Prosiding

Ekspedisi Saintifik Biodiversiti

Hutan Paya Gambut Selangor Utara

28 November 2013

Hotel Quality, Shah Alam
SELANGOR D. E.




Seminar Ekspedisi Saintifik Biodiversiti Hutan Paya Gambut Selangor Utara 2013

Dianjurkan oleh

Jabatan Perhutanan Semenanjung Malaysia

Jabatan Perhutanan Negeri Selangor

Malaysian Nature Society

Ditaja oleh

ASEAN Peatland Forest Programme (APFP)

Dengan Kerjasama

Kementerian Sumber Asli and Alam Sekitar (NRE)

Jabatan Perlindungan Hidupan Liar dan Taman Negara (PERHILITAN) Semenanjung Malaysia

ISI KANDUNGAN

North Selangor Peat Swamp Forest

Spanning an area of around 73,392ha, the North Selangor Peat Swamp Forest (NSPSF) is the largest contiguous peat swamp forest on the West Coast of Peninsular Malaysia.

The bulk of NSPSF falls within two forest reserves, i.e. the Raja Musa Forest Reserve (23,486ha) and Sungai Karang Forest Reserve (50,106ha), both of which are managed by the Selangor Forestry Department. The outer edges of this peat swamp complex extend just beyond the boundaries of the reserves, into agriculture land (especially in the southern and eastern sections) and a Protected Area, i.e. the Sungai Dusun Wildlife Reserve, which lies to the northeast of Raja Musa Forest Reserve.

The NSPSF plays a critical ecosystem service in ensuring a continuous supply of clean water to the Tanjong Karang granary area, which is located along the Selangor coast, to the west of the peat swamp. As a tropical peat swamp forest, the NSPSF is also a significant carbon sink, crucial to storage and sequestration of atmospheric carbon and hence the regulation of the global carbon cycle.

In terms of biodiversity, the NSPSF is a unique ecosystem that harbours an assemblage of rare and endangered species. Records of its biodiversity include:

- 107 tree species, most of which are peat swamp specialists with restricted distribution.
- Rare and endangered mammals such as the Sun Bear, Clouded Leopard, Tapir, and False Gharial.
- 173 species of birds, of which 145 are breeding residents, including endangered species such as hornbills and the Short Toed Coucal.
- Over 100 species of fishes including six endemics and 50 species restricted to black-water rivers.

However, a significant portion of the NSPSF has been degraded by fire and deforestation. It is estimated that around 6,500 ha in the southern part of Raja Musa Forest Reserve has been severely degraded are a result of forest fires, and around 3,500ha ha of this area is now covered by lalang (*Imperata cylindrica*).

In recent years, the Selangor State Government through the Selangor State Forestry Department, together with other partners including the Forestry Department Peninsular Malaysia and Global Environment Centre, have taken significant steps towards rehabilitating the NSPSF.

These include efforts to block old logging canals in order to restore the water table, and to re-establish the forest canopy through replanting with pioneer tree species. The local community has also been mobilised following the establishment of the community-based organisation, Sahabat Hutan Gambut Selangor Utara (SHGSU). The local community is now deeply involved in and committed to the rehabilitation effort, with various programmes in place such as providing saplings for replanting through a buy-back system, a community fire monitoring programme, and various community-led awareness and volunteer activities.

North Selangor Peat Swamp Forest Scientific Biodiversity Expedition 2013

The North Selangor Peat Swamp Forest Scientific Biodiversity Expedition 2013 was held over a total span of four weeks in May-July 2013. The expedition was a joint collaboration between the Forestry Department Peninsular Malaysia, the Selangor State Forestry Department, and the Malaysian Nature Society under the ASEAN Peatland Forests Programme (APFP).

