rattans are common (mainly *Calamus* and *Korthalsia* species), along with climbers such as *Ipomoea* species and *Cayratia trifolia.* Along nutrient poor blackwater streams species such as *Pandanus helicopus* (rasau) may be locally dominant, while species such as *Gluta renghas* and *Barringtonia acutangula* may dominate along more nutrient-rich streams. Closer to the coast, species such as *Cerbera odollam, Fagraea crenulata* and *Barringtonia conoidea* are common, with patches of the robust floating herb *Hanguana malayana* lining the river banks in places.

**Freshwater swamps**

True freshwater swamps are not very widespread in the ex-PLG area, as riparian habitats merge into peat swamps over relatively short distances. Nevertheless, typical freshwater swamp types did (and do) occur, the main ones being: i) gelam *Melaleuca cajuputi* forest; and ii) kahui *Shorea balangeran* forest. *Melaleuca* forests naturally occur in the freshwater habitat directly inland of mangrove habitats – this may of occasion be affected by brackish-water, but on the whole it occurs in freshwater habitats. *Melaleuca* typically forms dense, almost pure stands, but may also include species such as *Glochidion littorale, Cayratia trifolia* and *Dendrophthoe pentandra. Shorea balangeran* can occur in low densities in mixed forests, including peat swamp forests, but in freshwater swamps where occasional fires occur it may form dense stands that do not include many additional species, although *Mallotus borneenis* and *Timonius salicifolius* may locally accompany kahui. Both gelam and kahui forests increase under disturbed conditions, such as clearing, fires, and in the case of gelam, increased acidity.

**Peat swamps**

Peat swamps of Southeast Asia, and particularly in Central Kalimantan, were originally all forested. Most peat swamp forests of the EMRP area were therefore also covered with tall, mixed forests, with trees often attaining a height of more than 30 metres. As most of these habitats in Kalimantan are only 5000-12000 years old, there are not many endemics, and many of the species are shared with swamp forest, riparian, kerangas (heath forest) and even lowland forest. Endemics recorded for Kalimantan PSF include *Archidendron clypearia, Dactylocladus stenostachys, Gonystylus bancanus, Horsfieldia crassifolia,* and *Shorea teysmanniana* (Page, 2006). 130 tree species have been recorded in a variety of peat swamp forest habitats in the Sungai Sebangau region of Central Kalimantan (Shepherd *et al*., 1997), while a recent inventory by Bogor Herbarium (LIPI; Widjaya *et al.,* 2007) in the Sebangau NP found a total of 816 species. However, the latter list includes a lot of introduced and weed species. Page (2006) reports more than 380 tree species for Borneo, with 75-120 tree species per hectare on average. Table 2 summarises plant diversity in peat swamps.

**Aquatic habitats**

True aquatic habitats are relatively uncommon under pristine conditions, being limited to oxbow lakes, backwaters and occasional pools and ponds that may line rivers and streams. In blackwaters, typical free-floating species are bladderworts *Utricularia* species and the robust *Hanguana malayana,* the latter at times forming dense, impenetrable mats. Emergent species in blackwater streams include various sedges such as *Lepironia articulata* and *Eleocharis dulcis* (both locally known as purun). In more nutrient-rich waters, free-floating species such as kangkung *Ipomoea aquatica* and floating attached species such as water lilies *Nymphaea nouchali* and *Nymphoides indica* are locally common.

**Table 2 Plant diversity in peat swamp forests**

| # | Location | Type of PSF | Method | Number of species | Author |
|---|---|---|---|---|---|
| **Tree species only** | | | | | |
| | P. Malaysia: Kuala Langat | Mixed primary | 3.6 ha plot | 54 | Shamsudin & Chong, 1992 |
| | P. Malaysia: Sungai Karang | Mixed primary | 4.5 ha plot | 95 | Ibrahim, 1997 |
| | P. Malaysia: Pahang | Mixed primary | 5 ha plot | 132 | Ibrahim, 1997 |
| | Sumatra: Kluet, Aceh | Mixed, logged over forest | 1.6 ha plot | 44 | Purwaningsih & Yusuf, 2000 |
| | Brunei | Mixed | 3.33 ha plot | 80 | Stoneman, 1997 |
| | South Kalimantan | *Shorea balangeran* dominated degraded PSF | Total species from several transects | 10 | Giesen, 1990 |
| | South Kalimantan | *Combretocarpus rotundatus* dominated degraded PSF | Total species from several transects | 7 | Giesen, 1990 |
| | Central Kalimantan: Sebangau | Mixed primary | total for variety of PSF habitats | 130 | Shepherd *et al.*, 1997 |
| **All higher plant species** | | | | | |
| | Sumatra: Riau | Mixed PSF | total of 3 sites, each 2-8 ha | 130 | Mogea & Mansur, 2000 |
| | Sumatra: P. Padang, Riau | Pole forest | Total of a dozen 100m transects | 37 | Giesen and van Balen, 1991 |
| | Sumatra: P. Padang, Riau | Mixed PSF | Total of a dozen 100m transects | 94 | Giesen and van Balen, 1991 |
| | Sumatra: Berbak NP, Jambi | Mixed PSF & swamp forest | total count | 261 | Giesen, 2004 |
| | Central Kalimantan: Sebangau | Mixed primary | total for variety of PSF habitats | 130 | Shepherd *et al.*, 1997 |
| | Central Kalimantan: Sebangau | Mixed primary | total for variety of PSF habitats (including weeds) | 813 | Widjaja *et al.*, 2007 |

## 1.2 Key species

Key wildlife species in the EMRP area are mainly linked with mangroves/riparian habitats, and peat swamp habitats. Mangroves and riparian forests provide a habitat for the Borneo endemic proboscis monkey *Nasalis larvatus,* which is listed as Endangered (IUCN 2007 Red List) and has been declining throughout its range over the past two decades. They are also important for silvered langur *Trachypithecus (Presbytis) cristata,* listed as Vulnerable, while coastal mudflats are important for migratory waders. Peat swamp forests streams abound in freshwater fish species, and this is thought to be mainly due to the occurrence of various microhabitats (Ahmad *et al*., 2002). Some fish species are unique to this habitat and can be regarded as threatened due to habitat loss. Although much peat swamp forest has been lost to logging and fire, it remains the dominant habitat in most of the current range of the false gavial *Tomistoma schlegelii*, which is found only in Sumatra, Kalimantan and Peninsular Malaysia and is listed as Vulnerable on the IUCN Red Data List (Bezuijen *et al*., 2001). It is also the preferred habitat of the hairy nosed otter *Lutra sumatrana*, Storm's stork *Ciconia stormi*, grey-headed fish-eagle *Ichthyophaga ichthyaetus*, and the largest remaining habitat for Kalimantan populations of orangutan *Pongo pygmaeus* (Meijaard, 1997).

The Sebangau NP area adjacent to (and west of) the EMRP has been well-studied in terms of biodiversity, and records kept at the park's Natural Laboratory of Peat Swamp Forest (NLPSF). Birds recorded at Sebangau include 154 confirmed and 44 unconfirmed species (Dragiewicz *et al.,* 2007), including endangered species such as Storm's stork, and vulnerable species such as lesser adjutant stork, Wallace's hawk-eagle, crestless fireback and hook-billed bulbul. The list of fish species is not that extensive, totalling 46 species to date (Dragiewicz, 2005), but the list of reptiles is more impressive, including 23 snakes, 2 crocodilians, 3 turtles and 11 lizards (Dragiewicz & Husson, 2007). Only three amphibians have been recorded at Sebangau (Dragiewicz & Husson, 2007), suggesting that this group has been under-recorded to date. As many as 65 mammal species have been recorded to date (Husson *et al.,* 2007a; includes 10 unfonfirmed speces), including the endangered proboscis monkey and orangutan, and vulnerable species such as pig-tailed macaque, clouded leopard and marbled cat. The plant species list maintained at the NLPSF includes more than 300 species, nay of which still need to be determined to species level.

Threatened plant species recorded from Kalimantan peat swamp forests include *Dyera polyphylla* (listed as Vulnerbable on the IUCN Red List)*, Gonystylus bancanus* (Vulnerable)*, Horsfieldia crassifolia* (Lower Risk/Near Threatened) and *Shorea balangeran* (Critically Endangered[1]). These species are also recorded in PSF in the EMRP, while *S. balangeran* is also common in freshwater swamps, for example, along the banks of the Sebangau River.

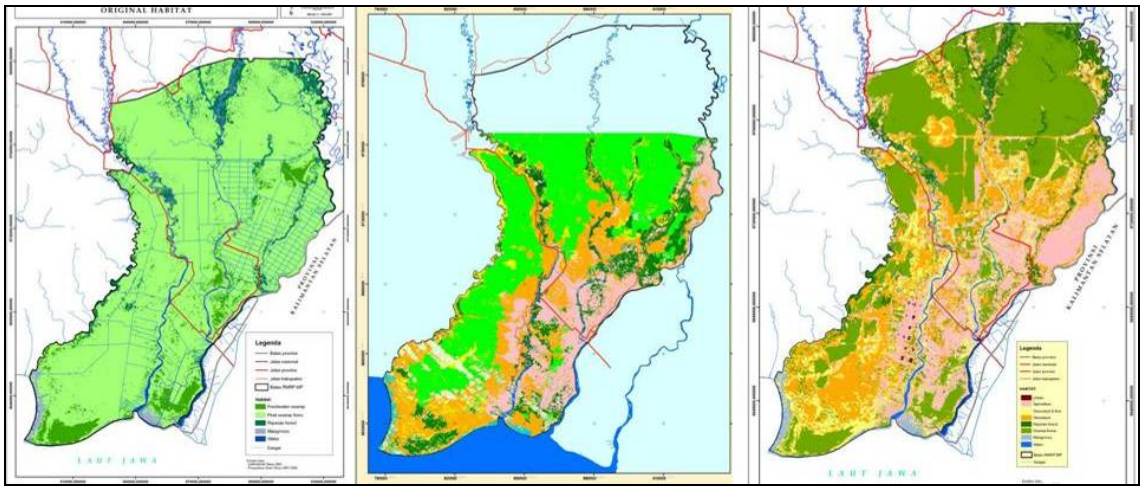
[1] This listing as Critically Endangered seems inappropriate for *Shorea balangeran*, as the species is common in many parts of Central and West Kalimantan, and is commonly used for replanting exercises in Central Kalimantan, including the EMRP area.

# 2 Current biodiversity values in EMRP area

## 2.1 Introduction

Changes in the main habitats are depicted in Figure 1, below (with data summarised in Table 3), which shows that large areas of (peat) swamp forest (light green in 1a) had given way to agriculture and secondary vegetation types by 1994, prior to the PLG (pink and orange in 1b). Apart from Block E to the north of the main SS-I canal, the vast majority of (peat) swamp forest that remained in 1994 had disappeared by 2007, leaving only a fraction (dark green in 1c). Total areas of PSF had declined from more than 1,000,000 ha, to almost 800,000 ha in 1994 and just over 400,000 by 2007. Note that not all of this is primary PSF, as by 1994 most had been selectively logged by commercial companies.

**Figure 1 Changes in main habitats**



a. Original habitats b. Pre-PLG (1994) c. Current (2007)

**Table 3 Changes in area of main forested habitats**

| No. | Habitat | Original area approx. (ha) | Area just prior to PLG (1994) | Current area (ha) | current % of original habitat | current % of total EMRP area |
|---|---|---|---|---|---|---|
| 1. | Mangrove | 25,000 | 5770* | 14,000 | 56 | 1% |
| 2. | Peat swamp forest | ?1,000,000 | 780,000 | 430,000 | 43 | 30% |
| 3. | Freshwater swamp forest | 300,000 | 112,440 | 100,000 | 33 | 7% |
| 4. | Riparian forest | 120,000 | 10,575* | 93,000 | 78 | 6.5% |

* These small, linear habitats are probably not accurately mapped on the 1994 pre-MRP map.

## 2.2 Mangroves & other coastal habitats

Recent assessments of mangroves in the EMRP area are not available, and the consultant has had to rely on remote sensing imagery and brief field surveys to the mangrove area at the mouth of the Kahayan River (Annex 1), and south of the mouth of the Sebangau River (Annex 5). The best remaining mangrove areas in the EMRP area are the southwestern part of Block C (Sebangau mouth), and the area east of the mouth of the Kahayan, between the Kahayan and Kapuas rivers (southern tip of Block D). The latter area has a largely intact and healthy coastal fringe (200-300 m wide) dominated by *Sonneratia caseolaris,* backed by a much wider belt of mixed mangrove dominated by *Rhizophora mucronata*, with *Bruguiera, Excoecaria agallocha, Acrostichum aureum* and *Xylocarpus granatum.* Closer to the Kahayan River this merges into a broad zone dominated by *Avicennia marina.* Desa Pantai Kiapak is the main fishing village located in this mangrove belt, and tellingly, they have not disturbed the mangroves in any noticeable way. The broad *Sonneratia* belt in front of the village is still intact, sheltering the village, while the back of the village gives way to healthy, mixed mangrove forest. The area is still important for wildlife, and during the survey groups of proboscis monkey *Nasalis larvatus* (bekantan) and silvered leaf-monkey *Trachypithecus cristatus* (lutung) were observed, along with a host of bird species including the uncommon changeable hawk-eagle *Spizaetus cirrhatus*.

The mangrove belt to the south of the mouth of the Sebangau River is in a poorer condition than that at Kiapak. A 100-300 metres wide belt of mangroves dominated by *Avicennia alba,* with some *Sonneratia caseolaris*, occurs along the entire coast south of the Sebangau mouth right up to the cape. It was probably formerly backed by tall, mixed mangroves with many Rhizophoraceae, but this is heavily degraded, possibly by past felling, and now consists of low, mixed species (e.g. *Rhizophora parviflora*), but also with some open patches with a ground cover of *Acanthus iliifolius* and *Derris trifoliata.* It is likely to regenerate rapidly is not subject to more tree felling, although there will be a lower abundance of desirable timber species. The area is important for birds, including migratory waders such as redshank *Tringa totanus* and whimbrel *Numenius phaeopus*, but also for resident egret (great & little), kingfisher (mangrove & stork-billed) and birds of prey (white-bellied sea-eagle, Brahminy kite).

The area between the two aforementioned healthy mangrove stands has a history of disturbance that dates back at least 10 years, when the first extensive brackish water fishponds (*tambak*) were constructed by Banjarese settlers. Development has continued since then, and the remaining mangroves consist of a coastal fringe of *Nypa fruticans,* along with *Avicennia alba.* On the landward side this merges into *Melaleuca cajuputi* stands and tambak areas. No mangrove stands remain in the semi-intensive tambak area. The bird population is still good, indicating that poisoning[2], trapping and shooting are not widespread. Healthy numbers of lesser whistling duck, egret, pondherons and kingfisher were observed, but waders were uncommon or absent.

[2] Ponds are often poisoned (commonly with Thiodan/Undosulfan) before restocking, to remove trash fish and carnivorous fish.

Overall assessment:

- Biodiversity value of the EMRP mangroves has largely been retained, especially in the southern tip of Block D near Desa Pantai Kiapak (alternatively written as Kapuk or Kapak). Mangroves south of the mouth of the Sebangau are botanically less interesting due to recent tree felling of mixed mangroves (associated with failed tambak developed), but are important for birds, including resident and migratory wader species. Natural regeneration of the latter mangroves will occur rapidly if tree felling is curbed.
- Extensive tambak such as occur west of the Kahayan mouth still have reasonable bird biodiversity, including waders. This is likely to change under the current Fisheries Service intensification programme, or when tambak owners have more access to firearms and/or fish poisons.

## 2.3 Freshwater swamp & riparian habitats

Freshwater swamp forest (i.e. swamp forest on mineral soil) is often one of the first habitats to disappear, as these areas are usually suited for conversion to agriculture, while at the same time they are very susceptible to fires (van Steenis, 1957). Primary freshwater swamp forest no longer occurs in the EMRP area, but secondary habitats can be found. The main area of secondary swamp forest habitat are the extensive gelam *Melaleuca cajuputi* forests that occur in the southern and southeastern parts of the EMRP area, and the extensive areas of belangiran/kahui *Shorea balangeran* that occurs along the middle and northern reaches of the Sebangau River (Annex 5).

Gelam occurs naturally in the transition area between mangroves and freshwater swamps, but rapidly colonises disturbed swamp forest areas, especially following fires (it is fire tolerant) and in areas with high acidity (e.g. due to oxidation of acid sulphate soils). Unlike in Vietnam, where it also occurs on deep peat (e.g. U Minh forest; Maltby *et al.*, 1996), gelam generally does not occur on peat soils in southern Kalimantan, although it has been recorded on shallow peat (1-1.5m) in South Kalimantan (Giesen, 1990). These gelam forests merge into similar habitats found in adjacent parts of South Kalimantan. Apart from the dominant *Melaleuca cajuputi,* few other tree species are found, although close to the coast cabbage tree kayu bulan (*Fagraea crenulata*) occurs. The edible climbing fern kelakai *Stenochlaena palustris* is commonly associated with gelam forest, along with purun sedges *Lepironia articulata,* although *Eleocharis* can also dominate locally, especially where the pH is particularly low.

The belangiran forests found along the northern and middle reaches of the Sebangau River are typical for areas of swamp forest (and former shallow peat) in Kalimantan that have been subjected to degradation by logging and burning. Similar fire sere forests occur in South Kalimantan (Giesen, 1990) on areas of shallow peat, and on mineral soils in Danau Sentarum NP in West Kalimantan (Giesen, 2000). These are accompanied by shrubs such as *Timonius salicifolius* and *Pternandra teysmanniana,* and closer to the river by occasional perupuk trees *Mallotus borneensis.* Belangiran trees are fire resistant due to the thick bark and can stand fires as long as the trees are large enough, and as long as the fires are not too hot (i.e. there should not too much fuel build up on the ground).

Wildlife is impoverished both in the gelam and belangiran forests, although nectivorous birds (e.g. sunbirds) may be common when gelam trees flower, and ubiquitous species such as spotted dove, bulbuls and Pacific swallow are generally found.

Riparian habitats have generally fared better than freshwater swamp forest, and relatively diverse riparian habitat may be seen along parts of the Kahayan, Sebangau and Kapuas rivers. Dominant tree species are rengas (*Gluta renghas*), belantik (*Mallotus sumatranus*), beringin (*Ficus microcarpa*), bunggur (*Lagerstroemia speciosa*), ringin (*Dillenia excelsa*), putat (*Barringtonia acutangula*), *Neesia* sp., *Pometia pinnata* and *Artocarpus teysmanni,* while closer to the coast *Cerbera odollam* also occurs. *Sonneratia caseolaris* – a mangrove species – can be found far upstream from the mouth of the major rivers in the zone that can be slightly saline during extended dry seasons[3]. Shrubs also abound in the riparian habitat, and include *Croton, Timonius* and *Dodonaea* species. Lianas are also common, and include a numbers of rattans (*Calamus, Korthalsia*), and *Connarus* and *Uncaria* species. Along more deeply flooded fringes (e.g. along the Sebangau River), rasau (pandan, *Pandanus helicopus*) may be locally very common to dominant, often along with shrubs such as *Timonius* and *Croton* species.

The riparian habitat is important for fish species (spawning, feeding, shelter), and fish populations are probably quite reasonable, in spite of the presence of many fine-meshed (mosquito) nets[4]. Bird life along the Kahayan River was found to be relatively poor, with very few typical riparian species such as kingfisher, and very few birds of prey. As there are few settlements along the river, this relative poverty is not directly because of human disturbance. Primate species such as kera (long-tailed macaque *Macaca fascicularis*), bekantan (proboscis monkey *Nasalis larvatus*) and lutung (silvered leaf monkey *Trachypithecus cristatus*) reportedly also still occur in the riparian fringe.

The riparian habitat along the Sebangau River (Annex 5) appears to have been much more impoverished than the Kahayan over the past decade. Species rich, mixed riparian forests seen in 1996 (Giesen, 1996) have been replaced by more monotonous vegetation, and tellingly, large numbers of primates seen in 1996 are now largely absent. In 1996, Giesen (1996) observed 12 groups (120+ individuals) of long-tailed macaque and 11 groups (80+ individuals) of proboscis monkey during a 1-day survey along the lower Sebangau, while during a similar survey in April 2008 only two silvered leaf monkey and one long-tailed macaque were seen (Annex 5). A similar lack of primates was also observed along the Kapuas River, between Tuanan and Mandomai, on 4-5 April 2008. It is likely that a combination of hunting and loss of habitat in the hinterland (i.e. lack of intact swamp forest adjacent) has led to their demise.