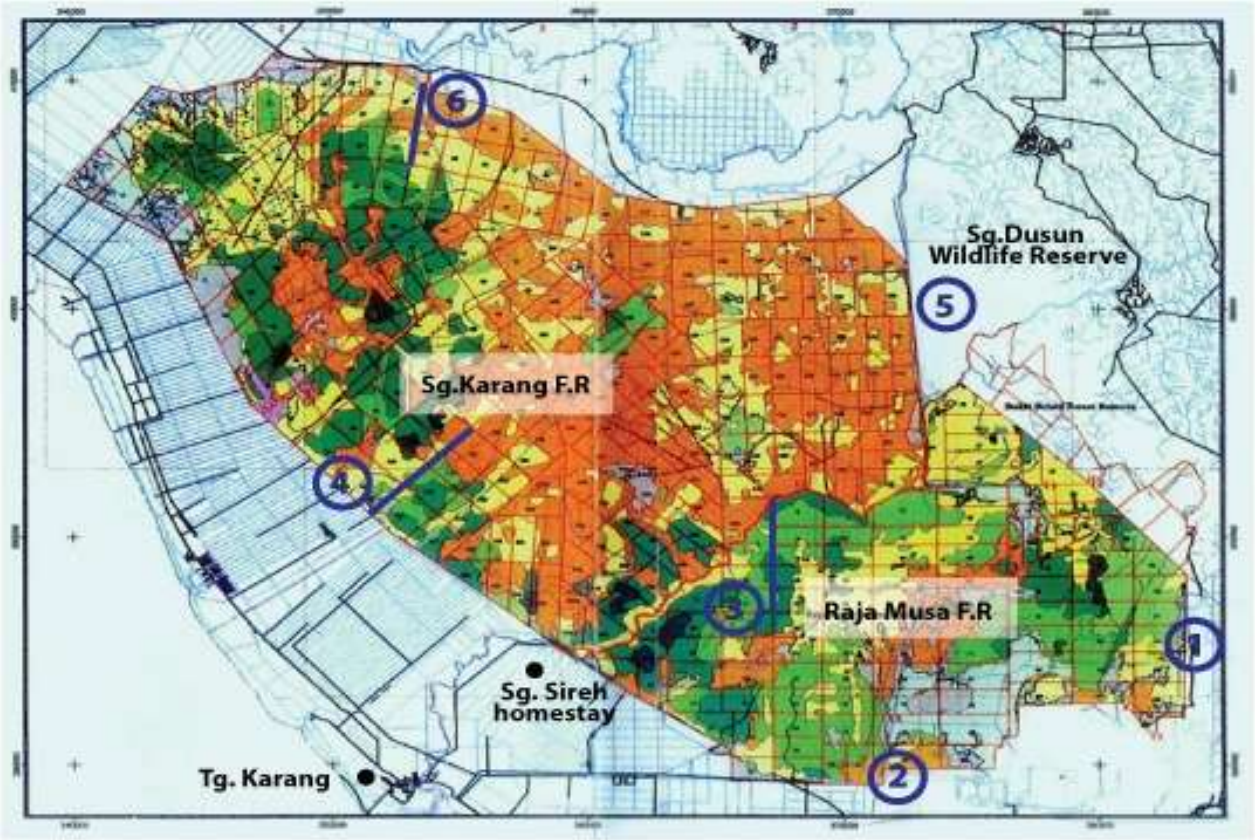
The objectives for the North Selangor Peat Swamp Forest (NSPSF) Scientific Biodiversity Expedition 2013 are:

a. To bring together Malaysia's scientists, naturalists and other interest groups to explore and conduct field research in the NSPSF, in order to develop a better understanding of the current state of biodiversity in this critical habitat;
b. To form the scientific basis that will guide the revision of the Integrated Management Plan for NSPSF and the Selangor State Action Plan for Peatlands; and
c. To increase public awareness of the unique beauty and global importance of the NSPSF, as well as the challenges faced in conserving this critical ecosystem.

The expedition was divided into two parts, each lasting two weeks. Part 1 was held on 15–25 May 2013 while Part 2 was held on 24 June – 6 July 2013. Kuala Selangor Nature Park (KSNP) was used as the base camp for most of the expedition period. The based camp was moved to Sungai Sireh Homestay for the last few days of the second phase.

A total of 25 research teams from 18 organisations, including universities, government agencies and NGOs participated in the expedition. Six trails were cut into the NSPSF by the Selangor State Forestry Department to enable the researchers to access the forest (See Map).