Overall assessment:

- Biodiversity value of remaining swamp forests is low, as only secondary fire sere vegetation remains, dominated by gelam *Melaleuca cajuputi* or belangiran *Shorea balangeran,* which has lost most species associated with mixed freshwater swamps.
- Riparian habitats along some rivers are still of value to biodiversity as they still harbour most plant species and many wildlife species, although those requiring a larger range (e.g. into adjacent freshwater swamp forest and PSF) have probably disappeared. Populations of primates and typical forest birds have significantly declined.

[3] Along the Kahayan River, for instance, *Sonneratia caseolaris* is found as far upstream as Buntoi, which is located about 55 km from the mouth.

[4] These are common along the riparian fringe, but altogether do not extend along more than several percent of the river length.

## 2.4 Peat swamp forest

Peat swamp forests (PSFs) in the EMRP are largely degraded to heavily degraded, or have disappeared altogether and given rise to shrubland, sedge and fern scrub and in some cases even open water. The total area still mapped as PSF is 430,000 ha, which is just over half of what was still present in 1994, before the onset of the MRP. Within Blocks A-D, this varies from very open stands with a low tree cover (some of it recovering), to areas of secondary, logged-over PSF with a canopy cover that is close to 100%. The best stands are in the northern parts of A & C, close to Block E.

Block E still harbours the best forest, as this area was originally selectively logged using a tramline (kuda-kuda) system that did not destroy the hydrology as is often the case in areas where logs are extracted using canals. In the eastern part of Block E (Mawas; see Annex 6) forests are vigorously regenerating, and although large trees are generally absent, it is still highly biodiverse, with healthy populations of orangutan and forest birds. Species requiring large and old trees (e.g. hornbills), though, are absent or uncommon. Illegal logging is rampant, however, and 15 recently excavated small canals (1-2 m wide, 2-10 km long) now provide access for illegal loggers in the eastern Mawas Block. Timber being taken out (mainly terentang *Campnosperma coriacea* and jelutung *Dyera polyphylla*) is small, with diameters no larger than 20-25 cm. Illegal logging is even more rampant in the western half of Block E, and forests in this area are rapidly degrading instead of regenerating such as in much of the Mawas Block.

In heavily degraded areas, the main tree and shrub species that appear to be regenerating naturally are tumih (*Combretocarpus rotundatus*), geronggang (*Cratoxylon glaucum*), asam-asam (*Ploiarium alternifolium*), ubah (*Eugenia* spp.), terentang (*Campnosperma coriacea*) and sesendok (*Ficus deltoidea*). These have to compete with a very dense herbaceous layer consisting mainly of a variety of ferns (mainly *Stenochlaena palustris* and *Blechnum indicum*, along with *Pteridium aquilinum, Lygodium* spp., *Gleichena linearis* and *Nephrolepis biserrata*) and sedges (mainly *Scleria* spp., *Lepironia articulata* and *Fimbristylis* sp.). Other species also found on occasion include *Nepenthes rafflesiana* and *Willughbeia grandiflora.* The latter is an Apocynaceous climber, and an uncommon species, found on Borneo, and in Peninsular Malaysia and southern Thailand (Middleton, 2007). Bird life is poor, and only ubiquitous species such as spotted dove *Streptopelia chinensis,* Pacific swallow *Hirundo tahitica* (along canals) and Brahminy kite *Haliastur indus* (passing overhead) are common. Near secondary forest such as in the CIMTROP study area in the northern part of Block C, many more plant and wildlife species occur, and even orangutan and sun bear venture from secondary PSF into heavily degraded PSF in order to access drinking water in canals, or fruit trees (e.g. *Ficus deltoidea*).

Selectively logged PSF that has been logged but has not been burnt also occurs in the northern parts of Block C (CIMTROP study area) and Block A. This secondary forest is dominated by large emergent tumih *Combretocarpus rotundatus,* punak *Tetramerista glabra,* pantung (*Dyera polyphylla*), nyatoh (*Palaquium* spp.), and ubah (*Eugenia* spp.), with a host of smaller tree species in the substorey, including manggis hutan (*Garcinia* spp.), cikang (*Teysmanniodendron* sp.), tutup kebali (*Diospyros pseudomalabarica*) and hangkang (*Diospyros siamang*). Noticeably absent are the meranti species (dipterocarps) and ramin (*Gonystylus bancanus;* listed as Vulnerable by IUCN, and CITES listed App. 2), which have all been selectively removed during logging operations, although seedlings and saplings occur. On the whole, these forests seem well on the way to recovery, although skewed in composition to species that are less desirable

for forestry purposes. Wildlife is abundant, and includes most species associated with primary PSF such as sun bear, orangutan and clouded leopard. Birdlife is likewise abundant and diverse, although certain sensitive forest floor species such as pittas are likely to be absent.

Overall assessment:

- (Heavily) degraded PSF habitat as occurs in much of the EMRP area has lost most of its biodiversity value, and what remain is a scarcely a fraction of the original flora and fauna. Areas adjacent secondary PSF may recover over time, as additional species colonise recovered areas.
- Selectively logged PSF has retained much if not most of its biodiversity value, and apart from sensitive or selectively removed species, appears to be well on the way to recovery. This is particularly the case in the eastern part of Block E (Mawas) and in the northern (CIMTROP-managed) part of Block C, and to a lesser extent in the northern part of Block A and the western half of Block E.

## 2.5 Streams, rivers & lakes

Few assessments have been carried out in streams, lakes and rivers in the EMRP area other than sporadic stock assessments by the Fisheries Service, and little is known about the present biodiversity of these systems. However, some things can be inferred from what is known from other areas where studies have been carried out in blackwater systems in Southeast Asia (e.g. in Peninsular Malaysia, Furtado & Mori, 1982; Giesen, 1998; Sumatra by Bezuijen *et al.,* 2001; and recently in South Kalimantan by NLDS[5]).

From these studies it is apparent that the quality of the swamp forest and peat swamp forest determines the quality of the aquatic systems as well. In disturbed areas, shading of the rivers and streams is low, and as a result temperatures increase and dissolved oxygen levels decrease. Also, if canals are constructed, water levels in peat swamp habitats drop, which further exacerbates the decline in water quality. This is especially if potential acid sulphate soils (PAS) are exposed to air and begin to oxidise, as pH levels can then drop to below 3.0, which is inimical to most fish species. This may be a seasonal event (i.e. during the dry season), but can be sufficient to wipe out most fish species, except for the hardiest (e.g. *gabus Channa striata, seluang Rasbora* spp.). In South Kalimantan it was found that fish populations and fishing as generally good soon after excavation of canals, but that this dropped precipitously after several extended dry seasons. Recovery was also found to be minimal in intermediate wetter seasons or years. Peat swamp forests streams abound in freshwater fish species due to the occurrence of various microhabitats (Ahmad *et al.,* 2002), and the loss of such habitats in the EMRP area has probably resulted in a significant impoverishment of the fish fauna. Buaya senyulung (false gavial *Tomistoma schlegelii*) also depend on good vegetation cover along larger blackwater streams and smaller rivers – their primary habitat. These are also likely to have suffered due to widespread deforestation of the freshwater and peat swamp forests.

[5] An ongoing project funded by Partners for Water, the Netherlands: 'Towards Formulation of a National Strategy for Participative Lowland Water Resources Management', being carried out by Euroconsult MMD and WUR, together with PT Indec Internusa.

Large rivers such as the Barito, Kapuas, Kahayan and Sebangau probably still harbour reasonable to good fish populations. Firstly, the riparian vegetation is still in a reasonable condition in much of the EMRP area, providing food, shelter and spawning areas. Secondly, there is relatively little habitation along these rivers, as towns and villages are widely spaced and have small populations. Thirdly, there is little industry in the area, although alluvial gold mining (using metallic mercury or cyanide) in some upstream areas may have a local influence, but due to a vast dilution this is expected to have little effect at present. Buaya (estuarine crocodile *Crocodylus porosus*) populations are low to absent in most of the large rivers, due to excessive hunting.

Overall assessment:

- Small to medium-sized streams located in degraded freshwater swamp and peat swamp areas are generally impoverished in terms of biodiversity due to declined water quality and quantity, although fish populations may remain economically important.
- Large rivers generally fare better in terms of biodiversity, as riparian habitats are in a better condition than swamp forests and peat swamp forests, and the effect of ln use changes, industry and habitation on the environmental condition of these large rivers has not been as dramatic.

## 2.6 Key species

Table 4 lists all increasing and decreasing species in the changed (and changing) habitats of the EMRP area. The general trend is that of loss of biodiversity in most habitat types due to loss of primary habitat species. The only species that increase are ubiquitous hardy ones, tolerant of disturbance and/or human presence, and/or tolerant of extreme conditions (pH, flooding, drought, fires). To date, this trend holds for all habitats except mangroves and the large rivers, as not all mangroves have been felled or converted, and large rivers can buffer the effects of limited habitation and industry.

**Table 4 Increasing & decreasing species in EMRP area**

| Ecosystem | Species Group | Increasers | Decreasers |
|---|---|---|---|
| Mangrove | Flora | *Acanthus ilificolius*<br>*Acrostichum aureum* | Tree species<br>*Nypa fruticans* |
| | Fauna | Mudflat species (e.g. mudskippers, waders) | Mangrove forest species such as primates, *tupai* and forest birds |
| Peat swamp forest | Flora | Tree species not targeted by logging companies (e.g. *Combretocarpus rotundatus, Tetramerista glabra, Palaquium*) and fast growing, robust pioneers (e.g. *C. rotundatus, Cratoxylon glaucum, Ploiarium alternifolium);* along with ferns & sedges. | Tree species targeted by logging companies, such as meranti (dipterocarps) and ramin (*Gonystylus bancanus*), and slow growing species. |
| | Fauna | Ubiquitous opportunistic species of open areas and habitation, e.g. spotted dove, bulbuls; and open waters, e.g. Pacific swallow. | Most forest bird and mammal species, false gavial and Storm's stork. |
| Freshwater swamp forest | Flora | Fire, flooding and acidity tolerant species such as gelam *Melaleuca cajuputi*, along with ferns and sedges. Fire and flood tolerant species such as belangiran/kahui *Shorea balangeran*, along with *Timonius* and *Pternandra teysmanniana* shrubs. | Most tree and palm species of this habitat. |
| | Fauna | Ubiquitous opportunistic species of open areas and habitation, e.g. spotted dove, bulbuls. | Most forest bird and mammal species. |
| Riparian | Flora | Fast growing species such as *Barringtonia acutangula, Mallotus sumatranus* and *Timonius* species. Species tolerant of deep flooding, such as *Pandanus helicopus, Barringtonia, Timonius* and *Croton.* | Slow growing species such as *Artocarpus teysmanni.* |
| | Fauna | Ubiquitous species such as doves, pigeons, bulbul | Species requiring a large habitat, such as (large) birds of prey, (larger) forest birds and primates. |
| Rivers, streams & lakes | Flora | In small streams: no increasers, except perhaps *Eleocharis* and *Lepironia* sedges along edges. | Species typical for undisturbed blackwater habitats, such as *Cryptocoryne* species. |
| | Fauna | None known. | Most fish species of small blackwater streams, false gavial, hairy-nosed otter. |

## 2.7 Goods & services provided by these habitats

All habitats provide goods and services that benefit humans, and Table 5 summarises the main goods and services provided. Evident from this table is that the greatest benefit and the widest range of goods and services are provided by natural/non-degraded habitats. Also, for the EMRP area, the greatest benefits are provided by non-degraded peat swamp forests and mangroves.

**Table 5 Goods & services provided by main ecosystems**

| Ecosystem | Sub-type / condition | Ecosystem Goods & Services* | | | | |
|---|---|---|---|---|---|---|
| | | Employment & income | Provisioning | Regulating | Supporting | Cultural |
| Mangrove | Natural | + | ++ | ++ | ++ | + |
| | Converted (tambak) | ++ | - | -- | - | - |
| Peat swamps | Natural forests | + | ++ | ++ | ++ | + |
| | Degraded forests | - | - | - | - | - |
| | Rehabilitated forests | + (initial) | + | + | + | 0 |
| Freshwater swamps | Natural forests | 0 | ++ | + | + | + |
| | *Melaleuca* forest | + | + | 0 | 0 | - |
| Riparian habitat | Riparian forest | - | ++ | + | + | + |
| | Degraded | - | 0 | 0 | 0 | - |
| Rivers, lakes & streams | Pristine black-water streams | 0 | + | + | + | 0 |
| | Degraded black water streams | - | - | - | - | - |
| | Rivers | + | + | + | + | + |

* Ecosystem goods and services:

- Employment & income: Jobs on farm/field, jobs in the value chain, jobs related to the value chain, monetary return
- Provisioning: Food production (e.g. crops, fisheries), feed production, fuel production, water supply, genetic resources and biodiversity, raw materials, mobility
- Regulating: Flood control, climate control, fire control, pest & disease control
- Supporting: Nutrient cycling and carbon sequestration
- Cultural: Spiritual, recreational and aesthetic values
- Score: = very negative; - = negative; o = neutral; + = positive; ++ = very positive

# 3 Challenges to remaining biodiversity value of the EMRP area

## 3.1 Impacts of ongoing development & activities on biodiversity

The impacts on biodiversity of the main developments and ongoing activities in the ex-PLG area are described below.

**Oil palm & rubber plantations**
Plantations in the EMRP area all still need to follow the EIA (AMDAL) process in order to obtain their official permits, but in spite of this various plantations are well underway towards establishment, with areas being cleared and seedlings being planted. Most oil palm and rubber plantations are designed and established as monocultures, although some companies may follow HCVF principles and establish conservation areas in relict forest areas within their concessions. The original biodiversity is generally lost with the disappearance of the original habitat, which in the EMRP area was mainly peat swamp forest and freshwater swamp forest, and the introduced species (oil palm and rubber) are both exotics. The loss of diversity is particularly the case in oil palm plantations, as palm roots prevent the establishment of other tree/shrub species, which further impoverishes the system. Also, groundwater levels need to be kept low (<50cm below surface for oil palm) by means of drainage, which in peat areas leads to peat subsidence and oxidation, and increased fire risk.

Rodents are a major potential pest in oil palm plantations, and rodenticides are commonly used, especially zinc phosphide (marketed as Fosfit or Rackus) and aldicarb (marketed as Temik). Aldicarb is a highly hazardous pesticide that has been officially banned in Indonesia, but is nevertheless commonly and widely applied for a wide range of mammalian pests. The disadvantage of rodenticides is that they also eliminate non-target species, especially natural rat predators such as snakes, birds of prey (such as barn owls) and small cats[6].

The combination of habitat loss and widespread use of pesticides leads to a loss of most of the biodiversity value of the former peat swamp forests. An exception are old plantations (esp. oil palm), which may abound in epiphytes (esp. ferns) and include more species than young plantations.

**Logging**
Legal logging activities stopped more than a decade ago, and areas that have been selectively logged by logging concessionaires (HPH companies) such as the Mawas Block (southeastern Block E) are regenerating vigorously, as logs were extracted using rails rather than canals and the hydrology has remained more-or-less intact (see Annex 6).

[6] In many transmigration schemes, rats have been particularly troublesome after the government-sponsored supply of pesticides ran out (i.e. after 3 years). Rat populations rebounded very quickly, as most of their natural predators had been eliminated, and these rodents are then far more troublesome than before pesticides were being used.

Although legal logging has stopped, illegal logging is widespread and common in all parts of the EMRP area where forests (-remnants) still occur (see Annexes 2, 4 & 6). Some of this is for charcoal production (Annex 4), but most is for timber (Annexes 2 & 6). For charcoal production, all trees are removed and the result is a clear-felled, denuded area where a secondary scrub will regenerate, provided that fires can be prevented. Timber currently being taken out of the EMRP area all consists of non-dipterocarp species such as *Campnosperma coriacea, Dacrydium beccari* and *Dyera polyphylla.* All timber being extracted is well below the normal minimum dbh range, and most extracted logs have a diameter of only 20-30 cm. This means that recruitment of these species will stall, and such desirable species will be uncommon or disappear if forests were to regenerate.

However, continued illegal logging leads to increased desiccation (as the canopy is opened) and increased availability of fuel, both of which increase the fire hazard and the likelihood of natural regeneration of such areas greatly diminishes. As all taller trees are taken, much of the species diversity is lost, at least temporarily until areas can be recolonised from nearby forests. Another aspect of illegal logging that prevents natural regeneration is that logs are commonly extracted using small canals (1-2 m diameter), which leads to peat subsidence and oxidation, and further increases the fire hazard.

**Fires**

Fires have been a major issue in the EMRP area from the onset of the PLG, and locals speak of three seasons: wet season, dry season and smoke season. A ban has been issued on the use of fire for clearing land, and this is enforced fairly rigorously. In 2007, few fires occurred, but this was an unusually wet year and it remains to be seen what will happen during a dry year. Fires have been both in remaining (opened up) forests and in peat areas devoid of forest. The net effect of fires on biodiversity is highly destructive: most of the biodiversity values are lost, and recovery is also affected as seed stocks (in the soil) are also lost. Formerly burnt areas are therefore characterised by the occurrence of only a few particularly resilient or pioneer species that will take a long time to recover. Areas that have been subjected to more than one fire have an additional handicap that prevents natural regeneration: as peat layers have been lost, the degree of flooding in the wet season increases, and if this is deep or prolonged, normal peat swamp forest species will no longer survive (Giesen, 2004; van Eijk & Leenman, 2004). Such areas may then become lake-like habitats such as occur along the Siak Kecil River in Riau, and are developing along the Air Hitam Laut River in Berbak NP, Jambi.

**Tambak**

Brackish-water fishponds or tambak have been developed in mangrove areas between the Sebangau and Kahayan rivers. Near the mouth of the Sebangau River (the mangroves south of the Sebangau), these ponds have subsequently been abandoned, and the area is currently rapidly being recolonised by mangrove species (mainly climbers and herbaceous species; see Annex 5). The largest tambak area has been established west of the mouth of the Kahayan River (Annex 1) – originally this was opened by Banjarese, but over the past decade the area has been taken over by Buginese. These tambak systems are extensive and have a low productivity. However, although all original forest species are lost (no trees are left standing), these extensive ponds still have a reasonable biodiversity value as they attract many waterbirds, including duck and waders. Since 2007, however, the Fisheries Service (Dinas Perikanan dan Kelautan) has started a programme of intensification, leading to higher investments and productivity, but probably also a loss of remaining biodiversity, as there will be

a greater incentive to protect investments against predation (by piscivorous birds), and use of pesticides and antibiotics. It is estimated that about half of the original mangrove habitat has been lost due to this conversion (see 2.1).

## 3.2 Impacts of proposed development on biodiversity

Part of the proposed development (plantations, tambak development) is already discussed under 3.1 and is not covered any further here. However, additional development is proposed under the EMRP and INPRES 2/2007, including channel blocking, regreening, *jelutung* plantations and increased agricultural development.

**Channel blocking**

If properly designed and constructed, channel blocking will result in raised water levels, both in channels and in peat domes. This will reduce the fire hazard and increase the likelihood of recovery/natural regeneration, and increase the effectiveness of regreening programmes. On the whole, channel blocking will therefore have a positive effect on biodiversity. One potential negative effect is that deeper waters in channels and canals may serve as barriers for certain wildlife species (e.g. primates such as orangutan). However, the overall impact will be overwhelmingly positive in terms of biodiversity.

**Regreening**

The regreening programme envisaged under the EMRP and INPRES 2/2007 will focus on the re-establishment of a forest cover with indigenous species on degraded peat areas. The impact this will have on biodiversity will depend on which species are used, and whether many species will be mixed or areas will be replanted with one or several species only. For restoration of biodiversity value, the best results will be obtained if species are mixed, and if species that attract birds and mammals are planted. For the latter, trees with edible fruits and nectar-rich flowers are important. To date, however, regreening trials have focused more on species that survive and have an economic value (e.g. jelutung *Dyera polyphylla* and kahui *Shorea balangeran*) rather than species that also attract wildlife. It is also important that any plant species that regenerates in a regreening area is left, and not removed (e.g. if the regreened area is managed like a plantation, with removal of competing species). In any case, regreening programmes will have an overall highly positive effect on biodiversity, compared to a denuded peat landscape.

**Jelutung plantations**

Jelutung *Dyera polyphylla* plantations will have a number of the same disadvantages as the oil palm and rubber plantations, but there are also some significant advantages. First and foremost is that groundwater levels can be kept high as jelutung is a peat swamp species, and this means that the peat dome can be kept intact. Secondly, jelutung occurs naturally in the area and plantations do not involve the introduction of an exotic; this is important if such plantations are to be established close to or adjacent a conservation area.

**Increased agricultural development**

In Block D and the southern and southeastern part of Block A, increased agricultural development is proposed under the EMRP. This will probably include improvement of existing drainage and transportation infrastructure, provision of support to farmers (seed stock, seedlings, livestock improvement, extension work, training), and investment in market development. In these areas, however, biodiversity values are already low. Most of the original habitats were already heavily degraded under the PLG, and most of the past agricultural development focused on these locations. Therefore, it is not expected that proposed increased agricultural development will have significant impacts on biodiversity. However, some mitigation measures are proposed, such as i) promotion of IPM to reduce pesticide use and improve surface and groundwater quality; ii) establishing of community forest plots, to reduce pressures on remaining forest areas; and iii) sanitation programmes (for solid waste and effluents) to reduce impacts on ground- and surface waters.

# 4 Legal & policy requirements, their implementation & impacts on biodiversity

## 4.1 National laws, regulations & policies

**Protected Area system and conservation**

The existing Forestry (UU RI Nomor 41 Tahun 1999 Tentang Kehutanan) and Conservation (UU RI Nomor 5 Tahun 1990 Tentang Konservasi Sumber Daya Alam Hayati dan Ekosistemnya) Laws recognise a number of basic conservation area categories:

1. Kawasan Suaka Alam (Nature Reserve)
2. Cagar Alam (Strict Nature Reserve)
3. Suaka Margasatwa (Wildlife Reserve)
4. Cagar Biosfer (Biosphere Reserve)
5. Kawasan Pelestarian Alam (Nature Conservation Area)
6. Taman Nasional (National Park)

These are managed at the Provincial level by the Balai Konservasi Sumber Daya Alam (BKSDA), except for the National Parks, which are managed directly by the central government via a local TN branch established for each NP. The main aim of these areas is the conservation of nature and biodiversity, and most areas are regarded as being as (near) natural as possible and have been selected for their value for preservation of biodiversity.

There are no PAs in the EMRP area at present, although the BOS Foundation has taken steps towards having the Mawas part of Block E gazetted as a protected area. Forestry Department Master Plan part of INPRES 2/2007 proposes the establishment of a wide range of protected areas in the EMRP area (see 5.1). However, the proposed categories (Conservation of Flora & Fauna, Mangrove Conservation, Conservation of Black Water Systems, Hydrology Conservation, Conservation of Quartz Sand, Conservation of Deep Peat, Conservation of *Melaleuca* forest & *Lepironia* sedges) do not match any of those currently used by BKSDA, and the areas do not meet the basic conservation criteria of the Conservation Law. Apart from Block E, all of the areas listed require restoration and large scale regreening programmes, and have little or no conservation value at present. Also, regreening and restoration is not part of BKSDA's mandate, and adding this would dilute their already scant human resources, and divert activities from more pressing conservation needs.

The Forestry Law is currently being overhauled again, but this focuses mainly on the establishment of Forest Management Units (Kesatuan Pengelolaan Hutan/KPH). Under the KPH system, three broad management functions are recognised: Conservation, Protection and Production. FMUs are to be the smallest management unit for forestry, and are to consist of single ecosystems or cover one watershed. More than one function may occur in a single FMU, but it is to be classified according to the dominant type of function. According to the system, it is

logical that each of the three peat domes in the ex-PLG area each be recognised as a separate FMU. The seven conservation categories proposed by the Forest Department Master Plan of the INPRES do not follow the KPH system, as these are based on *forest* management functions and do not refer to peat, sand or hydrology.

**Coastal green-belt policy**

A coastal green-belt is a protective zone of mangroves maintained along the coast, which is not allowed to be cut, converted or become degraded. The function of such green-belt is basically twofold: to protect the coast against erosion, and to maintain the nursery and breeding function of the forest for fin- and shellfish. The green-belt policy in Indonesia has taken a bumpy ride over the past three decades:

- In 1975 an instruction was issued by the Directorate General of Fisheries (No H.I/4/2/18/ 1975) stipulating that a green-belt of 400 metres width should be maintained along the coast, from the mean low tide level.
- In response to this regulation by 'Fisheries' a Letter of Decree (Surat Keputusan) was issued by the Directorate General of Forestry (No. 60/KPTS/DJ/I/ 1978), on the Guidelines for Brackish Water Forest Silviculture that set a green-belt 10 metres along the river bank and 50 metres along the coast from the lowest tide.
- In 1984, a settlement was reached when the ministries of Agriculture and Forestry issued the Joint Ministerial Decrees, No. KB 550/246/ KPTS/4/1984 and No. 082/KPTS-II/1984, stipulating to conserve a green-belt of 200 metres-width along the coast, prohibiting mangrove cutting in Java, and preserving all mangroves on small islands (less than 1000 ha).
- In 1990, Presidential Decree No. 32, 1990 (Pengelolaan Kawasan Lindung), overrules all the preceding regulations, and according to paragraph 27, the coastal mangrove belt is minimally to be 130 metres times the average tidal range (in metres), measured inland from the lowest point of low tide.
- With the revised decentralisation legislation in 2004, application of the green-belt policy and legislation became a matter of interpretation at provincial level. At the time, the Ministry of Internal Affairs (Dalam Negeri) issued a decree stating that green-belts are to be established and confirmed at local level. However, in most areas this has not been confirmed or applied, and confusion reigns.

## 4.2 International obligations

**Ramsar Convention**

The Ramsar Convention or Convention on Wetlands of International Importance especially as a habitat for waterfowl was signed by Indonesia in 1992, and came into force on 8 August 1992. Indonesia presently has three sites designated as Wetlands of International Importance – i.e. Berbak NP (Jambi, designated 1992), Danau Sentarum NP (West Kalimantan; 1994) and Wasur NP (Papua; 2006) – with a combined surface area of 656,510 hectares. Pulau Rambut (West Java) and Rawa Aopa (Southeast Sulawesi) have been submitted to the Ramsar Secretariat, but have not yet been accepted. Under the Convention, Indonesia is obliged to set aside and sustainably manage these wetlands of international importance, while at the same time performing 'wise use' principles in remaining wetlands[7]. Much of the latter are set out in the

[7] These 'wise use' principles are enshrined in the Ramsar Bureau's manuals; 3rd edition (2007) *Ramsar Handbook for the Wise Use of Wetlands,* 17 volumes of which are available at: http://www.ramsar.org/lib/lib_handbooks2006_e.htm

Indonesian National Wetland Strategy and Action Plan, drafted in 1996 by the Forestry Department, with assistance from Wetlands International.

The Indonesian National Report to COP9, held in Kampala in 2005, includes many references to peat and peatland priorities, including assessments, wise use documents and fire prevention, with a main focus on Kalimantan and Sumatra ( http://www.ramsar.org/cop9/cop9_nr_indonesia.pdf). Ramsar COP10 is planned for October-November 2008 (Changwon, South Korea), but the Indonesian National Report has not yet been drafted.

The three Indonesian Ramsar sites are generally threatened by development. Since the early 1990s, Berbak NP is rapidly being deforested and has also suffered from large scales fires and encroachment. Local government has re-allocated land for development (mainly oil palm, but also small scale farming), and as a result the park has dwindled in area from 186,000 ha (as gazetted) to 132,000 ha (2007). Jakarta Post (11th September 2008) reports that 40% of Berbak NP has become degraded 'by illegal logging and foraging activities'. Danau Sentarum NP has suffered from repeated fires since the 19th century, but this has grown worse since the 1980s. It also threatened by large scale oil palm development all around the periphery, fueled by investment from neighbouring Malaysia. Wasur NP is threatened by poaching and alien invasive species such as waterhyacinth and *Mimosa pigra*, as well as population pressures from the nearby town of Merauke.

**CITES**

The Convention on International Trade in Endangered fauna and flora Species (CITES) is an international agreement between governments that aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES was drafted as a result of a resolution adopted in 1963 at a meeting of members of IUCN (The World Conservation Union). The text of the Convention was finally agreed at a meeting of representatives of 80 countries in Washington DC., on 3 March 1973, and on 1 July 1975 CITES entered in force. Indonesia acceded to CITES on 28 December 1978, and the convention came into force in the country on 28 March 1979. Under CITES, species are listed according to various categories, in lists that form an appendix to the convention and are regularly updated. Appendix I is a list of species which are fully protected, i.e. all trade is prohibited by law; Appendix II lists threatened species, the trade of which is heavily regulated and kept to a minimum.

Many wildlife species found in the EMRP area are CITES listed, including many mammals (esp. primates and carnivores, but also squirrels, fruit bats and pangolin), birds (esp. birds of prey, owls and parrots) and reptiles (esp. turtles, tortoises, monitor lizards, pythons and crocodiles).

Relatively few plants are listed under CITES, but those found in the EMRP area include all pitcher plants (*Nepenthes* species), all orchids, and most members of the Thymelaeaceae family. The latter includes *Gonystylis bancanus* (ramin), which is IUCN Red listed as Vulnerable and included on CITES Appendix II, which means that trade is regulated. In 2007 5000+ cubic metres of processed ramin was exported from Indonesia. Ramin may be felled and processed to some degree, but its export and trade is (heavily) regulated under the CITES convention.

**UNFCCC / Climate Change**

The United Nations Framework Convention on Climate Change (UNFCCC or FCCC) is an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro from 3 to 14 June 1992. The treaty is aimed at stabilising greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The treaty as originally drafted did not set any mandatory limits on greenhouse gas emissions for individual nations and contained no enforcement provisions; it is therefore considered legally non-binding. Rather, the treaty included provisions for updates (called "protocols") that would set mandatory emission limits. The principal update is the Kyoto Protocol, which has become much better known than the UNFCCC itself.

The UNFCCC is also the name of the United Nations Secretariat charged with supporting the operation of the Convention, with offices in Bonn, Germany. COP-13 of the convention took place at Nusa Dua (Bali) from 3-15 December 2007, whereby an agreement was reached on a timelined negotiation on the post 2012 framework (a successor to the Kyoto Protocol).

Indonesia is a Non-Annex 1 Party to the UNFCCC, having signed the Climate Change Convention on 5th June 1992; this was ratified on 23rd August 1994 and came into force on 21st November 1994. Indonesia signed the Kyoto Protocol on 13th July 1998, but this was not ratified until 3rd December 2004; it came into force on 3rd March 2005.

Indonesia has implemented various projects aimed at reducing emissions, for example, power plants using biofuels (crop residues, methane from swine manure), and currently several REDD (Reduced Emissions from Deforestation & Degradation) and CDM (Clean Development Mechanism) projects are in the pipeline in Central Kalimantan. A REDD project development document for REDD has been developed (by the firm Winrock) for Block E, and similar projects are being considered for Block A as part of a proposed AusAid project[8]. A proposal for a CDM-funded project for a pilot area in the northern part of Block C has been drafted by ClimateCare, and is being considered by the UNFCCC Secretariat. In a nutshell, the REDD proposals aim at promoting forest conservation (by preventing illegal logging and fires, and regreening), while the CDM proposal aims at peat conservation (by preventing fires)

[8] Kalimantan Forests and Climate Partnership. Framework Design Mission: Aide Memoire, 11 April 2008.

# 5 Planning for biodiversity conservation & sustainable use

## 5.1 Existing spatial plans

**Ad Hoc Team EMRP**

The Ad Hoc Team established to guide and plan rehabilitation of the EMRP area produced several reports and broad brush spatial plans, including a first plan drafted in 2003 (Tim Ad Hoc, 2003). In this report and spatial plan, Block E is entirely designated as Conservation Area (Kawasan Konservasi), while Blocks A-D have a variety of designations that are similar to what was later included in the Forestry Department Master Plan (see below).

**Forestry Department Master Plan & INPRES 02/2007**

Out of a total of 1,454,541 ha, the Forestry Department (Dep. Kehutanan, 2007) recommends that 874,453 ha (60%) of the EMRP area be designated as conservation area, while the balance (40%) be utilised for both forestry and non-forestry purposes. The INPRES 02/2007 includes a draft spatial plan developed in conjunction with Departemen Kehutanan's (2007) Master Plan, listing seven broad "conservation targets" (see Table 6). The Forestry Department Master Plan proposes that each of these seven targets be designated as Protection Forest (Hutan Lindung/HL), Strict Nature Reserves (Cagar Alam/CA), Wildlife Reserve (Suaka Margasatwa/SM) or Limited Production Forest (Hutan Produksi Terbatas/HPT), depending on the degree of disturbance of the original habitat (lightly disturbed or heavily disturbed) and type of utilisation by locals (owned or not owned). The report provides figures on the land cover (esp. tree cover) of each of the seven conservation targets, it does not provide this for the conservation designation type (HL, CA, SM or HPT).

While it has its definite merits as it places the emphasis squarely on conservation and rehabilitation, the approach provided has significant drawbacks:

- The conservation agency of the Forestry Department that would be responsible for managing SMs and CAs – i.e. the Balai Konservasi Sumber Daya Alam (BKSDA) does not recognise the seven conservation targets. BKSDA's conservation targets are biodiversity-oriented, and targets that aim at conserving hydrology, quartz sand or deep peat does not feature in this approach.
- The seven conservation targets do not match the new Forest Management Unit approach or FMU (Kesatuan Pengelolaan Hutan/KPH) system recently launched by the Forestry Department that recognises three broad management functions: Conservation, Protection and Production. FMUs are to be the smallest management unit for forestry, and are to consist of single ecosystems or cover one watershed. More than one function may occur in a single FMU, but it is to be classified according to the dominant type of function. According to the system, it is logical that the three peat domes in the ex-PLG area each be recognised as an FMU. The most appropriate function type for the domes of Block C and Block B/western Block E is likely to be Protection (e.g. of peat, hydrology, quartz sand), while the

most appropriate function of the third dome – northern Block A and eastern Block E is Conservation.

- According to the existing legal system on conservation and protected areas (e.g. UU No. 05 1990 Tentang Konservasi Sumber Daya Alam Hayati dan Ekosistemnya), Wildlife Reserves and Strict Nature Reserves are areas set aside for protection of existing biodiversity value(s). In the approach outlined in the Forestry Department Master Plan, degraded areas are to be restored via a regreening programme, and at the same time designated CA or SM although biodiversity values are low to very low.
- Designating large areas (e.g. of peat domes) as Protection Forest (HL) has its drawbacks, as such areas cannot be legally utilised, while certain forms of land use may be sustainable and perhaps even preferable. Large areas of peat dome are heavily degraded with little or no tree cover, and are to be targeted with hydrological restoration and regreening efforts in order to reduce the fire hazard. This will require significant investments, with an uncertain outcome if protection cannot be guaranteed. Protection would seem more likely if either local communities or commercial companies have a direct stake in this area, e.g. by establishing community forests or commercial HTI in the rehabilitated area. In order to prevent (enhanced) peat loss, the hydrology should be restored, and species used for 'regreening' are to be adapted to deep peat conditions (e.g. belangiran *Shorea balangeran*; jelutung/pantung *Dyera polyphylla*).
- A particular case is that of the *Melaleuca* forest and *Lepironia* sedge areas, which according to survey data (Balai PKHW, 2007; see Table 6) currently consists of shrubland/deforested area (66%), rice paddies (30%) and settlements (4%). Under the proposed programme the area is to be regreened and partially used as HPT, while the rest is to be designated at HL or CA. *Melaleuca* forests are highly utilised as a source of building material (mainly durable poles) and fuelwood, but also reeds for weaving (mainly *Lepironia*), honey, and so on. These forests display a rapid growth and very successful rapid colonisation of suitable habitat. However, *Melaleuca* forests are characteristic for heavy disturbance and generally replace mixed swamp forest types after logging and fires have depleted the original forests. They are of little value for biodiversity, although they may be valuable for local economies. HPT would therefore seem an appropriate designation, and not conservation / HL (for they can and should be used without causing environmental issues) or CA (as biodiversity value is low).
- Lastly, the map included in the INPRES 02/2007 does not accurately reflect the situation on the ground regarding the mangrove area. Firstly, a large part of the area mapped as Mangrove Conservation area is not forested at present (as indicated in Table 6), and the Master Plan therefore proposes reforestation of the area. However, a large part (i.e. the eastern half) of this area between the Sebangau and Kahayan rivers is not simply degraded forest, but has been converted to brackish water fishpond (tambak). This process was initiated more than 10 years ago by Banjarese fishermen, who constructed extensive pond systems, and much has lately been converted into more intensive ponds by Buginese settlers. Since 2005, the Fisheries Service (Dinas Perikanan dan Kelautan) has also started a programme in the area of converting extensive ponds into semi-intensive ponds, and to date 200 ha out of a planned 600 ha has been constructed. This is in addition to the much larger extensive system. Secondly, the area mapped on the Forestry Department Master Plan as 'Tambak' (between the Kahayan and Kapuas rivers) actually consists of primary mixed mangrove habitat with a very high biodiversity value. During surveys, groups of proboscis monkey, silvered leaf-monkey and many forest bird species were observed in a largely intact and mature mangrove forest.

**Table 6 Areas targeted for conservation as proposed by Forestry Department**
(adapted from report Departmen Kehutanan, 2007)

| No. | Conservation target | Land cover | Area (ha) | % of total area |
|---|---|---|---|---|
| **I** | **Protected Areas** | | | |
| 1. | Conservation of Flora & Fauna | a. Reasonably dense forest | 28,381 | 1.95 |
| | | b. Forest with few trees | 6,525 | 0.45 |
| | | c. Shrubs/not forested | 93,101 | 6.40 |
| | | subtotal | 128,006 | 8.80 |
| 2. | Mangrove Conservation | a. Forest with few trees | 25,350 | 1.74 |
| | | b. Shrubs/not forested | 739 | 0.05 |
| | | subtotal | 26,090 | 1.79 |
| 3. | Conservation of Black Water Systems | a. Reasonably dense forest | 2,766 | 0.19 |
| | | b. Forest with few trees | 127 | 0.01 |
| | | c. Shrubs/not forested | 19,137 | 1.32 |
| | | subtotal | 22,029 | 1.51 |
| 4. | Hydrology Conservation | a. Reasonably dense forest | 171,930 | 11.82 |
| | | b. Forest with few trees | 8,535 | 0.59 |
| | | c. Shrubs/not forested | 92,443 | 6.36 |
| | | subtotal | 272,908 | 18.76 |
| 5. | Conservation of Quartz Sand | a. Reasonably dense forest | 34,726 | 2.39 |
| | | b. Forest with few trees | 5,825 | 0.40 |
| | | c. Shrubs/not forested | 43,832 | 3.01 |
| | | subtotal | 84,384 | 5.80 |
| 6. | Conservation of Deep Peat | a. Reasonably dense forest | 49,359 | 3.39 |
| | | b. Forest with few trees | 15,460 | 1.06 |
| | | c. Shrubs/not forested | 203,020 | 13.96 |
| | | d. Rubber | 145 | 0.01 |
| | | e. Rice paddies | 1,516 | 0.10 |
| | | subtotal | 269,500 | 18.53 |
| 7. | Conservation of *Melaleuca* forest & *Lepironia* sedges | a. Shrubs/not forested | 47,108 | 3.24 |
| | | b. Rice paddies | 21,793 | 1.50 |
| | | c. Settlement | 2,636 | 0.18 |
| | | subtotal | 71,537 | 4.92 |
| | | subtotal Protected Areas | 874,453 | 60.12 |
| **II.** | **Cultivated Areas** | | | |
| 1. | Forest cultivation | a. Forest with few trees | 34,569 | 2.38 |
| | | b. Shrubs/not forested | 117,151 | 8.05 |
| | | subtotal | 151,720 | 10.43 |
| 2. | Non-forestry cultivation | a. Reasonably dense forest | 1,418 | 0.10 |
| | | b. Forest with few trees | 1,159 | 0.08 |
| | | c. *Melaleuca* | 2,523 | 0.17 |
| | | d. Shrubs/not forested | 423,179 | 29,09 |
| | | e. Rice paddies | 84 | 0.01 |
| | | f. Settlement | 4 | 0.00 |
| | | subtotal | 428,368 | 29.45 |
| | | subtotal Cultivated Areas | 580,088 | 39.88 |
| | | **Total of EMRP area** | 1,454,541 | 100.00 |

## 5.2 Priority areas

In all, six *Areas of Conservation Value* are proposed by the Biodiversity Specialist of the Master Plan team for the EMRP area. Characteristics of these areas are summarised in Table 7, while further descriptions and justifications are provided in 5.2. A map is provided in Figure 2. It must be note that for proposed conservation areas, an intermediate status of Rehabilitation Forest (Hutan Rehabilitasi) should be given to parts that require regreening, as otherwise such activities may not officially be allowed. After regreening has been successful, the Rehabilitation Forest status can be revoked and the desired conservation status can subsequently be designated.