Map of North Selangor Peat Swamp Forest Scientific Biodiversity Expedition 2013



Legends

1. **Forest Rehabilitation**
   Highly degraded forest. Site of recent rehabilitation efforts by SFD/GEC.
2. **Forest fire area**
   400ha affected by forest fire in 2012. Mainly open grassland.
3. **Sg. Tengi trail**
   Deep into the centre of NSPSF. Access by boat along Sg. Tengi.
4. **Western trail**
   Access from across irrigation canal. Sg. dusun area
5. **Good condition peat swamp forest**
   within Sg. Dusun Wildlife Reserve.
6. **Restoran Rimba trail**
   Northwestern section of NSPSF.Adjacent to villages within Sg. Karang PRF.

Expedition Trails

ATURCARA SEMINAR

HARI 0 (Rabu, 27 Nov 2013)	
	Ketibaan semua urusetia/pembentang/peserta
1500	Pendaftaran Masuk ke Hotel Quality, Shah Alam, Selangor
Hari 1 (Khamis, 28 Nov 2013)	
0830	Pendaftaran Pembentang/Peserta
	Kedatangan Tetamu Kehormat
0900	Bacaan Doa
	Ucapan Aluan oleh Presiden *Malaysian Nature Society* (MNS)
	Ucapan Perasmian oleh YBhg. Dato' Prof. Dr. Ketua Pengarah Perhutanan Semenanjung Malaysia
	Persembahan Multimedia
0935	**Jamuan Ringan**
Sesi I: Kajian Komuniti, Fauna and Hutan Paya Gambut	
1000	Pembentang 1 : **En. Nagarajan Rengasamy (GEC)** *The Socio-Economic Survey on Importance of Peat Swamp Forest Ecosystem to Local Communities Adjacent to Raja Musa Forest Reserve*
1015	Pembentang 2 : **En. Mohd Jinis Abdullah (JPSM)** *Assessment of North Selangor Peat Swamp Forest for forest tourism*
1030	Pembentang 3 : **En. Andrew Sebastian (MNS**) *Developing a Preliminary Checklist of Birds at North Selangor Peat Swamp Forest*
1045	Pembentang 4 : **En. Mohd Faid Abdul Rahman (UPM)** *The Southern Pied Hornbill of Sg. Panjang, Sabak Bernam, Selangor*
1100	Pembentang 5 : **Dr. Noor Amal Azmai (UPM)** *Fish diversity in North Selangor Peat Swamp Forest*
1115	Pembentang 6 : **Dr. Amirrudin b. Ahmad (UMT)** *Freshwater Fishes Recorded from North Selangor Peat Swamp Forest, Selangor*
1130	Pembentang 7 : **En. Ryon Siow (DOF)** *Fish fauna assemblages and their distribution patterns in the NSPSF*
1145	Pembentang 8 : **Cik Mariani bt Ramli (UKM)** *A camera trap survey of mammals in NSPSF: Flat-Headed cat and Malayan Tapir*
1200	Pembentang 9 : **Dr. Holly Barclay (Monash Univ.)** *An assessment of peat depth & carbon content at North Selangor Peat Swamp Forest*
1215	Pembentang 10 : **Dr. Stephanie Evers (Nottingham Univ.)** *Seasonal Variation in Dissolved Organic Carbon (DOC) Concentrations within NSPSF*

1230	**Panel Perbincangan & Sesi Soaljawab Sesi I** Pengerusi: Pengarah Kanan Bahagian Pengurusan Hutan, Jabatan Perhutanan Semenanjung Malaysia
1300	**Makan Tengahari**
Sesi 2: Kajian Flora dan Serangga	
1415	Pembentang 11 **: En. Salleh bin Endot (JPT)** Tumbuhan Tinggi Dan Tumbuhan Ubatan Di Hutan Paya Gambut Selangor Utara, Selangor Darul Ehsan
1430	Pembentang 12 : **Cik Julia Lo (GEC)** *Preliminary Result on the Floristic Composition of North Selangor Peat Swamp Forest and It's Correlation to Peat Depth*
1445	Pembentang 13 : **Cik Chew Ming Yee (FRIM)** *A brief flora survey of North Selangor Peat Swamp Forest*
1500	Pembentang 14 : **Assoc. Prof. Rusea Go (UPM)** *Orchid diversity in North Selangor Peat Swamp Forest*
1515	Pembentang 15 : **Cik Nor'izzati Shaipudin (UPM)** *An Inventory of Useful Plants in North Selangor Peat Swamp Forest*
1530	**Minum Petang**
1545	Pembentang 16 : **Dr. Yong Kien Thai (UM)** *Mossess of Raja Musa Peat Swamp Forest*
1600	Pembentang 17 : **Cik Amira Peli (UPM)** *Diversity of macrofungi in North Selangor Peat Swamp Forest*
1615	Pembentang 18 : **En. Mohd Fairuzuddin Faizan Mohd Yusoff (SIRIM)** *Fungi associated with North Selangor Peat Swamp Forest*
1630	Pembentang 19 : **En. Muhammad Azman Yahya (JPSM)** Labah-labah di Hutan Paya Gambut Selangor Utara
1645	Pembentang 20 : **Dr. Chong Chee Yen (UKM)** *The Odonata of North Selangor Peat Swamp Forest*
1700	**Panel Perbincangan & Sesi Soaljawab Sesi 2** Pengerusi: Timbalan Presiden *Malaysian Nature Society* (MNS)
1730	Ucapan Penutup oleh Pengarah Perhutanan Negeri Selangor
1740	**Seminar Tamat**