**Table 7 Proposed priority areas for conservation & protection**

| No. | Name of Area | Land cover | Proposed status | Area (ha) | % of total area |
|---|---|---|---|---|---|
| **Conservation areas** | | | | | |
| 1. | Mawas | Mainly peat swamp forest, <recovering after selective logging> | Conservation function FMU <NP (TN) or Special Conservation Area> | 288,233 | 20.5 |
| 2. | Kahayan-Kapuas Conservation area | Degraded peat swamp forest, with patches of secondary PSF | Conservation (of orangutan), Protection (of peat dome) or Production function | 253,654 | 18.0 |
| 3. | Sebangau-Kahayan | Secondary peat swamp forest & degraded PSF | *Kwasan Lindung* Protection function FMU <status that will permit local sustainable utilisation of forest resources> | 57,018 | 3.1 |
| 4. | Sebangau south mangrove | Mangrove forest with reasonable cover, along shores facing westwards | Either SM or CA | 15,584 | 1.1 |
| 5. | Pantai Kiapak Conservation Area | Mixed mangrove with good to excellent cover; *Sonneratia caseolaris* zone along seaward side | Either SM or CA | 7,635 | 0.5 |
| 6 | Sebangau NP Bufferzone (East) | Mosaic of degraded PSF, *Melaleuca* areas, riparian forest and sedge/fernland | Bufferzone of Sebangau NP | 41,987 | 3.0 |
| | | | Subtotal | 664,111 | 46.2% |

**1. Mawas Conservation Area**. This is the eastern half of Block E and the northern part of Block A, a large peat dome area extending over more than 288,000 ha and consisting largely of peat swamp forest. The area has been logged over by commercial logging companies (HPH) that used tramline systems and not canals to extract timber. As a result, the forest is vigorously regenerating and is well on the way to recovery although large trees are largely absent. The area supports about 3000 orangutan and is considered one of the key priority areas for conservation of this species in Kalimantan. The NGO BOS Mawas is active in the area and has established a network of stations in the area, including a research/field station at Tuanan (along the Kapuas River, in the southwestern part), an orangutan release station (Camp Release) along the Mentangai River, a field station (Camp Bagantau) along the Mentangai River north of the main SS-I canal, and six guardposts (4 in south, 2 in the north). In addition to study, orangutan and other species conservation, they have carried out channel blocking activities together with local communities (these are 1-2 m wide channels used for illegal logging) and community-based regreening programmes.

The status of the area is unclear. The status recommended by Forestry Department (INPRES 02/2007) is a combination of Hydrological Conservation, Deep Peat Conservation and Conservation of Flora and Fauna. However, the distinction between deep peat and hydrology is very artificial, and the whole area would qualify for all three of these categories. The area should be managed as a single FMU with a Conservation Function, with the actual management status to be determined later. In the past, BOS Mawas was considering following the example of Sebangau NP and aimed at achieving NP designation. However, as conflicts have arisen at Sebangau (between NP and local communities, who feel that the designation has been forced upon them and limits their options), this choice is less obvious. (See Annex 6) The northern boundary is unclear, as good forest extends further north, beyond the PSF area (see Figure 2).

**2. Kapuas-Kahayan Conservation Area.** This is a vast peat dome area encompassing the western half of Block E and the northern part of Block B. The area has also been subjected to selective logging such as the Mawas area, but unfortunately illegal logging has been much more rampant than in the Mawas area, resulting in forest clearing and more frequent large fires. However, the orangutan population numbers more than 500, and if illegal logging could be halted and the small (1-2 m wide) extraction channels blocked, it would probably recover well, although this would take longer than at the Mawas site. The area also forms a natural FMU, which should also receive a Conservation Function status. The actual management status should be determined at a later date. (See Annex 2)

**3. Sebangau-Kahayan Protection Area (*Kawasan Lindung*)**. The study area utilised by CIMTROP in the northern part of Block C still has large swathes of secondary PSF that is well on the way to recovering from selective logging. The total area is about 57,000 ha of which less than half is well forested. CIMTROP has an extensive programme of study, rehabilitation and trials in the area, and this should certainly continue. The INPRES 02/2007 forestry map recommends that the area be designated a combination of ‘deep peat conservation area’ and ‘conservation of flora and fauna’ area. However, the area is of significance for biodiversity, harbouring – among others – an orangutan population, along with sun bear and forest birds.

It would make sense to pool resources and have the area linked to Sebangau NP, as agencies involved in Sebangau (e.g. those involved in RESTORPEAT and earlier programmes) are also working with CIMTROP. The area should become part of an FMU that covers the entire Block C

dome and has an overall Protection function (in the sense of peat protection). (See Annex 3) Based on further surveys, this area may be extended further south than indicated on the map, as this area adjacent Sebangau NP may be considered as of significance as a bufferzone for the NP.

**4. Sebangau South Mangrove Conservation Area.** A large swathe of mangrove lines the westward facing coastline south of the mouth of the Sebangau River. The total area is about 15,000 ha. Currently it has no protection status, but the INPRES 02/2007 forestry map recommends Mangrove Conservation and some form of conservation is appropriate. It should be managed together with the Block C peat dome FMU, and the actual management status (CA or SM?) should be determined later. Mangroves in this area are in a poorer condition than that at Kiapak (see below). A 100-300 metres wide belt of mangroves dominated by *Avicennia alba,* with some *Sonneratia caseolaris*, occurs along the entire coast south of the Sebangau mouth right up to the cape. It was probably formerly backed by tall, mixed mangroves with many Rhizophoraceae, but this is heavily degraded, possibly by past felling, and now consists of low, mixed species (e.g. *Rhizophora parviflora*), but also with some open patches with a ground cover of *Acanthus iliifolius* and *Derris trifoliata.* It is likely to regenerate rapidly is not subject to more tree felling, although there will be a lower abundance of desirable timber species. The area is important for birds, including migratory waders such as redshank and whimbrel but also for resident egret (great & little), kingfisher (mangrove & stork-billed) and birds of prey (white-bellied sea-eagle, Brahminy kite). (See Annex 5)

**5. Pantai Kiapak Mangrove Conservation Area**. This is a smaller (7,500 ha), more concentrated mangrove area located at the southern tip of Block D, east of the mouth of the Kahayan River, near the fishing village Desa Pantai Kiapak. The area was found to have a very high biodiversity value. The mixed mangroves located in this area were found to be healthy and well developed, and harbouring significant populations of proboscis monkey, silvered leaf monkey and birds. There is little to no indication of felling of trees by the local community, and there are no tambak in the area. The INPRES 02/2007 forestry map recommends that the area be designated for tambak development, but this is most unfortunate, as these are probably the most biodiverse and healthy mangroves in Central Kalimantan. It is recommended that tambak development remains in the area west of the mouth of the Kahayan River, where it is currently concentrated, and that the mangroves east of the Kahayan be designated for conservation. Either Cagar Alam or Suaka Margasatwa could be considered, depending if the focus is to be on wildlife or habitat. Maintaining a healthy mangrove system in the area would also be crucial for the coastal fisheries, upon which the population of Desa Pantai Kiapak seems to depend almost entirely for their livelihood. (See Annex 1)

**6. Sebangau NP Bufferzone (East).** This area forms a broad zone that runs along the east bank of the Sebangau River, south of area number 3 (Sebangau-Kahayan), which runs south up to the Garong Canal (runs east-west). In the INPRES 02/2007 forestry map this area is classified as *Kawasan Flora dan Fauna*, which agrees with the proposed status of National Park Bufferzone. The area is a mosaic of degraded (and regenerating) PSF, gelam *Melaleuca cajuputi* forest, scattered remnants of riparian forest, and patches of regularly flooded sedge-fern wilderness. The area still have significant conservation value, as sun bear and orangutan still occur (according to WWF, about 500 orangutan still occur along the east bank of the Sebangau River). The area will provide a buffer to the existing Sebangau NP, which is located to the west of the Sebangau River.

## 5.3 Partnership programmes

Conservation NGOs and UNPAR (via CIMTROP) are engaged in conservation activities in various parts of the EMRP (or immediately adjacent) area, either under CKPP or other programmes (e.g. RESTORPEAT). These programmes are:

- CIMTROP: study and conservation area in northern part of Block C
- Wetlands International: restoration of hydrology and regreening of the northwestern part of Block A
- BOS Mawas: hydrology restoration, regreening, biodiversity studies, orangutan detailed studies, in eastern half Block E
- WWF: restoration of hydrology in northeastern part of Sebangau NP, adjacent the EMRP area.

It is strongly recommended that these activities are further encouraged and expanded, and if areas are designated as conservation or protected area, management be implemented under a partnership programme (see Table 8).

**Table 8 Proposed conservation partnerships with Forestry Department**

| No. | Name of Area | Proposed status | Currently active Partner | Proposed Partnership |
|---|---|---|---|---|
| **Conservation areas** | | | | |
| 1. | Mawas Conservation Area | Conservation Function FMU with NP or special conservation area management status | BOS Mawas | BOS Mawas |
| 2. | Kahayan-Kapuas Conservation Area | Conservation Function FMU | None at present | ?BOS Mawas |
| 3. | Sebangau east Mangrove Conservation Area | Protection Function FMU, management status either SM or CA | None at present | Wetlands International or WWF |
| 4. | Pantai Kiapak Mangrove Conservation Area | Either SM or CA | None at present | Wetlands International or WWF |
| 6. | Sebangau NP Bufferzone (East) | Bufferzone of NP | None at present | WWF |
| **Protected areas** | | | | |
| 3. | Sebangau-Kahayan Conservation Area | *Kawasan Lindung* Protection Function FMU, with management status such that local community may sustainably exploit resources | CIMTROP | CIMTROP |

## 5.4 Biodiversity monitoring programme

### 5.4.1 Forest cover

Most of the biodiversity in the EMRP area occurs in the peat swamp forests and mangroves, and the most effective way to monitor forest cover (loss, and possible recovery following restoration and regreening efforts) is to use remote sensing techniques. A baseline has been established under the CKPP and EMRP projects, and changes can be followed by periodically updating the information. This means that digital RS-imagery should be obtained and analysed very 1-2 years. Imagery costs are limited, and are mainly related to staff input. It should be accompanied by ground truthing – at least to some extent – as it may not always be clear what type of forest is being mapped. In some cases, plantations may not be readily distinguishable from natural forests (e.g. jelutung plantations, with a natural hydrology), and this should be verified by means of surveys.

### 5.4.2 Species monitoring

In order to monitor the health of the various ecosystems, it is proposed that a number of tree and wildlife species are used as indicator species, and are subjected to a monitoring programme. These proposed indicator species are listed in Table 9. Monitoring programmes should be developed separately for the various habitats, e.g. in rehabilitating peat swamp areas or recovering mangrove areas.

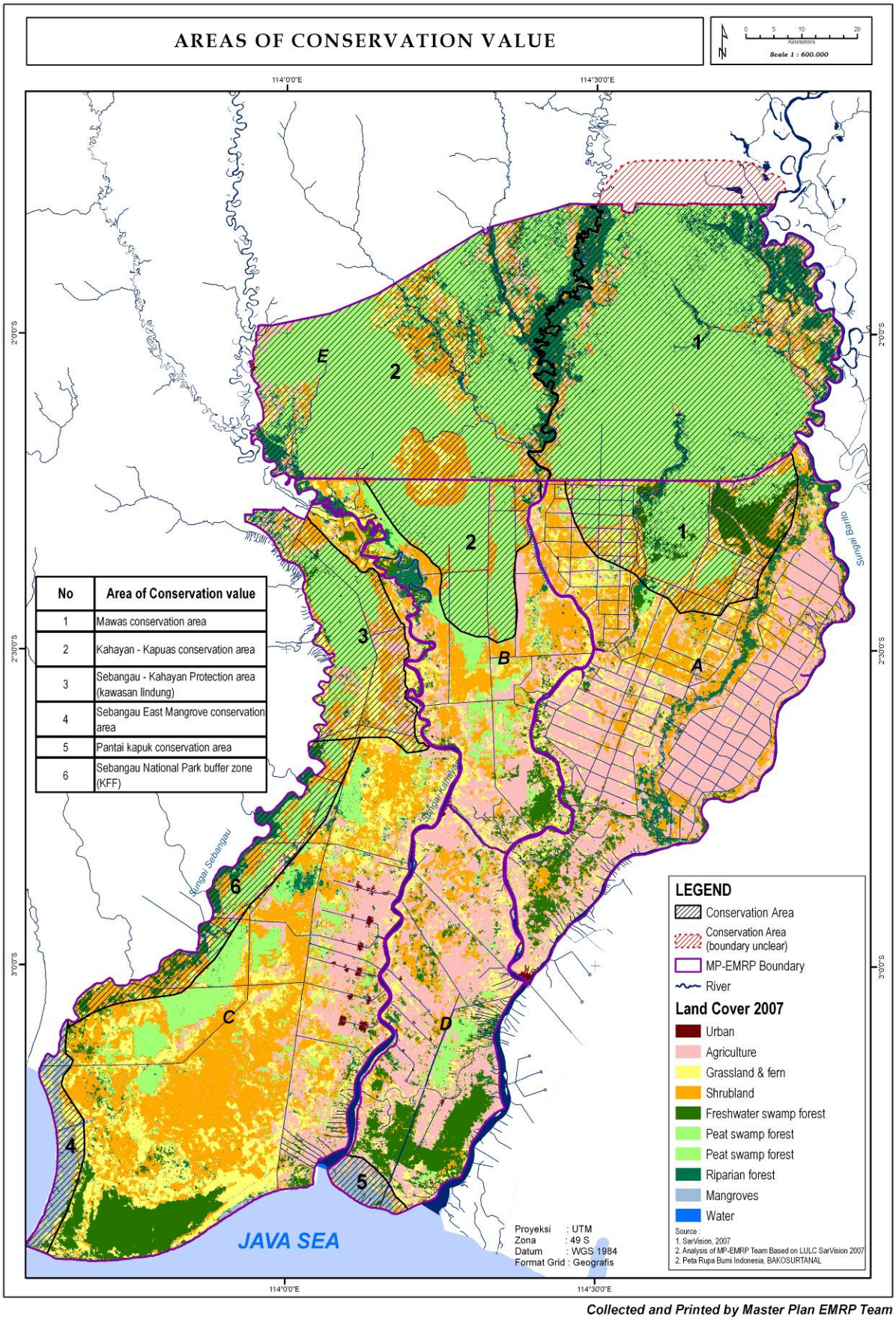
**Table 9 Proposed indicator species**

| No. | Common name | Scientific name | Main habitat in EMRP area |
|---|---|---|---|
| **Wildlife** | | | |
| 1. | Waders | Birds of the Charadriiformes, excluding sea birds such as gulls, terns, etc.., but including species such as redshank, whimbrel, greenshank, plovers, etc.. | Mangrove / mudflats |
| 2. | White-bellied sea-eagle | *Haliaeetus leucogaster* | Mangroves |
| 3. | Proboscis monkey | *Nasalis larvatus* | Mangroves & riparian forest |
| 4. | False gavial | *Tomistoma schlegelli* | Black water rivers in peat swamp forest |
| 5. | Storm's stork | *Ciconia stormi* | Peat swamp forest |
| 6. | Grey-headed fish-eagle | *Ichthyophaga ichthyaetus* | Peat swamp forest |
| 7. | Hornbills | Various species of the Bucerotidae | Peat swamp forest |
| 8. | Orangutan | *Pongo pygmaeus* | Peat swamp forest |
| 9. | Hairy nosed otter | *Lutra sumatrana* | Peat swamp forest |
| 10. | Arowana | *Scleropages formosus* | Black water rivers in peat swamp forest |
| **Plant species** | | | |
| 1. | Rhizophoraceae | Various species of the genera *Bruguiera, Ceriops, Kandelia* and *Rhizophora* | Mangroves |
| 2. | Ramin | *Gonystylus bancanus* | Peat swamp forest |
| 3. | Dipterocarps (other than kahui) | Members of the Dipterocarpaceae other than *Shorea balangeran* | Peat swamp forest |

Existing field research locations located in or adjacent the EMRP areas should be used for benchmarking in the most natural peat swamp forest remaining. The most important in terms of intensity of research and time over which monitoring has already been carried out is the CIMTROP Natural Laboratory at Sebangau NP, but the Tuanan research camp operated by BOS near Tuanan in Block E is also an important facility is this respect.

Husson *et al.* (2007b) proposed ecological monitoring of forest structure, biodiversity and ape density and behaviour rather than monitoring of key species. This avenue should also be explored and perhaps used to complement a species-oriented monitoring programme.

**Figure 2 Broad spatial plan for conservation**



# 6 Restoring biodiversity values in the EMRP area

## 6.1 Identification of key species in restoration process

### 6.1.1 Natural regeneration studies

Studies on natural regeneration of disturbed PSF in Indonesia have been limited to the EMRP area (Simbolon *et al.,* 2003), Berbak NP (Giesen, 2004; Van Eijk & Leenman, 2004) and Sebangau NP (Graham & D'Arcy, 2006). Although limited, these studies provide some insights, notably:

- Different forest types have the same regeneration barriers: reduced seed dispersal, competition, fire and soil nutrient availability.
- When good PSF is found nearby (e.g. 300m), seed dispersal is reasonable to good, and regrowth can be vigorous (Simbolon *at al.,* 2003).
- Fire history is important, and after more than one fire, diversity drops significantly (Giesen, 2004; Van Eijk & Leenman, 2004; Graham & D'Arcy, 2006). Repeated fires leads to peat loss and local changes in flooding depth and duration, and different species assemblages adapted to these conditions
- In regreening programmes, conditions of each site need to be understood so that appropriate species (-groups) are selected: blanket approaches are inappropriate. In most cases, using indigenous pioneer species appear most successful.

An IPB study of the recovery of a large area of former peat swamp forest at Kelampangan, Central Kalimantan, has produced some interesting results. A 1 ha plot of 100 by 100 metres was studied over the course of several years after the 1997 fires. Immediately after the fires it was concluded that all species had died, apart from two specimens of *jelutung Dyera lowii* that had miraculously escaped. In the first four months after the fire, very little regeneration occurred except for resprouting of *Combretocarpus rotundatus,* and it was therefore concluded that the seed bank in the peat soil had also been killed. By May 2003, i.e. 6 years after the fires, Simbolon *et al.* (2003) found that there were 1158 individual trees (with a dbh of 15 cm or more) growing in the plot. 103 tree species were identified, dominated by *Combretocarpus rotundatus, Cratoxylon arborescens, Palaquium gutta, Shorea teysmanniana* and *Syzygium ochneocarpa*. Common species (in terms of number) were: C. arborescens (256 indiv.), *S. teysmanniana* (104), *S. ochneocarpa* (50), *Horsfieldia crassifolia* (47) and *Campnosperma squamatum* (46). On the whole, the investigators were surprised by the vigorous regrowth. According to Simbolon (pers. comm., 2003), the seeds did not arrive by wind, as most are too heavy, and they were probably brought by birds and mammals, or by floodwaters. However, the latter happened only once since the IPB team began monitoring the area. One must note, however, that the plot is located only 300 metres from a patch of good peat swamp forest. Simbolon expected dbh to have recovered by 30-40 years, but full floristic recovery would take more than 100 years, and perhaps even several hundred years. In any case, this will depend on the proximity of good forest as a source of seeds.

### 6.1.2 Past and ongoing trials in Central Kalimantan

A recent review of peat swamp forest restoration and replanting attempts in Southeast Asia (Giesen, 2004) showed that until then experience in the region was very limited, and that the largest and most successful trials were outside Indonesia. Over the past few years, however, momentum has picked, especially in Central Kalimantan where under STRAPEAT, RESTORPEAT and CKPP, various PSF restoration trials have been carried out, notably by CIMTROP, and by various NGOs (Wetlands International, WWF, BOS Foundation). At the same time, the Forestry and Agriculture departments of Central Kalimantan have also been involved in replanting programmes, most notably under the Gerhan programme. These individual programmes are briefly described below.

**CIMTROP**

At the CIMTROP study area in the northern part of Block C, regreening trials have been carried out with *belangiran* (*Shorea balangeran*) and *jelutung* (*Dyera polyphylla*) in degraded swamp, along with several other species (including *gaharu, Aquilaria* sp.; cashew) on the higher dikes along the excavated canals. Local communities have in addition been provided with *jarak* (*Jatropha*) and rubber (*Hevea*). Belangiran trial plantings carried out in 2006 had a 80-90% survival rate, while those with jelutung had a 40-50% survival rate. Species tried and monitored by CIMTROP in 2006 are summarised below in Table 10. In addition to these, *gemor Alseodaphne coriacea, pulai*[9] *Alstonia spathulata, bintangur Calophyllum* sp., *kapur naga Dryobalanops* sp., *manggis hutan Garcinia* sp., *Melaleuca cajuputi* and *Syzygium* were also tried by CIMTROP under the RESTORPEAT programme (Limin, 2007), but monitoring results are not available yet. Natural regeneration in the fern-dominated heavily degraded parts of the CIMTROP study area consisted mainly of *tumih* (*Combretocarpus rotundatus*) and *gerongang* (*Cratoxylon glaucum*), with some *asam-asam* (*Ploiarium alternifolium*). (See Annex 3)

**Table 10 Results of CIMTROP restoration trials**

| No | Species | Family | Local name | Number planted | Survival rate (%) |
|---|---|---|---|---|---|
| 1 | *Dyera polyphylla* | Apocynaceae | Jelutung, Pantung | 100 | 21 |
| 2 | *Diospyros evena* | Ebenaceae | Uring pahe | 100 | 92 |
| 3 | *Gonystylus bancanus* | Thymelidaceae | Ramin | 100 | 78 |
| 4 | *Palaquium* sp. | Sapotaceae | Hangkang | 100 | 56 |
| 5 | *Shorea balangeran* | Dipterocarpaceae | Kahui | 1073 | 89 |
| 6 | *Shorea* sp. | Dipterocarpaceae | Meranti | 1290 | 37 |

Adapted from Limin (2007)

[9] There is some confusion regarding local names and Indonesia names of *Alstonia pneumatophora* and *Dyera polyphylla.* The Indonesian name for *Alstonia pneumatophora* is pulai, while that for *Dyera polyphylla* is jelutung. In Central Kalimantan, the local name for *Alstonia pneumatophora* is jelutung, while that for *Dyera polyphylla* is pantung.

**CKPP – Wetlands International**

Under CKPP, Wetlands International have planted 50 ha with 20,000 seedlings of *belangiran* (*Shorea balangeran*), *jelutung* (*Dyera polyphylla*[10]) and *kepot bajuku* (syn. Pasir-pasir; *Stemonurus secundiflora*). Planting occurred from 21-26 June 2007 in the peat dome area in the north of Block B, near Block E. The site consisted of heavily degraded peat swamp, dominated by a host of ferns: *Blechnum indicum, Gleichenia linearis, Lygodium* and *Stenochlaena palustris.* A broad swathe about 2 metres wide was cleared and the 40-50 cm tall seedlings planted. There was no further tending of the plants. A monitoring survey carried out early in October 2007 showed an average survival rate of 62%. The report does not indicate how many of each species was planted, nor what the survival rate was per species. A second study of the same three species (belangiran, jelutung & kepot bajuku/pasir-pasir) – whereby 350 seedlings of each species were planted in five plots each in the same area in May 2007 – was monitored on a monthly basis Wibisono & Gandrung, 2008). The results – depicted in Figure 3) shows that belangiran has the best survival rate, with almost 84% surviving after 8 months, while for jelutung this is considerably less favourable (55%). Pasir-pasir did not perform well at all, with less than 1% surviving after 8 months.

**CKPP – WWF**

As part of CKPP, WWF Central Kalimantan – which began its programme in the province in 2001 – has established a nursery with a capacity of 100,000 seedlings. This will be expanded to 160,000 this year, and species raised are mainly jelutung *Dyera polyphylla,* belangiran *Shorea balangeran,* hangkang *Diospyros siamang,* tutup kabali *Diospyros pseudomalabarica* and pasir-pasir *Stemonurus secundiflorus.* This year (2008) 20-25,000 will be planted along the degraded areas near the SS-1 canal, in the eastern part of the Sebangau dome. The seedlings of most species are doing well, except those of *Stemonurus,* which is susceptible to insect predation.

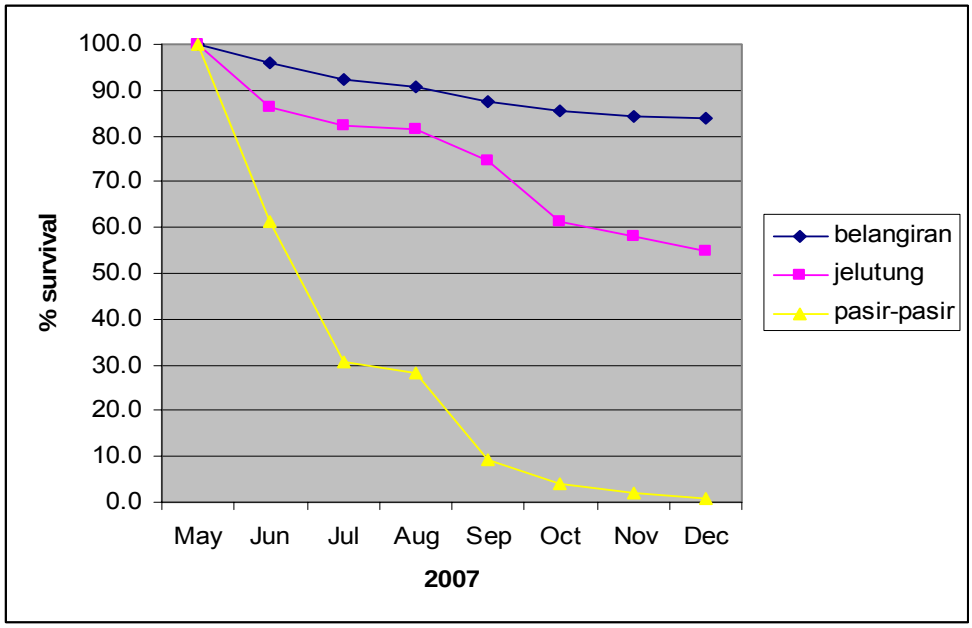



**Figure 3 Seedling survival trials Wetlands International**

- Belangiran = *Shorea balangeran;* jelutung = *Dyera polyphylla;* pasir-pasir = *Stemonurus secundiflorus*
- Data adapted from Wibisono & Gandrung (2008)

[10] Listed by Wibisono & Wardoyo (2008) as *Dyera lowii*, but this scientific name has been revised to *Dyera polyphylla.*

**CKPP – BOS Mawas**

BOS have planted 1900 ha to date, in eastern Block E and Block A. In areas near villages this has been with species that are useful for locals, such as belangiran (*Shorea balangeran*) and pantung (*Dyera polyphylla*), while further into the PSF they have planted species used by orangutan such as tutup kebali (*Diospyros*), pakan (?), rambutan hutan (*Nephelium* sp.) and manggis hutan (*Garcinia* sp.). Species were all locally sourced, and preparation consisted of clearing along a line, no other tending occurred. Planting was carried out by village groups (kelompok masyarakat). They have monitored these every 3 months, and after 6-12 months these species all reportedly have a 70-90% survival rate.

**Forestry & Agriculture departments**

The Forestry and Agriculture departments are also carrying out replanting programmes that target degraded peat swamp forest areas. One of these sites (Haparing Hurung) was visited by the consultant on 2 February 2008, near Tangkiling, just outside the EMRP area (see Annex 4), together with staff from the Balai Penyuluhan Pertanian (BPP). In this area, 500 ha had been planted in February 2006 with *Jatropha* (250 ha), rubber (125 ha) and *jelutung* (125 ha). However, neither the Forestry Department nor BPP monitor results, and after two years one may conclude that survival rates have been very low (they are now absent over much of the area they have been planted in), and growth of *jelutung* seedlings had been minimal.

**BPDAS Kahayan**

The Forestry Department's BPDAS Kahayan has developed a forest rehabilitation programme for the period 2008-2012, based on recognition of priority areas (priority class 1: 588 ha, class 2: 61,939 ha and class 3: 119,607 ha). These priority areas are recognised on the basis of land cover, management regime, erosion class, slope class, peat thickness, depth of pyrite layers, flooding and productivity. In all, 39 tree species have been identified for replanting, including for mangroves (e.g. *Avicennia, Rhizophora, Bruguiera, Excoecaria, Xylocarpus* and *Sonneratia*) and mineral soil areas (*e.g. Melaleuca cajuputi*). Some of the species listed, however, are unsuitable:

- *Dacrydium* species require shading.
- *Lagerstroemia speciosa* is a riparian species, and does not grow in swamp forest or peat swamp forest areas.
- *Dyera costulata* is a dryland species; the jelutung that occurs in peat swamp areas is *Dyera polyphylla* (formerly *D. lowii*).
- *Macaranga maingayi* probably does not occur in the area.
- *Diospyros malam* does not occur in the area, and this should probably be *Diospyros siamang, Diospyros pseudomalabarica* or *Diospyros evena.*
- *Alstonia scholaris* is a dryland species, should be *A. spathulata.*
- *Metroxylon sagu* is a notoriously difficult species to cultivate, and has resisted attempts in spite of extensive trials in Sarawak.
- *Fragraea crenulata* is a (near) coastal swamp species, occurring on mineral soils, and may be suitable for such specific areas only.

All replanting trials in the EMRP area have used only a limited number of species, often planted in single-species groups rather than in mixed assemblages. This makes replanted areas more vulnerable, for example to insect predation, and virtual monocultures will appear artificial for longer periods. Also, the replanting trials have not recognised differences (in hydrology) between areas to be replanted, and taken a similar approach in all regreening areas. Lastly, monitoring of seedling survival in regreened areas has been variable, varying from zero monitoring (Gerhan programme) to monthly monitoring (Wetlands International). Monitoring is vital, as this provides information about survival, guides species choice, and will provide lessons about planting methodologies.

### 6.1.3 Species trials in region: need for selectivity

Table 11 summarises species trials carried out in peat swamp areas in the Southeast Asian region. 17 of the 30 species listed are known to occur in Central Kalimantan, and of these 17, 10 species are known to have been successful. On the whole, however, the monitoring and evaluation of the trials rarely gives and in-depth analysis of the reason why a particular trial has failed. Sometimes it is due to insect predation (e.g. pasir-pasir/*Stemonurus secundiflorus*), while at other times prolonged flooding has lead to the demise of newly planted seedlings (e.g. attempts by Forestry Department at Berbak NP, Jambi). Although some recognise the need of shading for some species, few of the trials recognise that: i) not all peat swamp sites are equal, and ii) succession of species at a given site.

**Differences between peat swamp sites**
Natural peat swamps show differences between shallow and deep peat, and between edges and a central part of a peat dome. Degraded peat swamps that have been drained and/or burned show much greater differences. Areas that have been subjected to repeated fires, for example, have lost at least some of their peat, and depending on how much have been lost, will display flooding during the wet season.

In parts of Berbak NP in Jambi, for example, areas in the core part of the park along the Air Hitam River are subject to deep and prolonged flooding, and the only species that can survive here are *Pandanus helicopus, Thoracostachyum bancanum* and *Hanguana malayana* (Giesen, 2004; van Eijk & Leenman, 2004). Tellingly, reforestation attempts by the Forestry Department in Berbak failed as seedlings succumbed during floods, while planting trials on mounds in the same area by Wetlands International were largely successful. Based on detailed transect studies in burnt and naturally regenerating peat swamp areas, van Eijk and Leenman (2004) recognised six regeneration types, some of which were considered too difficult to attempt any reforestation (*Pandanus-Thoracostachyum*), and others being well on the way to natural recovery and not requiring replanting assistance (e.g. *Macaranga*-dominated types).

Reforestation attempts in the EMRP area should therefore map out the degraded areas into various flooding/peat depth types, and target these areas accordingly. In 6.1.3, a first attempt has been made to recognise four main types, each of which should be targeted by a different suite of species for reforestation.

**Succession of species**

On the whole, pioneer species are likely to be tolerant of open, unshaded conditions, while species characteristic for primary peat swamp forest are likely to be more shade tolerant or shade requiring. However, many replanting trials seem to ignore this principle, and it would seem that at least some of the past failures can be attributed to selection of shade requiring species for replanting trials. On the whole, it would seem best to begin replanting with (fast growing) pioneer species, and conduct enrichment planting with shade requiring species during later stages (see 6.1.3).

**Natural regeneration**

Graham and D'Arcy (2006) found at Sebangau that after the 1997 fires, the dominant tree genera were *Santiria* and *Sterculia,* while *Shorea, Dyera* and *Eugenia* also emerged. Following the second major fires in 2002 diversity dropped, and emerging tree species were low in number, with genera such as *Elaeocarpus, Syzygium* and *Ilex* becoming more dominant. Adult trees of *Combretocarpus rotundatus* (tumih) survived both fires, but saplings were low in number.

D'Arcy and Graham (2007) found in the Sebangau NP area that primary seed dispersers are important for dispersal and maintenance of tree species diversity in these peat swamp forests. However, their population densities are in decline, and especially in burnt areas are likely to play a limiting role in seed dispersal from adjacent intact areas. The implications are that if this decline continues, peat swamp forest may struggle to regenerate naturally in disturbed areas. Ongoing studies on seed dispersal by frugivorous birds at Sebangau NP indicate that, unlike in the Neotropics, seed dispersal by birds plays a less important role (pers. comm. L. Graham, 2008). However, it must be acknowledged that the forests under study (Sebangau NP) have been subjected to disturbance, and numbers of large frugivorous birds such as hornbills are low. Another factor that limits natural regeneration is the virtual absence of s viable seed stock in peat, especially after a fire has swept through an area.

**Table 11 Species used in restoration trials in Southeast Asia**

| No | Species | Family | Locations/ countries | Occurs at EMRP | Perform -ance | Refer- ence |
|---|---|---|---|---|---|---|
| 1 | *Alstonia spathulata* | Apocynaceae | Jambi | ?+ | ■ | 5 |
| 2 | *Anisoptera marginata* | Dipterocarpaceae | Malaysia | | ■ | 2 |
| 3 | *Baccaurea bracteata* | Euphorbiaceae | Thailand | + | ■ | 1 |
| 4 | *Calophyllum ferrugineum* | Guttiferae | Malaysia | | o | 2 |
| 5 | *Combretocarpus rotundatus* | Rhizophoraceae | Jambi | + | ■ | 5 |
| 6 | *Dialium patens* | Leguminosae | Thailand | + | o | 1 |
| 7 | *Diospyros evena* | Ebenaceae | Kalimantan | + | ■ | 6 |
| 8 | *Durio carinatus* | Bombaceae | Jambi, Malaysia | + | o, o | 2, 5 |
| 9 | *Dyera (lowii) polyphylla* | Apocynaceae | Jambi Kalimantan | + | ■, o, ■ | 5, 6, 7 |
| 10 | *Eugenia kunsterli* | Myrtaceae | Thailand | | ■ | 1 |
| 11 | *Ganua motleyana* (syn. *Madhuca motleyana*) | Sapotaceae | Thailand, Malaysia | + | ■, ■ | 1,2 |
| 12 | *Gluta wallichii* | Anacardiaceae | Jambi | | ■ | 5 |
| 13 | *Gonystylus bancanus* | Thymelidaceae | Jambi, Malaysia Kalimantan | + | ■, ■, ■ | 2, 5, 6 |
| 14 | *Hibiscus* sp. | Malvaceae | Riau | | ■ | 5 |
| 15 | *Litsea johorensis* | Lauraceae | Thailand | | o | 1 |
| 16 | *Macaranga hypoleuca* | Euphorbiaceae | Riau | | ■ | 5 |
| 17 | *Macaranga* sp. | Euphorbiaceae | Thailand | | ■ | 1 |
| 18 | *Melaleuca cajuputi* | Myrtaceae | Thailand, Vietnam | + | ■, ■ | 2,3 |
| 19 | *Palaquium* sp. | Sapotaceae | Jambi, Kalimantan | + | ■, ■ | 5, 6 |
| 20 | *Peronema canescens* | Verbenaceae | Kalimantan | + | o | 4 |
| 21 | *Polyalthia glauca* | Annonaceae | Thailand | | ■ | 1 |
| 22 | *Shorea balangeran* | Dipterocarpaceae | Kalimantan | + | ■, ■, ■ | 4, 6, 7 |
| 23 | *Shorea pauciflora* | Dipterocarpaceae | Jambi | | ■ | 5 |
| 24 | *Shorea pinanga* | Dipterocarpaceae | Kalimantan | + | o | 4 |
| 25 | *Shorea platycarpa* | Dipterocarpaceae | Malaysia | | ■ | 2 |
| 26 | *Shorea seminis* | Dipterocarpaceae | Kalimantan | | o | 4 |
| 27 | *Shorea* sp. | Dipterocarpaceae | Kalimantan | + | o | 6 |
| 28 | *Stemonurus secundiflorus* | Icacinaceae | Thailand, Kalimantan | + | o, o | 1, 7 |
| 29 | *Syzygium oblatum* (syn. *Eugenia oblata)* | Myrtaceae | Thailand | | ■ | 1 |
| 30 | *Tetramerista glabra* | Theaceae | Jambi | + | o | 5 |

■ = good to very good (or >50% survival) o = poor to fair (or <50% survival)

1 = Urapeepatanapong & Pitayakajornwute (1996) 2 = Ismail *et al.* (2001)

3 = Maltby *et al.* (1996) 4 = Takahashi *et al.* (2001)

5 = Giesen (2004) 6 = Limin (2007)

7 = Wibisono & Gandrung (2008)

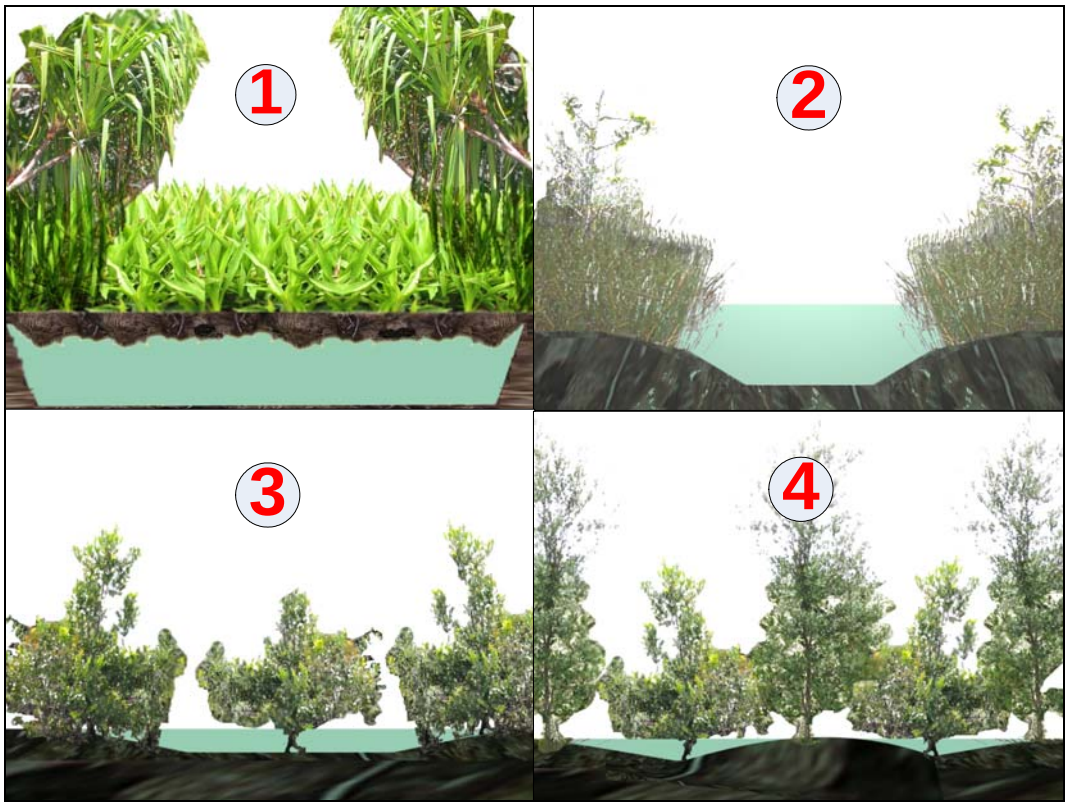
### 6.1.4 Initial species selection for EMRP area

Table 12 summarises species that have a promising potential for peat swamp restoration attempts. This recognises four different flooding regimes:

1. Deepwater areas (deeply flooded for long periods),
2. Deeply flooded areas (frequently deeply flooded areas),
3. Moderately flooded areas (regularly, shallowly flooded areas), and
4. Rarely flooded areas.

For each of these flooding types, a suite of suitable species has been recognised. At least location it is therefore important to recognise what the flooding regime is, and tailor the species to be planted accordingly. Note that the same suite can also be used for channel blocking programmes, with type 1 being equivalent to deep-sided channels, type 2 partially infilled channels, type 3 largely infilled channels, and type 4 completely infilled channels. Figure 4 illustrates how these canal green-engineering types appear.

**Figure 4 Canal regreening types**




Over time, these types will naturally evolve from one into another. Studies in peat swamp forests on Pulau Padang in Riau, Sumatra (Brady, 1997) show that deeper peat layers largely consist of *Pandanus* roots and stems, indicating that infilling of deeper waters may be an initial stage in natural peat formation in at least some areas. In deeply flooded former peat swamp forest areas in the EMRP area, a similar succession may be attempted. In type 4, once pioneer species have established a canopy, shade tolerant or requiring species can be planted as well, hastening the succession towards mixed peat swamp. A selection of these species that have been tried elsewhere are also listed in Table 12.