KERTAS PERBENTANGAN

The Socio-Economic Survey on Importance of Peat Swamp Forest Ecosystem to Local Communities Adjacent to Raja Musa Forest Reserve

NAGARAJAN RENGASAMY[1]*, HYRUL IZWAN BIN MOHD HUSIN[1], NURHAYATI BINTI HASSAN[1], MANGSOR BIN YUSOFF[2], ASZHAR BIN ALIAS[2] & ZANIDAH BT HASIM[2]

Abstract : Raja Musa Forest Reserve is located in the north western part of the Selangor state. Raja Musa Forest Reserve and Sungai Karang Forest Reserve form the North Selangor Peat Swamp Forest, where it forms a complex that is the largest peat swamp forest in Selangor with an area of about 73.660 ha. The total area of Raja Musa Forest Reserve is approximately 23,000 ha. Recently, Raja Musa Forest Reserve receives attention and pressure from local communities and the private sector for the development of economic activities. This study is to understand the use of the resources of peat swamp forest in the vicinity of Raja Musa Forest Reserve and local community response to the socio -economic activities. This study focused on four villages near the Raja Musa Forest Reserve and is located in the district of Kuala Selangor. The villages are as follows Kampung Bestari Jaya, Kampung Raja Musa, Kampung Sri Tiram Jaya and Kampung Ampangan. Local people from four villages are using the resources of peat swamp forest in the vicinity of Raja Musa Forest Reserve for a variety of purposes , namely (a) agriculture, (b) fishing and hunting, and (c) collecting non-timber forest . Two techniques were used to collect data for the study, the interview and survey research. The conclusion of this study, a continuous awareness campaign should be given to local residents to ensure that the benefits of peat swamp forests to improve their socio-economic rehabilitation and care programs existing ecosystem.

Abstrak : Hutan Simpan Raja Musa terletak di bahagian barat laut negeri Selangor. Hutan Simpan Raja Musa dan juga Hutan Simpan Sungai Karang membentuk Hutan Paya Gambut Utara Selangor, dimana ia membentuk sebuah komplek hutan paya gambut yang terbesar di Negeri Selangor dengan keluasan sekitar 73,660 ha. Jumlah keluasan Hutan Simpan Raja Musa adalah sekitar 23,000 ha. Sejak kebelakangan ini, Hutan Simpan Raja Musa menerima tumpuan dan tekanan daripada masyarakat tempatan dan pihak swasta bagi tujuan pembangunan aktiviti ekonomi. Kajian ini bertujuan adalah untuk memahami penggunaan sumber-sumber hutan paya gambut di kawasan sekitar Hutan Simpan Raja Musa dan respon masyarakat tempatan untuk perkembangan sosio-ekonomi mereka. Kajian ini fokus kepada empat buah kampung yang berhampiran dengan Hutan Simpan Raja Musa dan terletak di Daerah Kuala Selangor. Kampung-kampung tersebut adalah seperti berikut Kampung Bestari Jaya, Kampung Raja Musa, Kampung Sri Tiram Jaya dan Kampung Ampangan. Masyarakat tempatan daripada empat buah kampung ini menggunakan sumber-sumber hutan paya gambut dari kawasan sekitar Hutan Simpan Raja Musa untuk pelbagai tujuan, iaitu (a) pertanian, (b) memancing dan memburu dan (c) mengutip hasil hutan bukan kayu. Dua teknik telah digunakan untuk mengumpul data kajian ini, iaitu temuramah dan kajian penyelidikan. Kesimpulan kajian ini, kempen kesedaran berterusan perlu diberikan kepada penduduk setempat untuk menjamin manfaat hutan paya gambut bagi meningkatkan sosio-ekonomi mereka melalui program pemuliharaan dan penjagaan ekosistem sedia ada.