**Table 12 Species for green engineering**

| No | Green canal blocking | PSF restoration | Engineering species | Species | local name |
|---|---|---|---|---|---|
| 1 | Steep sided canals | PSF areas deeply flooded for long periods | ***Group-1: deep water***<br>• *Hanguana malayana*<br>• *Pandanus helicopus* | • *Hanguana malayana*<br>• *Hypolytrum nemorum*<br>• *Pandanus helicopus* | • *bakung*<br>• *?*<br>• *rasau* |
| 2 | Sloping sides of (eroded or backfilled) canals | Frequently deeply flooded PSF areas | ***Group-2: deeply flooded***<br>• *Combretocarpus rotundatus*<br>• *Lepironia articulata* | • *Combretocarpus rotundatus*<br>• *Lepironia articulata*<br>• *Mallotus borneensis*<br>• *Morinda philippensis*<br>• *Psychotria montensis*<br>• *Stenochaena palustris* | • *tumih*<br>• *purun*<br>• *perupuk*<br>• *?*<br>• *?*<br>• *Kiapak* |
| 3 | Largely infilled canals, with shallow pools | Regularly (shallowly) flooded PSF areas | ***Group-3: moderately flooded***<br>• *Cratoxylon glaucescens*<br>• *Ploiarium alternifolium*<br>• *Shorea balangeran* | • *Blechnum indicum*<br>• *Cratoxylon glaucescens*<br>• *Ploiarium alternifolium*<br>• *Shorea balangeran*<br>• *Stenochlaena palustris* | • *?*<br>• *gerongang*<br>• *asam-asam*<br>• *belangiran/kahui*<br>• *Kiapak* |
| 4 | Infilled canals | Flooding rare or absent in these PSF areas | ***Group-4: rarely flooded***<br>• *Alstonia spathulata*<br>• *Dyera polyphylla* | • *Alstonia spathulata*<br>• *Blechnum indicum*<br>• *Dyera polyphylla*<br>• *Macaranga* sp.<br>• *Stenochlaena palustris* | • *pulai*<br>• *?*<br>• *jelutung/ patung*<br>• *mahang*<br>• *Kiapak* |
| | *as above, with shade trees* | *as above, with shade trees* | ***Group-4b: rarely flooded, shade requiring*** | • *Alseodaphne coriacea**<br>• *Baccaurea bracteata*<br>• *Dialium patens **<br>• *Diospyros evena*<br>• *Durio carinatus **<br>• *Ganua motleyana*<br>• *Gonystylus bancanus*<br>• *Peronema canescens **<br>• *Shorea pinanga **<br>• *Tetramerista glabra ** | • *gemor*<br>• *rambai*<br>• *?*<br>• *uring pahe*<br>• *durian hutan*<br>• *?*<br>• *ramin*<br>• *?*<br>• *?*<br>• *punak* |

* Note: these species require testing, as they have not performed well in earlier tests, but this may be because of lack of shading.

## 6.2 Identification of sites with potential for restoration

The Land Use Land Cover (LULC) map produced for the EMRP (dated 20 June 2008) recognises three tree density classes in disturbed peat swamp areas: <11% tree/shrub cover (478,000 ha or 33% of EMRP area), 11-50% tree cover (613,000 ha or 42%), and >50% tree cover (175,000 ha or 12%). Restoration trials should focus on the first two classes only, as the third class (>50% tree cover) is likely to naturally regenerate and should under most circumstances not require any assistance, except channel closure and fire prevention (if these are an issue in this area). Full scale replanting should focus on the class <10%, while enrichment planting should focus on areas in the 10-50% cover class.

INPRES No. 2 (2007) identifies the need for restoration replanting of a total of 468,100 ha in the EMRP area. However, some of the areas recognised are regarded as unsuitable, or replanting is regarded as not required, at least in the short term. These areas are:

- Konservasi Hutan Gelam (Conservation of *Melaleuca* forest), targeting replanting of 76,300 ha of *Melaleuca cajuputi.* Replanting of gelam is misguided and unnecessary. Firstly, gelam forests are secondary forests of highly disturbed areas – these do not warrant the status 'conservation areas'. They are important for local economies and should be sustainably exploited. Secondly, gelam is a pioneer species that very rapidly colonises available habitat, and does not require any assistance in this area, other than seed trees nearby – these are readily available in the entire southern belt of Blocks C and D. Lastly, although natural regeneration occurs rapidly and successfully, attempts by Forestry Department to plant gelam in reforestation trials have largely failed (e.g. in Marabahan District, South Kalimantan).
- Konservasi Ekosistem Air Hitam (Black Water Ecosystems) targeted for replanting of 18,700 ha. These black water ecosystems are likely to be deep water ecosystems, and although replanting may be attempted in the long term (e.g. with *Pandanus helicopus* and *Hanguana malayana,* as suggested in 6.1.3), it should not be the initial focus of reforestation attempts. What is required in the short to medium term are some trials to assess the feasibility of such attempts, before venturing into large scale restoration trials. The process of natural succession may be very slow, for example, or these areas may be highly inaccessible, leading to high costs.
- Konservasi Mangrove, targeted for replanting of 27,100 ha. Replanting of mangrove vegetation in these coastal areas is regarded as unnecessary. Disturbed mangroves south of the mouth of the Sebangau River are naturally regenerating and only require protection against further disturbance, while those east of the mouth of the Kahayan (southern tip Block D) near Pantai Kiapak are in a good condition. The coastal area in between is either unsuitable for mangrove (consisting of beach swales), or have been or are being actively converted to brackish-water fishponds (tambak) by Banjarese and Buginese settlers and/or Fisheries Department. Also, the existing mangrove area (about 23,000 ha) indicates a loss of only several thousand ha of mangrove, much less than the 27,100 ha indicated in the INPRES.

## 6.3 Steps required for restoration

The following steps are required for a viable restoration programme:

1. Identification of peat swamp forest species suitable for restoration programmes (a first list has been provided in this report, but this requires further study and trials). This should include knowledge of flood tolerance, shade tolerance, and potential propagation methods. Of the 800+ species listed by Widjaya *et al.* (2007), only a very small cross-section is known and is being utilised. Also important is to know about potential economic uses, so that replanting with useful species can be prioritised, at least in areas identified for future sustainable exploitation.
2. Site selection. A preliminary site selection has occurred on the basis of tree cover (LULC map) – this needs to be combined with details on flooding depth and duration, and subsequently linked to a suitable suite of species (see 6.1.3).
3. Link to restoration of hydrology. The PSF restoration programme needs to be intimately linked with a restoration of the hydrology, which in most areas has been significantly disturbed by excavation of drainage channels that lead to desiccation (in dry season), peat subsidence (and flooding in wet season) and fires.
4. Social embedding. All restoration attempts need to be socially embedded, as without local acceptance and support it is highly likely to fail. Local communities need to agree to restoration of the hydrology (they may lose access to forest resources or transport access), but this can be off-set by intimately involving them in restoration (e.g. payment for nurseries/seedlings, involvement in actual planting and tending of seedlings), and giving them access and in some cases exploitation rights to replanted areas (e.g. areas replanted with jelutung or fruit trees).

# 7 References

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# Annex 1 Mangroves at Muara Kahayan

Itinerary: Leave KMC by vehicle together with Ingrid Gevers (int'l fisheries expert) at 06:00, meet Uras (national fisheries expert)in Palangkaraya at 06:45, drive on to Pulang Pisau (district capital) and arrive at 09:00. Meet with Dinas Perikanan & Kelautan (Marine & Fisheries Service) from 09:00-10:00. Leave for coast with fisheries boat at 10:00, arrive at mouth of the Kahayan at 11:30. Cannot enter channel leading to brackish water fishponds (*tambak*) west of the mouth of the river, as it is low tide, and have to push the boat through 300m of shallow water. Enter channel (constructed by Dinas) and head to 200 ha of locally constructed and Perikanan fishponds; stay in this area until 14:30. Lunch, then head by boat to the intact mangroves east of the mouth of the Kahayan. Follow coastline until the mouth of the channel leading to Desa Pantai Kiapak – follow this through the village until the largely intact mangroves behind the village. Follow the canal constructed linking the village to the Kahayan through the mangrove area. Leave mangroves at 16:30, refuel on the way, and arrive in Pulang Pisau at 18:30. Dinner, then on to Palangkaraya (21:15) and KMC (22:00).

Observations along way to mouth of the Kahayan: i) along road to Pulang Pisau (see photo's 1-2): sedge-fernlands (*Blechnum indica-Scleria-Lepironia articulata*) in foreground, with dead trees and secondary scrub on peat in background. ii) just south of case study area in Block-C: on west bank a plantation of *Albizia falcata* (several tens of ha?), and more towards the mouth of the Kahayan, coconut groves line the river banks. There seems to be little economic activity along much of the way: there are few boats, not much in the way of cultivation, and villages are widely scattered. Most of the banks are lined by low riparian vegetation dominated by *Barringtonia acutangula*, with *Gluta renghas* and *Cerbera odollam*, and an occasional *Pandanus helicopus.* Not far downstream (at Buntoi, about 14 km) of Pulang Pisau the first *Sonneratia caseolaris* (a true mangrove species, esp. of lower salinities and in pioneer areas) was observed, an indication that at times saline water intrusion occurs to this point. A small well-forested island (Pulau Mintin) located about 15 km downstream has been established as a reserve for proboscis monkey by the Forestry Department. Fine-meshed (mosquito) nets draped on long poles line the riparian vegetation at many points, and as fish of all sizes are caught this is deleterious to fish populations. However, at most several percent of the length of the riparian 'forest' is lined by these nets. A single line of large poles occurs at the mouth of the Kahayan in the middle of the river, apparently used for draping large nets at times (not at present). One large cargo vessel and two Buginese *pinisi* (vessel) were moored at/near the mouth of the Kahayan. Very few birds were seen along the whole length of the river from Pulang Pisau to the estuary – only one large (unidentified) bird of prey, for example – an indication that biodiversity in the area has been depleted.

Discussion with Dinas Perikanan & Kelautan: in Pulang Pisau the survey team met with Perikanan staff to discuss the itinerary, and the Dinas' activities, especially at the mouth of the Kahayan. According to Dinas, they are investing into construction of semi-intensive brackish water fishponds (*tambak*). Originally, there were 16 ha of *tambak* constructed about 10 years ago by Banjarese. Three years ago Dinas began with a programme for semi-intensive *tambak*, whereby locally constructed (large) ponds were converted to smaller ponds and a denser network of channels to allow better flushing. The total scheme aims at 600 ha of semi-intensive *tambak,* of which 200 ha have been constructed to date. When completed, the scheme would measure 2.3 by 2.8 km, with six main canals/units: Papuyu I & II, Sangiang I & II, and Pandan Sari I & II. According to Dinas, 300 families (*k.k.*) are active in the area, each with about 10 ha of extensive *tambak.* The main species stocked in the ponds are reportedly milkfish (*bandeng, Chanos chanos*) and shrimp *Penaeus monodon* (*udang windu*) and *Penaeus vanamae* (*udang manis*).

Observations in tambak area: at the mouth of the Kahayan, a small channel branches westwards into the (former) mangrove area; shortly after entering this canal recently (2005) constructed by Dinas Perikanan branches southwards – the latter route was taken. **Ponds.** At present the area consists of ponds re-constructed by Dinas Perikanan to the east, and much larger, traditional ponds to the west that are targeted for future remodelling. From discussions with fisherfolk present, most of the families are recently settled Buginese (70 k.k. in all), who have purchased the land from the Banjarese who were there previously (and according to the Buginese not very successful with their *tambak.* All the Buginese have previous experience with *tambak* in South Sulawesi, and all have arrived in the last three years, some as recently as a few months ago. There is no active programme to resettle them in the area: they have arrived because of word-of-mouth, reporting on the success of those already in the area. Apart from milkfish and prawns, they also collect mud crabs *Scylla serrata* in the remaining mangrove areas. **Vegetation.** Developed ponds have little or no vegetation, except for some *Eleocharis dulcis* in the shallows, and some herbs and shrubs along the dikes (see Table 1). Going towards the area where the ponds are still being expanded into mangrove, it is apparent the original vegetation was mainly nipah (*Nypa fruticans*) with patches of *Avicennia alba*, along with mangrove fern *Acrostichum aureum, Derris trifoliata* and *Acanthus ilicifolius.* Further west the transition from nipah vegetation to *gelam* (*Melaleuca cajuputi*) could be observed. *Gelam* is common in the Greater Sundas as a species of disturbed habitats, such as burnt (peat) swamp areas and areas with high acidity (e.g. due to acid sulphate conditions). The transition observed at Muara Kahayan may be an example of where the species occurs naturally. **Bird** life is still good, with large number (120+) of lesser whistling duck, and significant numbers of little and great egret, Javan pondheron, Brahminy kite, barn swallows and wood-swallow. Savannah nightjars were common along some of the dikes. Hunting pressures are apparently low, as birds (even the duck) venture fairly close to the fisherfolk houses that dot the main canals. Species are listed in Table 2. No gulls or terns were observed, and very few waders apart from a few common sandpiper.

Observations along mangrove belt east of the mouth of the Kahayan: eastward from the mouth of the Kahayan River a broad zone of *Sonneratia caseolaris* mangrove occurs. At some points near the actual mouth it appears narrow due to clearing by villagers of a small village located on low beach swales in the estuary. The people here are villagers, but they also cultivate parts of the swales (reportedly they grow watermelon). East of this village, the *Sonneratia caseolaris* belt is dense and about 150-300 m wide; no additional species were observed occurring alongside *S. caseolaris.* After travelling several kilometres along the coast a small river was entered that leads through the fishing village Desa Pantai Kiapak. Here the mangroves were also largely undisturbed, and the *Sonneratia* belt appeared well-developed and undisturbed. Behind the village the mixed mangrove zone starts, and the survey team continued along the river, up to the point where a canal had been constructed that connects the village with the Kahayan River (near the mouth), providing villagers with access at times of poor weather conditions. This 5-8 m wide canal was followed up to the Kahayan. Surprisingly, the mangrove vegetation on either side also appeared largely intact and there was certainly no indication of logging. At one point, rice had apparently been planted on the bund, but this was extremely marginal (3 plants wide, along 20-30 m). Most of the vegetation consisted of *Rhizophora mucronata* (near the village) and *Avicennia marina* (closer to the Kahayan), along with *Avicennia alba, Bruguiera parviflora, Sonneratia ovata* and *Xylocarpus granatum* trees, along with mangrove fern *Acrostichum* and *Acanthus ilicifolius.* Of these, *S. ovata* is a noteworthy species as it is relatively uncommon throughout its range. As it was already late the team did not stop but passed through the area by boat at a leisurely pace, hence few forest birds were observed. Noteworthy was an adult dark phased changeable hawk-eagle *Spizaetus cirrhatus*, which was almost entirely black and was observed from close range on 3 occasions. Noteworthy wildlife included two groups of proboscis monkey *Nasalis larvatus* (15-20+ individuals in all), and two groups (12-20 in all) of silvered langur *Trachypithecus (Presbytis) cristatus.*

Photo 1: The extensive ponds have a rich bird population, including lesser whistling duck

Photo 2: 600 ha of semi-intensive ponds are under construction.

Photo 3: Desa Pantai Kiapak borders on healthy mangrove vegetation on all sides.

Photo 4: Mixed mangroves behind Kiapak, dominated by *Rhizophora mucronata.*

**Table 1 Mangrove & associate species at Muara Kahayan**

| No. | Species | Family | True or Associate | Tambak or Mangrove* | Uses** |
|---|---|---|---|---|---|
| 1 | *Acanthus ilicifolis* | Acanthaceae | T | T++<br>M++ | Medicinal & fodder |
| 2 | *Acrostichum aureum* | Pteridaceae | T | T++<br>M+++ | Medicinal (leaves, roots); thatch; food (young leaves) |
| 3 | *Avicennia alba* | Avicenniaceae | T | T+<br>M+ | Fuel, medicine, food (seedlings), resin from seeds |
| 4 | *Avicennia marina* | Avicenniaceae | T | M+++ | Edible fruit, resin from bark, pulp, medicinal |
| 5 | *Phyllanthus???* | Euphorbiaceae | A | T+ | Unknown. |
| 6 | *Bruguiera parviflora* | Rhizophoraceae | T | M+ | Timber, charcoal, firwood & pulp |
| 7 | *Cayratia trifolia* | Vitaceae | A | T+<br>M+ | Common eaten by birds |
| 8 | *Cyperus malaccensis* | Cyperaceae | A | T+ | Weaving and binding |
| 9 | *Cyperus stoloniferus* | Cyperaceae | A | T+ | Stablizes dunes |
| 10 | *Derris trifoliata* | Leguminosae | A | T+<br>M+ | Fish poison (*rotenone*), rope |
| 11 | *Eleocharis dulcis* | Cyperaceae | A | T+++ | Tubers are eaten |
| 12 | *Excoecaria agallocha* | Euphorbiaceae | T | M++ | Medicinal, carvings, fish poison |
| 13 | *Flagellaria indica* | Flagellariaceae | A | T+ | Medicinal purposes |
| 14 | *Glochidion littorale* | Euphorbiaceae | A | T++ | Medicinal purposes; fruit occasionally eaten; wood for fuel and as poles |
| 15 | *Melaleuca cajuputi* | Myrtaceae | A | T++ | Poles, fuelwood, honey |
| 16 | *Nypa fruticans* | Arecaceae | T | T+++ | Thatch, fruit eaten, stems used for pond sluices |
| 17 | *Rhizophora mucronata* | Rhizophoraceae | T | M+++ | Beams, fuel, charcoal, tannin, medicinal |
| 18 | *Scirpus grossus* | Cyperaceae | A | M+ | Weaving |
| 19 | *Sonneratia caseolaris* | Sonneratiaceae | T | T+<br>M+++ | Edible fruit, useful timber |
| 20 | *Sonneratia ovata* | Sonneratiaceae | T | M+ | Fuelwood, fruit eaten as *rujak;* uncommon |
| 21 | *Stenochlaena palustris* | Blechnaceae | A | M+ | Durable rope, good in seawater; food (young leaves) |
| 22 | *Wedelia biflora* | Asteraceae | A | T++ | Many medicinal purposes |
| 23 | *Xylocarpus granatum* | Meliaceae | T | M+ | Furniture, tannin, oil from seed, medicinal |

* + = present, ++ = common, +++ = very common  * *Adapted from Giesen *et al.* (2007)

**Table 2 Bird species observed at Muara Kahayan**

| No. | Common name | Scientific name | Tambak* | Mangrove * |
|---|---|---|---|---|
| 1 | little egret | *Egretta garzetta nigripes* | 50 | |
| 2 | great egret | *Egretta alba* | 20 | |
| 3 | Javan pond-heron | *Ardeola speciosa* | 100+ | |
| 4 | striated heron | *Butorides striatus* | | 2 |
| 5 | yellow bittern | *Ixobrychus sinensis* | 2 | |
| 6 | lesser whistling duck | *Dendrocygna javanica* | 120+ | |
| 7 | black-shouldered (black-winged) kite | *Elanus caeruleus* | 2 | |
| 8 | Brahminy kite | *Haliastur indus* | 15 | |
| 9 | white-bellied sea-eagle | *Haliaeetus leucogaster* | 1 | |
| 10 | changeable hawk-eagle | *Spizaetus cirrhatus* | | 1 |
| 11 | common moorhen | *Gallinula chloropus* | 2 | |
| 12 | common sandpiper | *Tringa hypoleucos* | 5 | 4 |
| 13 | spotted dove | *Streptopelia chinensis* | | 3 |
| 14 | savanna nightjar | *Caprimulgus affinis* | 10 | |
| 15 | stork-billed kingfisher | *Pelargopsis capensis* | | 1 |
| 16 | white-throated kingfisher | *Halcyon smyrnensis* | 1 | |
| 17 | collared (mangrove) kingfisher | *Todirhamphus chloris* | 2 | 3 |
| 18 | blue-tailed bee-eater | *Merops philippinus* | 3 | |
| 19 | Pacific swallow | *Hirundo tahitica* | +++ | |
| 20 | grey wagtail | *Motacilla cinerea* | 2 | |
| 21 | white-breasted wood-swallow | *Artamus leucorhynchus* | 100+ | |

* Numbers observed.

# Annex 2 SP1 & Block E Bereng Bengkel

Itinerary: Leave KMC by vehicle together with Peter van der Meer at 06:00; arrive at Bereng Bengkel (along the Kahayan River) at 07:30, arrange a small *klotok* boat and leave at 08:00. Enter main SP-I Canal, and enter this via the bypass (located to the north of the terminal dam of the canal); travel up the SP-I up to the first main canal blocking dam constructed by CKPP, about 15 km upstream from the Kahayan River. Walk along the canal for several hundred metres, noting plant species present on the dike and in the degraded peat swamp. Start return journey at 10:30, stopping along the way to enter an open, degraded peat swamp area halfway, and to photograph and identify tree species. Return to Bereng Bengkel by 13:00, and from there back to Palangkaraya.