[1] Global Environment Centre, 2nd Floor, Wisma Hing, 78, Jalan SS2/72, 47300 Petaling Jaya, Selangor. Phone: + 603 7957 2007 / 012-2968438 Fax: + 603 7957 7003
[2] Jabatan Perhutanan Negeri Selangor, Tingkat 3, Bangunan Sultan Salahuddin Abdul Aziz Shah, 40660, Shah Alam, Selangor
*Corresponding author: nagarajan@gec.org.my

1. INTRODUCTION OF NORTH SELANGOR PEAT SWAMP FOREST & ITS UTILIZATION

Peat swamp forest development and management has attracted much attention at both national and international levels. The location of peat swamp forest relatively near to human settlements has often resulted in its utilization and development by the state or the local villagers. The case of Raja Musa Forest Reserve (RMFR or North Selangor Peat Swamp Forest/ NSPSF) is a typical example of utilization of peat swamp forest for various purposes. Forest utilization often affects the livelihood of residents in the vicinity. While much study has focused on the natural ecosystem of NSPSF, there is a general lack of research on the socio-economic impacts of its utilization.

The Raja Musa Forest Reserve / NSPSF is an ideal study area for two reasons. First, it comprises a substantial proportion of forested area in the state of Selangor. Out of the total land area of 791,084 ha in Selangor, 241,568.30 ha are permanent forest reserve. Of the total forest area, peat swamp forest covers about 81,458.50 ha. These peat swamp forest comprises two main areas, 73,593.05 ha of the NSPSF and 7,865.47 ha of the South Selangor Peat Swamp Forest (SSPSF). The NSPSF is comprised of the Sungai Karang Forest Reserve with 50,106.60 ha and the Raja Musa Forest Reserve with 23,486.43 ha - respectively two-thirds and one thirds of NSPSF. The SSPSF comprises of the Kuala Langat North Forest Reserve with 957.63 ha and Kuala Langat South Forest Reserve with 6907.84 ha. The area of Sungai Karang Forest Reserve and Raja Musa Forest Reserve was gazetted in 1990, *(Laporan Tahunan 2009 JPNS, P- 29,).* The NSPSF comprises 90% of total peat swamp forest in Selangor and covers an area slightly bigger than Singapore. Secondly, the state of Selangor is one of the fastest growing states in Malaysia. Since the Malayan Independence (1957), the development in Selangor has involved the utilization of the NSPSF in various ways and this has affected local livelihood.

Local communities make use of resources in Raja Musa Forest Reserve for various purposes, i.e. (a) settlement, (b) agricultural cultivation, (c) fishing & hunting, and (d) harvesting of non-wood forest products (NWFP). A study is needed to provide better understanding on local uses of peat swamp forest and resulting socio-economic impacts. This study output could be used for sustainable management of peat swamp forest.

1.1 Introduction of the socio-economic study

A socio-economic survey was carried out over three months (October to December 2012) in four Sahabat Hutan Gambut Selangor Utara (SHGSU) villages located at the vicinity of RMFR. The purpose of this survey is to find out how people in the local communities surrounding Raja Musa Forest Reserve (RMFR) use the forest and how they view threats and opportunities in it.

This paper presents the results of a socio-economic survey that aims:

- To determine and document the use of natural resources and forest services by local communities
- To assess the socio-economic impact on people living around the peat swamp forests through their relationship with the forest, and
- To understand local responses and perceptions about the wise use of peat swamp forests

1.2 Historical utilization of NSPSF (including RMFR)

Minimal utilization in early twentieth century

At the turn of the century, there was little utilization of the peat swamp forest in NSPSF. Population was relatively small and most of them concentrated along the coastal areas. There was little

pressure or incentive for the state government and villagers to use the peat swamp resources. *(Based On Malaysian-DANCED Project on Sustainable Management of Peat Swamp Forest, Peninsular Malaysia.1999)*