Nurseries in Bereng Bengkel: At least 5 houses in Bereng Bengkel have small nurseries in their front yard where tree seedlings are raised. Species include *Hevea* rubber and *jelutung* (*Dyera polyphylla*). There is some confusion about the latter, as the local name for *Dyera* is *pantung,* which is one of the species they raise, but they nevertheless call another species they also cultivate *jelutung. Dyera* fruits are collected in the wild by villagers, who either then use these in their own nurseries, or sell the fruits for Rp6000 each. Seedlings are sold to companies involved in replanting, and the price of *Dyera* is Rp1500 per seedling. Reportedly, one area that is currently being replanted with this material is located near Tangkiling. On the whole the nurseries appear fine, with young, healthy stock that is shaded and well-tended. In the past there used to be many *Dyera* trees in the PSF opposite the village, and these were tapped for latex; the current price is around Rp 6500/kg, but none is tapped in the area any more.

Observations on way to SP-I canal: On the bank opposite the village and on towards the entrance of the SP-I canal, the Kahayan River is lined with mixed riparian vegetation, dominated by a mix of typical riparian trees such as *Barringtonia acutangula, Gluta renghas, Lagerstroemia speciosa, Mallotus sumatranus, Ficus microcarpa* and *Pometia pinnata* (see Table 1). Along part of the distance, the vegetation had been cleared of large trees, and there was a vigorous regrowth of shrubs, young trees and rattan (mainly *Calamus* spp.). Along much of the river, *Hevea* rubber has been planted on the river bank behind a narrow fringe of riparian vegetation, away from the main channel. From the river, the end of the SP-I canal can be seen as consisting of a large, intact, concrete-based dam. The entrance to the SP-I canal is a small (5-8m wide), winding channel cut to the north of the SP-I, linking this with the Kahayan. The current in the channel is swift, and the *klotok* has to labour to make progress. Non-cultivated exotics include *Passiflora foetida, Mikania, Senna alata* and *Mimosa pigra*. *Mimosa pigra* was mainly observed along the Kahayan and the excavated channel (see below); this species is an invasive and noxious species, and has formed very extensive, impenetrable thickets in South Sumatra (Ogan-Komering) and South Kalimantan (Sungai Negara wetlands).

Observations along first part of the canal: Along the first part of the canal, approximately up to the TSAP station (02º 13' 42" S/114º 02' 40" E), the banks of the canal are high and consist largely of mineral soil. This has been planted with banana, *Hevea* rubber, cassava, bamboo and oil palm – presumably by local villagers, as a wide assortment of name boards bearing names of local villagers has been erected. In addition to the planted crops, riparian species such as reed *Phragmites karka, Dodonaea, Mallotus* and climbers such as *Merremia hederacea, Flagellaria indica* and *Mikania* are common, while sorrel *Polygonum barbatum* is locally common, especially in burnt patches of former swamp forest near the junction of the excavated by-pass channel and the main canal. Most of the planted species appear to be doing well, but the total area is small (the dike is narrow) and there is not much indication of economic activity (only a few small huts, no houses; no people seen).

Observations along rest of canal, up to the first channel blocking dam (02º 13' 45" S/114º 07' 23" E). In a broad swathe (500 m to about 1 km; broader. to the south) on either side of the canal the PSF has been heavily degraded and very few trees remain. Main herbaceous species observed in the degraded area are *Scleria* and *Lepironia articulata* sedges, along with the ferns *Blechnum indicum* and *Stenochlaena palustris.* Main tree species observed in the degraded PSF are *Combretocarpus rotundatus* (tumih or serapat, a Rhizophoraceae), *Eugenia* sp. (*ubah*) and *Campnosperma coriacea* (terentang). Many more species were recorded on the low dikes along the SP-I canal, which in this area consists of peat, but because flooding is less pronounced, more species seem to survive. These additional species include small trees and shrubs such as *Ploiarium alternifolium, Timonius salicifolius, Ficus* and *Melastoma malabathricum,* herbs such as *Lycopodium cernuum, Fimbrystilis dichotoma, Nephrolepis biserrata* and *Pteridium aquilinum,* and a host of climbers including three species of *Nepenthes (N. gracilis, N. mirabilis, N.* spec.*)*, *Lygodium flexuosum* and *L. microphyllum.* The forest to the north of SP-I (i.e. in Block E) appears to be in a reasonable condition: logged, but still with a reasonably closed canopy of mixed species, albeit with most large trees removed. If left undisturbed, it would probably regenerate quickly and become indistinguishable (to the lay person's eye) from normal mixed PSF within 20 years.

Illegal logging: One of the main challenges to recovery of forests in Block E is ongoing illegal logging activity (the other main challenges are drainage and fire). During the field visit five illegal logging camps (each with a sawmill) and six rafts of logs were observed. All the camps were operational, and at two sawing was ongoing, one with 6 persons attending. Beams are hauled out with a large *klotok,* which also pull out the log rafts. A variety of timber is taken out, but all logs are small (max. 35-40 cm diameter). The location of the camps are:

- 02º 13' 45" S/114º 06' 27" E: camp with sawmill + 4 small houses
- 02º 13' 43" S/114º 05' 33" E: three smaller sawmills
- 02º 13' 43" S/114º 03' 48" E: one logging camp + sawmill at mouth of small river leading north into forest

Wildlife: Wildlife in the area is impoverished – very few bird species (see Table 2) and no mammals (except for one *tupai* along the Kahayan) were observed. Most bird species are typical of open areas along streams (Pacific swallow, Brahminy kite), and disturbed areas near settlements (greater coucal, sooty-headed bulbul). Forest species are lacking. Apart from 4 Brahminy kites, an unidentified bird of prey was observed in a dead tree on the PSF edge.

Photo 1: Secondary forest along the southern edge of Block E

Photo 2: *Combretocarpus rotundatus* and the ferns *Blechnum indicum* and *Stenochlaena palustris* dominate much of the regrowing area.

Photo 3: Illegal logging camp along SP-I

Photo 4: In spite of heavy disturbance, some characteristic PSF climbers such as *Nepenthes rafflesiana* still occur in the area.

**Table 1 Plant species observed in degraded PSF at SP1**

| No. | Family | Species | Riparian | Peatland | Local name & uses |
|---|---|---|---|---|---|
| 1 | Anacardiaceae | *Campnosperma coriacea* | | + | Terentang; wood |
| 2 | | *Gluta renghas* | ++ | | Rengas; timber |
| 3 | Arecaceae | *Calamus* sp. | ++ | | Rattan |
| 4 | Asteraceae | *Mikania cordata* | + | | climber |
| 5 | Blechnaceae | *Stenochlaena palustris* | ++ | +++ | Pakis; young shoots are eaten |
| 6 | Blechnaceae | *Blechnum indicum* | | +++ | ? |
| 7 | Bombaceae | *Neesia* sp. | + | | ? |
| 8 | Caesalpiniaceae | *Senna (Cassia) alata* | + | | Pods used medicinally |
| 9 | Connaraceae | *Connarus* sp. | + | | climber |
| 10 | Convolvulaceae | *Merremia hederacea* | | + | climber |
| 11 | Cyperaceae | *Fimbrystilis dichotoma* | | ++ | ? |
| 12 | | *Lepironia articulata* | | +++ | Purun; weaving |
| 13 | | *Scleria terrestris* | | +++ | ? |
| 14 | Dilleniaceae | *Dillenia excelsa* | + | | ? |
| 15 | Euphorbiaceae | *Macaranga* sp. | ++ | + | Mahang |
| 16 | | *Mallotus sumatranus* | +++ | | Belantik |
| 17 | Flacourtiaceae | *Flacourtia rukam* | ++ | | Rukam; edible fruit |
| | Flagellariaceae | *Flagellaria indica* | + | | Binding |
| 30 | Gleicheniaceae | *Gleichenia linearis* | ++ | +++ | ? |
| 18 | Lecythidaceae | *Barringtonia acutangula* | ++ | | Putat; floats for fishing |
| 19 | Lycopodiaceae | *Lycopodium cernuum* | | +++ | ? |
| 20 | Lythraceae | *Lagerstroemia speciosa* | ++ | | Bunggur; ornamental |
| 21 | Marantaceae | *Donax canaeformis* | ++ | | Bemban; weaving |
| 22 | Melastomaceae | *Medinilla motleyi* | + | + | Kelemunting |
| 23 | | *Melastoma malabathricum* | + | ++ | Kelemunting |
| 24 | Mimosaceae | *Mimosa pigra* | ++ | | exotic noxious weed |
| 25 | Moraceae | *Artocarpus teysmannii* | + | | cempedak air |
| 26 | | *Ficus deltoidea* | + | ++ | ara |
| 27 | | *Ficus microcarpa* | ++ | | beringin |
| 28 | | *Ficus sumatranus* | + | | ara |
| 30 | Myrtaceae | *Eugenia spicata* | + | + | ? |
| 31 | | *Eugenia* sp. | | ++ | ? |
| 32 | Nepenthaceae | *Nepenthes gracilis* | | + | Kantong semar |
| 33 | | *Nepenthes mirabilis* | | + | Kantong semar |
| 34 | | *Nepenthes raffelsiana* | | | ? |
| 35 | Nephrolepidaceae | *Nephrolepis biserrata* | | + | pakis |
| 36 | Pandanaceae | *Pandanus atrocarpus* | + | | Mengkuang; weaving |
| 37 | Passifloraceae | *Passiflora foetida* | ++ | | Edible fruit |
| 38 | Poaceae | *Imperata cylindrica* | + | | Alang-alang |
| 39 | | *Phragmites karka* | +++ | | ? |

| No. | Family | Species | Riparian | Peatland | Local name & uses |
|---|---|---|---|---|---|
| 40 | Polygonaceae | *Polygonum barbatum* | ++ | | ? |
| 41 | Pteridaceae | *Pteridium aquilinum* | | +++ | Pakis |
| 42 | Rhizophoraceae | *Combretocarpus rotunidfolia* | | +++ | Merapat; fuelwood, timber |
| 43 | Rubiaceae | *Morinda philippensis* | | ++ | buah nasi |
| 44 | | *Mussaenda ?frondosa* | + | | Ornamental |
| 45 | | *Neolamarckia cadamba* | + | | ? |
| 46 | | *Timonius salicifolius* | ++ | + | ? |
| 47 | | *Uncaria sclerophylla* | ++ | ++ | Kekait |
| 48 | Sapindaceae | *Pometia pinnata* | + | | Timber |
| 49 | | *Dodonaea* sp. | + | | ? shrub |
| 50 | Schizaceae | *Lygodium flexuosum* | ++ | ++ | ? |
| 51 | | *Lygodium microphyllum* | + | + | ? |
| 52 | Theaceae | *Ploiarium alternifolium* | | ++ | ? |
| 53 | ?Urticaceae | *Trema cannabina* | + | + | ? |
| 54 | Xyridaceae | *Xyris indica* | | +++ | ? |

+ = present, ++ = common, +++ = very common

**Table 2 Bird species observed in degraded PSF at SP1**

| No. | Common name | Scientific name | Numbers |
|---|---|---|---|
| 1 | Brahminy kite | *Haliastur indus* | 4 |
| 2 | common sandpiper | *Tringa hypoleucos* | 1 |
| 3 | common kingfisher | *Alcedo atthis* | 1 |
| 4 | spotted dove | *Streptopelia chinensis* | ++ |
| 5 | greater coucal | *Centropus sinensis* | 1 |
| ?6 | Sand martin? | *Riparia riparia* | + |
| 7 | Pacific swallow | *Hirundo tahitica* | +++ |
| 8 | sooty-headed bulbul | *Pycnonotus aurigaster* | 2 |
| 9 | clamorous reed-warbler | *Acrocephalus stentoreus* | + |

# Annex 3 CIMTROP study site

**Field trip report – drafted by Peter van der Meer (Forestry expert EMRP), edited by Wim Giesen**
**Block C CIMTROP, 31 January 2008**

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Itinerary: Peter van der Meer and Wim Giesen eave KMC by vehicle at 07:15; arrive at CIMTROP fire-station (Posko TSA) along road between Palangkaraya – Jabiren Raya (at Kanal Kalampangan) at 08.30. Meet with Dr. Suwido and colleagues (Agung & Franciscus), Ahmad Jauhari also joins. Leave station at 09.00 on back of motorcycles along main canal, stop at Dam 4. Have a look at dam construction and main tree species. Continue along main canal to south canal (Kanal Kalampangan South). Stop at crossing to look at orang utans nest. Continue along south canal, stopping at student plot. Continue to Researchers Base camp, arrive 10.30. Walk towards flux tower through logged over peat swamp forest, noting down tree species. Climb tower (45 m), return back to base camp, then back to main canal, stopping on the way to look at planted Shorea seedlings. Via damaged dam 5 back to base camp (13.00), from there back to Palangkaraya.

Fire fighting station CIMTROP (Posko TSA): CIMTROP has established this station which is permanently manned. Men are trained in firefighting, using small units which can be connected to deep wells which have been established in the forest area. Wells have to be deep enough (20-30 m ??) otherwise water runs out very soon. Not clear whether system really works as the last dry season was fairy wet.

Nursery at Posko TSA: there is a small nursery at the post with seedlings of kahui (*Shorea balangeran),* jelutung (*Dyera polyphylla*) and galam (*Melaleuca cajuputi*). They also tried *Jatropha* but most seeds did not germinate. Seedlings are given to villagers who plant the seedlings along canal and at trial sites. See for more info on germination trials overview below on CIMTROP reforestation trials (section E1).

Dam 4 Kanal Kalampangan: Dam in main canal, made of galam posts. Around dam on elevated area abundant growth of tumih (*Combretocarpus rotundidfolia), gerongang (Cratoxylon glaucum)* asam asam *(Ploiarium alternifolium).*

Dam 5 Kanal Kalampangan: (sponsored by Restorpeat project) This major dam was just being completed, but unfortunately part of the dam washed away after heavy rain on January 29. Apparently dam was put in wrong place, it should have been placed on top op peat dome to capture water there.

Along main canal: planting of *Shorea balangeran* at bank at 10 m interval, survival is around 90% (after 1 year ??). See also overview of planting trials below.

Along south canal: fresh tracks of sunbear. Replanting site at west side of the track. *Shorea*, planted in 2006, 90% survival, still being measured. At the same site natural regeneration of Tumih

and Asam asam. Observe and photograph profusely flowering *Willughbeia grandiflora* (Apocynaceae climber) – this is an uncommon species, found on Borneo, and in Peninsular Malaysia and southern Thailand (Middleton, 2007).

Researchers Base Camp : Basic facilities for researchers, can stay for several weeks in house. Camp is permanently manned.

Flux tower & primary forest: Tower placed by a Japanese University, measuring eddy-fluxes (CO2 emission). 45 m tall, offering good overview of nearby primary (logged over) forest and burnt forest. Two orangutans were seen in distant (around 50 m) treetops. Forest around the tower and continuing further south has been selectively logged between 1997-2001. Ramin (*Gonystylus bancanus*), Shorea spp. and other commercial species have been logged. Remaining canopy trees around tower are mainly tumih (*Combretocarpus rotunidfolia)*, kapur naga (*Dryobalanops spp*), and punak (*Tetramerista glabra*). There is abundant regeneration of trees in the understorey, also of logged commercial species. It is estimated that it will take at least 30-40 years before the forest has recovered from logging. Recovery of commercial species should be monitored and possibly needs silvicultural treatment.

**OVERVIEW OF REFORESTATION TRIALS CIMTROP**

During our brief visit we were not able to visit all reforestation trials performed by CIMTROP. Below a brief overview is given based on draft paper/presentation (?) by Dr. Suwido Limin.

**A. KEYTROP PROJECT (Collaboration with Helsinki University)**

1. Planting in burnt area, north of Dam 02
   - Kahui (*Shorea balangeran*) 500 seedlings (2.3 ha)
2. Planting in burnt area, south of Dam 02
   - Kahui (*Shorea balangeran*) 500 seedlings (2.3 ha)
3. Planting in Forest area
   - Kahui (Shorea balangeran) 500 seedlings (2.3 ha)

NB Planting date : February 2006

**B. RESTORPEAT PROJECT (14 Partners)**

1. Planting along of Kalampangan canal and Taruna canal
   - Kahui (*Shorea balangeran*) 1200 seedlings (2 rows)
   - Gaharu (*Aquilaria* spp) 300 seedlings (2 rows)
2. Planting west of Trans Kalimantan road, behind of private l and, from Kalampangan canal to Taruna village (± 7 km)
   - Kahui (*Shorea balangeran*) 1400 seedlings (2 rows)
3. Planting of local species and cultivation crops along the transect from Kahayan river to Sabangau river (± 12 km)
   - Kahui (*Shorea balangeran*) 480 seedlings
   - Jelutung (*Dyera polyphylla*) 200 seedlings
   - Rubber unggul (*Hevea braziliensis*) 200 seedlings
   - Palm Oil 100 seedlings

NB Planting date : February and March 2006

**C. CIMTROP Plot : Collaboration with Forestry High School, south of Dam 02**

1. Planting in burnt area 2002
    - Kahui (*Shorea balangeran*) 200 seedlings (1 ha; planting Nov 2005)
2. Planting in burnt area 1997 and 2002 (species trial; planting date Mar 2005)
    - Kahui (*Shorea balangeran*) 200 seedlings
    - Ramin (*Gonystylus bancanus*) 50 seedlings
    - Uring pahe (*Diospyros evena*) 200 seedlings
    - Jambu-jambuan (*Syzygium* sp.) 100 seedlings
    - Jelutung Rawa (*Dyera polyphylla*) 50 seedlings
    - Hangkang (*Palaquium* sp.) 400 seedlings

**D. CIMTROP Plot : Collaboration with Student Dept. of Forestry of UNPAR Planting in burnt area 2002 (for student research)**

- Kahui (*Shorea balangeran*) 100 seedlings
- Ramin (*Gonystylus bancanus*) 50 seedlings
- Pulai (*Alstonia pneumatophora*) 50 seedlings

NB 0.6 ha, panted Jan 2006

**E. Seed Treatment for Seedling Preparation (Collaboration with Ehime University and Moyai NPO – Japan)**

1. Nursery:
    - Root cutting of Gemor (*Alseodaphne coriacea*) 20 seedlings
    - Punak cutting (*Tetramerista glabra*) 60 seedlings
    - Hangkang cutting (*Palaquium* spp) 60 seedlings
    - Uring pahe cutting (*Diospyros evena*) 50 seedlings
    - Bintangur cutting (*Parastemon spicatum*) 50 seedlings
    - Kapur Naga cutting (*Dryobalanops* spp.) 50 seedlings
    - Manggis Hutan cutting (*Garcinia* sp.) 30 seedlings
2. Planting in burnt 2002 between Dam 01 and 02 east of Taruna Kalampangan (NB 2 ha, Planted 14 – 15 Mar 2006):
    - Kahui (*Shorea balangeran*) 540 seedlings
    - Ramin cutting (*Gonystylus bancanus)* 650 seedlings

**F. JPTROP (Collaboration with Hokkaido University)**

Planting in burnt 1997 in Palangka Raya and Pulang Pisau border

- Kahui (Shorea balangeran) 1073 seedlings -> 950 trees
- Meranti (*Shorea* sp.) 1290 seedlings -> 476 trees
- Ramin (*Gonystylus bancanus*) 100 seedlings -> 78 trees
- Hangkang (*Palaquium* sp) 100 seedlings -> 56 trees
- Uring Pahe (*Diospyros evena*) 100 seedlings -> 92 trees
- Jelutung (*Dyera polyphylla*) 100 seedlings -> 21 trees

**G. Experiment for Reforestation ”Buying Living Tree System” (Collaboration Restorpeat , Ehime University and Moyai NPO-Jepang).**

- Kahui (*Shorea balangeran*) 469 seedlings
- Jelutung (*Dyera polyphylla*) 332 seedlings
- Galam (*Melaleuca cajuputi*) 888 seedlings

NB 4 ha, planted 29 Oct 2005

**Table: Tree Species used in reforestation trials by CIMTROP**

| No. | Family | Species | Canal Banks | Peatland | Local name & uses |
|---|---|---|---|---|---|
| | Apocynaceae | *Alstonia pneumatophora* | | + | Pulai; light construction ? |
| | | *Dyera polyphylla* | + | + | Jelutung (rawa); latex |
| | Chrysobalanaceae | *Parastemon spicatum* | + | + | Bintangur; timber |
| | Clusiaceae | *Garcinia sp.* | + | + | Manggis hutan |
| | Dipterocarpaceae | *Dryobalanops spp.* | + | + | Kapur naga; timber |
| | | *Shorea balangeran* | + | + | Kahui; timber |
| | | *Shorea spp.* | + | - | Meranti; timber |
| | Ebenaceae | *Diospyros evena* | + | + | Uring pahe; timber |
| | Euphorbiaceae | *Hevea brasiliensis* | + | - | Rubber unggul; latex, timber |
| | Lauraceae | *Alseodaphne coriacea* | ? | + | Gemor |
| | Myrtaceae | *Melaleuca cajuputi* | + | - | Galam |
| | | *Syzygium sp.* | + | + | Jambu-jambuan |
| | Sapotaceae | *Palaquium sp* | + | + | Hangkang (nyatoh ?); timber |
| | Tetramisticaceae | *Tetramerista glabra* | - | + | Punak; beams & light construction |
| | Thymelaeaceae | *Aquilaria malaccensis (?)* | + | - | Gaharu; resin |
| | | *Gonystylus bancanus* | - | + | Ramin; timber |

+ = suited for planting / - = not suited for planting

# Annex 4 Haparing Hurung

Itinerary: Leave KMC by vehicle together with Joost van de Veer at 15:45 in the direction of Palangkaraya, past km 29. Meet with Pak Mochtar Khodhori, head of the local Balai Penyuluhan Pertanian (BPP). Head for Kel. Haparing Hurung (Kec. Bukit Batu), and meet with Pak Mochtar's assistant, Ibu Nuraini. On the way, pick up a local farmer (Pak Betel) who knows his way around well in the area. Head to edge of secondary forest and charcoal kilns, on the edge of the Sebangau peat dome. Return to KMC at 18:30.

Planting organised by BPP: In February 2006, BPP organised the planting of 500 ha by local farmers for Dinas Pertanian. In all, 250 ha of jarak (*Jatropha*; at a density of 1650 plants/ha), 125 ha of rubber (*Hevea,* at a density of 400/ha) and 125 ha of jelutung (*Dyera polyphylla,* also at a density of 400/ha). BPP weren't sure from where the seedlings were sourced, and had no idea of exact location or the survival rate – this was apparently not monitored. In any case, most of the *Jatropha* had succumbed to flooding, but the rubber seemed to be doing a bit better, although the plants were still quite small (<1.2m). The jelutung was also not doing particularly well: most plants appear very small (1-1.2 m) in spite of their having been planted two years ago. Also, many appear to have disappeared altogether, and the original planting density (5m by 5m) does not appear to been present any more. Soils are peat – in the agricultural area this is 1.5-2 m thick, with a mineral soil underneath consisting of coarse white sand. The area planted with jelutung (pantung) borders on secondary (logged) over peat swamp forest.

Charcoal kilns: At the end of the road past the jelutung planting area, a small shelter had been erected to store bags of charcoal. A log rail connected this with the secondary forest, and several kuda-kuda sleds were seen lying around. The rail was followed to the edge of the forest, where several charcoal mounds were being assembled, and several more were slowly smouldering (see photo below). The camps are encroaching into the secondary forest, and all trees are felled and are being used for charcoal, including relatively large jelutung trees (diameter 35-40 cm). No persons were seen in the camp, but met on their way out as the team was heading in. All are from the local transmigration village – this is not a particularly viable one, as most of the first transmigrants moved back to Central Java, and the current ones are relatively new arrivals/locally resettled persons.

Photograph of a charcoal kiln in operation at the edge of secondary forest, Haparing Hurung.

# Annex 5 Sebangau River & mangroves

Itinerary: Leave Tangkiling by vehicle at 06:15, pick up Pak Sabarman in Palangkaraya at 07:00, and leave the harbour (pelabuhan) at Bangkirai at 07:40, together with Pak Tatang (Taman Nasional Sebangau) and Pak Abraham (WWF). Head down the Sebangau River, visit the Sebangau Fire Station and nursery area (UTM 0171400 / 9714154), channel blocking structure, and head to the mouth of the river. Visit the mangrove area to the east of the mouth up to 1km beyond UTM 079045 / 9694560, and head back to Bangkirai. Arrive back in Palangkaraya at 18:00, and from there back to Tangkiling.

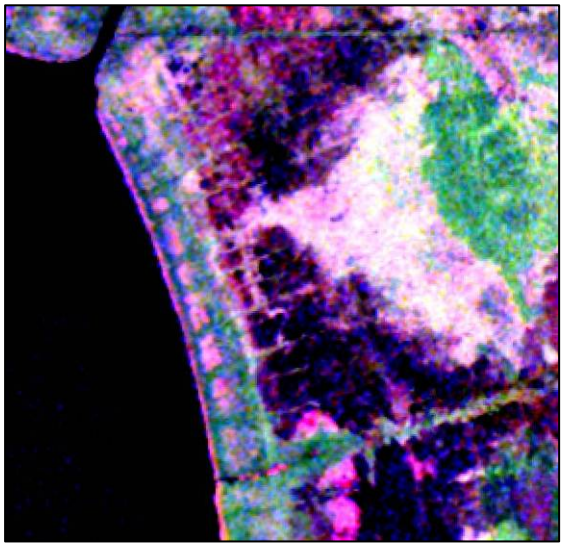
General impressions along the Sebangau River: The Sebangau River is a typical blackwater stream, lined with pandans/rasau (*Pandanus helicopus*) along most of its length. Near Bangkirai, vast areas of *Timonius* (*T. salicifolius*) and *Pternandra teysmanniana* shrubland occurs directly behind the rasau zone in areas that have been burnt and are now flooded for extensive periods. Further south (several 10s of kms) the *Timonius* gives way to large areas of kahui/belangiran (*Shorea balangeran*) – because of its thick bark this species can stand some degree of burning, and many trees show some signs of recent fires. It is often accompanied by perupuk (*Mallotus borneenis*) and *Timonius salicifolius*; typical riverine species such as *Kleinhovia hospita, Barringtonia acutangula, Gluta renghas* and *Lagerstroemia speciosa* are noticeably absent along most of the length of the river. The first isolated bakung *Hanguana malayana* plants are found far upstream (UTM 0170508 / 9707040), but large stands do not occur until much closer to the coast, at UTM 0172092 / 9701454. Close to the coast (south of UTM 0830491 / 9697490), disturbed peat swamp forest is dominated by gelam *Melaleuca cajuputi,* which tend to form large, single-species stands. Nipah *Nypa fruticans* is first found at UTM 0830668 / 9694814, while dense nipah starts at about UTM 0811767 / 9669218. Where the first nipah starts, *Hevea* rubber stands also occur along the west bank. There is little sign of agricultural activity, and areas opened for transmigration appear largely abandoned. There are numerous small fishing villages (see below), especially in former sites of logging camps and sawmills. *Cerbera odollam* occurs where nipah starts to appear, and behind the nipah zone proper there are still stands of nibung *Oncosperma tigillarium.* Sago *Metroxylon sagu* also occurs in occasional clumps along the river. According to surveys carried along the Sebangau River in 1996[11], the middle, lower course of the river has a very mixed vegetation, and included species such as *Artocarpus integer, A. teysmannii, Barringtonia acutangula* ssp. *spicata (putat)*, *Cerbera odollam, Eugenia flos-aquae (jambu air), Excoecaria indica (kebuau), Ficus microcarpa, Gardenia tubifera, Gluta renghas (rengas)* and *Lagerstroemia speciosa (bungur).* Many of these species are now uncommon, rare or absent.

[11] Giesen, W. (1996) Initial Environmental Impact Assessment, Sebangau Barat, Central Kalimantan. For the Low Land Development Project, Sebangau Barat and Barito-Negara, Kalimantan. Pre-feasibility Study. Euroconsult, for Salim Group, Jakarta, December 1996, 60 pp.

Wildlife along the Sebangau: Birdlife is limited, but includes occasional Brahminy kites *Haliastur indus,* black-shouldered kite *Elanus caeruleus*, stork-billed kingfisher *Pelargopsis capensis,* spotted dove *Streptopelia chinensis,* blue-tailed bee-eater *Merops philippinensis* and green pigeons xxx. Far fewer bird species were observed than noted by Giesen in 1996 (see footnote); current observations do not include any species typical of primary forest, such as rhinoceros hornbill *Buceros rhinoceros,* greater racket-tailed drongo *Dicrurus paradiseus* and green imperial pigeon *Ducula aenea.* Obvious is also the current scarcity of primates. During the present survey only one long-tailed macaque *Macaca fascicularis* and two lutung/silvered leaf monkey *Trachypithecus cristatus* were seen, while in 1996 Giesen observed 11 groups (84 individuals) of proboscis monkey *Nasalis larvatus* and 12 groups (112 individuals) of long-tailed macaque along the lower Sebangau alone on a one day trip.

Conservation value of zone along the Sebangau: Habitats and fauna along the Sebangau River have become severely depleted since 1996, with many of the key species being lost, displaced or having become very rare. The current biodiversity value of the zone along the river is therefore regarded as being moderate to low. There may be some opportunities for recovery, but this will take time, and there do not appear to be nearby populations from which recovery might be facilitated.

Mangroves: Nipah vegetation dominates along the Sebangau River for a large part of the lower course (see above), giving way to rambai *Sonneratia caseolaris* only in the last relatively short part of the river's course. A dense mangrove fringe lines the coast south of the mouth of the Sebangau – near the mouth it is dominated by *S. caseolaris,* but the rest is dominated by api-api *Avicennia alba,* dotted with an occasional *S. caseolaris.* This api-api fringe is at least one to several hundred metres wide, and appears to have been backed by a broad zone of mixed mangrove species. However, the latter has been felled – at two sites these were entered, and at both only a secondary regrowth of mixed mangrove was seen. A radar image of the latter area taken in 2007 (see below) shows that the area had been converted to brackish-water fishponds that have since been abandoned. The mixed mangrove that occurs includes tree species such as *Rhizophora pauciflora* and *Sonneratia ovata,* and herbs/climbers such as *Acrostichum aureum, Derris trifoliata, Acanthus ilicifolius.* The areas seen were not species rich (such as the mangroves east of the mouth of the Kahayan), although there may be more diverse pockets that were not seen during the survey.



Radar (PALsar) image (2007) of coastal rea south of the Sebangau River mouth (top-left), showing abandoned tambak that appear as box-like forms.

Birds were common, and groups of little egret *Egretta garzetta* (total 40+), great egret *Egretta alba* (5), redshank *Tringa totanus* (120), whimbrel (6) were observed, along with Brahminy kite *Haliastur indus* (3), white-bellied sea-eagle *Haliaeetus leucogaster* (1), mangrove kingfisher *Halcyon chloris* (2), stork-billed kingfisher *Pelargopsis capensis* (1), magpie robin *Copsychus saularis* (2), and striated heron *Butorides striatus* (3). Terns and grey heron seen by Giesen in 1996 were not observed.

Fish & fishing villages: Little fishing activity was directly observed along the Sebangau – only five fishermen were observed to be actively fishing. However, fishing does seem to be one of the main economic activities in the smaller villages and hamlets along the river, probably supplemented with harvesting of NTFPs and felling of timber. In all, 330 houses and fishing huts were observed in 22 hamlets, some of which are located on the former site of a sawmill or logging company. In addition there is the larger transmigrant village of Muara Pangkoh (UTM 081900 / 947000) with several dozen houses, but although fishing occurs, this primary focus is on agriculture and trade. At the Muara Pangkoh market, dried and salted sepat *Trichogaster trichogaster* and biawan *Helostoma temminckii* were sold for Rp.12,500 and Rp.20,000 per kg, respectively.

Photo 1: Dam constructed by WWF near the Sebangau NP Fire Station.

Photo 2: WWF nursery near the Sebangau NP Fire Station.

Photo 3: Typical zonation along the lower part of the Sebangau River, upstream of the nipah zone: bakung *Hanguana malayana,* backed by rasau *Pandanus helicopus* followed by belangiran *Shorea balangeran.*

Photo 4: Mangroves south-southeast of the Sebangau River mouth: dominated by *Avicennia alba* and *Sonneratia caseolaris,* but with a young, disturbed hind mangrove where formerly a mixed species mangrove occurred.

# Annex 6 Block E (Mawas) + northern Block A

Itinerary: Day-1: Leave KMC by vehicle with Peter van der Meer at 06:15; pick up Pak Sabarman and Pak Ferry in Palangkaraya at 07:00-07:15; pick up BOS Mawas staff (Yanti & Mudah) at 07:30. Drop Peter and Ferry near the Kalawa adat forest area, near Pulang Pisau. Arrive at Mandomai (along Kapuas River) at 09:30. Leave by speedboat with Frans Kaverius (BOS field officer), and arrive at Mentangai at 11:30. Visit the BOS headquarters for the Mawas area, meet other BOS staff, and have lunch. Leave for Camp Release (by klotok boat at 13:00), located along the Mentangai River; arrive at 15:00. Leave for Camp Begantan in the southern part of Block E; briefly visit the camp, stopping at the Wetlands International camp along the SS-I main canal on the way back to see the dam, nursery and replanting. Spend night at Camp Release.

Day-2: Leave Camp Release at 07:30 by klotok, following Mentangai River up to SS-I main canal; follow this double canal eastwards up to BOS's Pos Jaga Pantau (Pantau Guard post), located 3 km from Barito River end of canal. Along the way visit several channel blocking structures located on small streams used to extract logs. Double back along main canal, up to Purun River, following this south to the primary north-south canal; follow this to southern point, then head westward to the Mentangai River. Take speedboat from Mentangai town, along the Kapuas River, up to Tuanan (Pasir Putih). Spend night at Camp Tuanan field/research station.

Day 3: 06:00 enter Mawas peat swamp forest via boardwalk and other transects; locate three orangutan and follow these together with BOS field assistants and two Indonesian MSc students. Return to Camp Tuanan for lunch. Visit the community reforestation area located < 1km from Camp Tuanan. Return to Mandomai (16:00) by speedboat, and from there by vehicle to Palangkaraya (18:00) and Tangkiling (19:00).

Mentangai River: The Mentangai River is a typical blackwater stream – near the confluence with the Kapuas River at Mentangai it is about 25 metres wide, while near Camp Release at the northern end of Block A it is only 5-8 metres wide. Along much of its length the river lining vegetation is dominated by pandan *Pandanus helicopus,* along with many *Eugenia* species (including *E. spicata*), *Elaeocarpus* and *Stenochlaena palustris.* The peat swamp vegetation further from the river has been severely disturbed by past logging, in combination with fires in areas closer to the river. Illegal logging is ongoing on both east and west banks, and several rafts with small timber (diameter 20-25 cm) were observed, mainly consisting of jelutung (*Dyera polyphylla*) and terentang (*Campnosperma coriaceum*).

Peat swamp forest condition northern Block A: The PSF on the eastern side of the Mentangai River (north Block A) is generally in a reasonable condition – it has been logged by a commercial logging company (HPH), but is regenerating vigorously.. At present, however, recovery is being hampered by illegal logging and fires along the river (see above). This eastern area is where the orangutan release programme by BOS is focused. The PSF to

the west of the Mentangai River (north Block A) is in a considerably worse condition, although largely still bearing a tree cover, the density is much lower due to more rampant logging, and more frequent fires. BOS has stopped the original programme of releasing orangutan in this area and has relocated orangutan in this area to the PSF on the eastern bank.

Peat swamp forest condition southern Block E: The PSF in the Bagantung (mid south) and Tuanan (southwest) parts of Block E has been logged in the recent past by commercial logging companies (HPH). However, these have used rail systems to extract the logs instead of via channels, and the forest is regenerating vigorously in all area. These regenerating logged over forests appear to still have a well balanced mix of species, and there are currently many trees in the range 15—25 (-30) cm dbh, with a height of 15-20 (-25) metres. There are also occasional large specimens that have been left standing, e.g. because of a hollow bole. If left undisturbed by logging or fires, it is estimated that almost full recovery would be possible in another 20-30 years.

Natural recovery of heavily degraded PSF (burnt areas): All burnt areas are densely vegetated with ferns (mainly *Stenochlaena palustris;* some *Blechnum indicum* & *Pteridium aquilinum*) and sedges (*Scleria* species), along with occasional trees and shrubs (<10%). In some areas this tree/shrub cover is definitely higher and in the range of 10-50%. The main woody species that occur in regenerating burnt areas are gerongang *Cratoxylum glaucum* (+++), tumih *Combretocarpus rotundatus* (+++), terentang *Campnosperma coriaceum* (++), kahui/belangiran *Shorea belangiran* (++), and *Ficus deltoidea* (+++). Climbers are also common and include kantong semar *Nepenthes mirabilis, Morinda philippenis* and *Uncaria* species. On higher ground (e.g. dikes along canals) that has been burnt *Trema cannabina* trees can be locally very common.

Regreening/tree planting activities: Two nurseries we visited: one at the Wetlands International camp along the SS-I canal, and the other at BOS's Camp Tuanan. The WI one is well maintained and being run at full capacity, while the one at Tuanan is being phased out as this activity is being transferred to the local communities. Species under cultivation are mainly jelutung (local name = patung) and belangiran (local name = kahui). Trees seen at the Wetlands International location near the camp (mainly jelutung) were growing well, and after two years these were already 2.5-3.0 (even > 4m) tall. By comparison, trees planted two years ago by the local community at Tuanan (both belangiran and jelutung) were not doing very well; survival rates were still high (>70%?), but specimens were all <2 metres tall and some overgrown by ferns. The difference between the two sites is that the Tuanan site is drier (canal nearby with lowered water table, and there has been little/no follow-up in terms of clearing around the trees after initial planting.

Condition of channel blocking structures: It is possible to travel along the main SS-I canal from the Mentangai to the Barito, along the main primary north-south canal in Block A and along the Purun River (between main and primary canal), as channel blocking structures either have by-passes or have been breached in the middle. This is worrisome, as this means that water is not being retained in the dome areas to the extent as hoped (some structures are fully functioning, such as the one at the Wetlands International camp along the SS-I canal.

Illegal logging: At least a dozen rafts, each with 100-300 small logs (20-25 cm diameter; mainly consisting of jelutung *Dyera polyphylla* and terentang *Campnosperma coriacea*) were observed along the Mentangai River, the main SS-I canal, and along the north-south primary canal. According to BOS, 15 small, 1-metre wide channels have been excavated from the main SS-I canal into the eastern Block E (Mawas area), each channel being 2-10 km long and serving to extract logs. This only occurs when water levels are high, and generally this is during 6 months per year. The illegal loggers are reportedly also responsible for the opening of channel blocking structures (see below); most loggers reportedly come from Mentangai and Manusup, where many sawmills occur (quite a few already closed or not operating at full capacity). BOS records the number of logs being taken out of the area, which occurs along two routes: via the main canal and the Barito River, or via the Mentangai River. Recording is done by Pos Jaga Pantau (exit via Barito River) and at Camp release along the Mentangai. In January 2008, for example, 2550 logs were recorded being extracted via the Mentangai, followed by 6580 logs in February 2008. All illegal logging activities are reported by BOS to Polda (regional police) in Palangkaraya, where a partnership (mitra) has been established. Polda then conducts field activities via Polsek (at local level). In practice, however, reports on illegal logging are seldom followed up; reportedly, only 10 police interventions have been carried out over the past 5-6 years.

Fish & fishing activities: On the Mentangai River, fishing activities are very limited; there are a few houses and huts (<10 between Mentangai and the main canal) belonging to fishermen in the area, and these fishermen generally have fish cages. According to Pak Udin (who has lived on the Mentangai River as a fishermen for more than 25 years), species such as *jelawat, toman, kelabau, kerandang, arowana* and *pipih* have all become scarce or have disappeared, while species such as *patung, pepuyu, tapah, pendek, lele, seluang, jelujung, babat* and *baung* are all still common. Along the Kapuas River, cage culture was seen to be common in larger villagers between Mandomai and Tuanan.

Quartz sand extraction: This occurred at Tuanan (location Pasir Putih) until January 2008, being carried out by a Banjarmasin-based company that exported this to Surabaya for production of high quality glass for lamps. However, this reportedly occurred on village land (right behind the housing area) without permission from the village head or other community members. According to the kepala desa it has taken years to stop the activities, and the area behind the village is now pock-marked with large, stagnant ponds. These may have a fisheries potential, but given the poor nature of the soil and the fact that it border on peat, this may require lots of nutrient inputs and liming.

Photo 1: Northern Block A – eastern bank of Mentangai River, with regenerating peat swamp forest, and some fire damage between PSF and river.

Photo 2: Vigorously regenerating logged-over peat swamp forest in the Tuanan area, close to the Tuanan research camp operated by BOS.

Photo 3: Wetlands International's nursery along the SS-I main canal, near the Mentangai River.

Photo 4: Jelutung *Dyera polyphylla* planted by Wetlands International in February 2006.

Photo 5: Rafts of logs taken from peat swamp forest in northern Block A, along the Mentangai River.

Photo 6: Dam on the main SS-I canal constructed by Wetlands International (location at WI camp, near confluence with Mentangai River.

Photo 7: Breached dam on the north-south primary canal, located in the middle-northern part of Block A.

Photo 8: Sand mining area at Tuanan; note the peat swamp forest located directly behind the pond.



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