Table 1 : Historical utilization of NSPSF

Years	**Subject**	**Details (brief notes)**
1930- 1940 (Under British administration)	Logging and land clearing for paddy cultivation began	• In the 1930s, logging began to take place • The kuda-kuda extraction method was used in combination with trail transport • The British colonial government encouraged villagers in the vicinity to clear the peat swamp forest land for paddy cultivation • By 1940, villagers have planted the cleared area with paddy
1941-1945 (During the Japanese occupation)	More peat swamp area cultivated to meet food needs	• More paddy land was opened up • under forced paddy cultivation, the paddy fields were relatively clear of weeds compared to the past • More people migrated from the nearby region and resided in the present paddy settlements
1950s (the return of the British administration)	Further development for paddy cultivation	• The government further improved the irrigation system • A large paddy area was developed by local villagers • A main canal and feeder canal were built to transport irrigated water from Sg. Bernam & Sg. Tengi to the paddy fields.
1950s	Tin mining began	• Tin mining began to take place in Raja Musa Forest Reserve. • Two tin mining leases were given to companies, namely Berjuntai Tin Dredging Bhd. (part of Malaysian Mining Corporation) & Perangsang Pasifik sdn. Bhd • Tin mining activities brought about further infrastructural development • The relatively remote peat swamp forest area was made more accessible by road. • The road encouraged land-hungry villagers to open up forest land for cultivation • vegetable farming was done by tin mine workers • the utilization of peat swamp forest for mining served an important purposes: generating income for national & local economy • Tin mining declined after the

		International Tin Crisis in 1985. Tin mines in the region began to reduce production due to increasing cost and low tin price • Perangsang Pasific Sdn. Bhd practically stopped operation, while Berjuntai Tin Dredging Bhd. continued tin mining on a smaller scale.
1960- 1990	Local settlement and faming	• Farming on the NSPSF began in the 1960s. • NSPSF is stateland status and logged many times since the 1960s • Canals were built for logging purposes • Within the NSPSF, the trees were felled, land opened, cleared, drained and subsequently planted with paddy, keladi, vegetables and oil palm by local villagers • Development of human settlements induced by farming • Cultivation of NSPSF by nearby residents
1990/1991	Gazettement into Forest Reserve	• The area of Sungai Karang Forest Reserve and Raja Musa Forest Reserve was gazetted in 1990, • The peat swamp forest was recognized as important in storing and supplying water for the Integrated Agricultural Development Project (IADP) scheme and this subsequently encouraged the Selangor state government to consider gazetting it as forest reserve • In view of forest land opening for agricultural purposes, the government examined the possibility of land conversion for crop cultivation. The forest land was found unsuitable for crop production but more appropriate for conservation. • In view of farming practised by local villagers and to discourage further forest land cultivation, the area was gazetted as forest reserve
1998	Utilization of NSPSF	• Logging and saw milling in the vicinity of NSPSF • Irrigation water for paddy field • Fishing along the river (Sg. Tengi) and canal (Main canal). Fish harvested include bujuk *(Ophicephalus lucius), Haruan (Ophicephalus striatus), toman (Ophicephalus micropeltes), belida (Notopterus notopterus), kalui*

		(Osphronemus goramy), baung (Mystus nemurus), keli (Clarias sp.) tapah (Wallago attu), Udang Galah (Macrobrachium rosenbergii), • Animal hunting at the forest fringes. An example of animal hunted is wild boar. • Harvesting of fruits, mainly asam kelubi by villagers near Raja Musa Forest Reserve • Local farming in NSPSF • Tin Mining carried out on a smaller scale • Recreational & Educational activities in the NSPSF became more important • Petronas gas line was constructed near the main canal. This gas line now serves the needs of households and industries along the west coast of Peninsular Malaysia
2002	Encroachment & Forest Fire	• Encroachment activity detected • 161 ha of RMFR area destroyed by forest fire
2004	Forest fire	• 10 ha of RMFR area destroyed by forest fire
2005	Forest fire	• 400 ha of RMFR area destroyed by forest fire
2007	Encroachment & Forest Fire	• Encroachment activity detected • 12 ha of RMFR area destroyed by forest fire
2008	Remedial/Mitigation Actions	• 630 ha of RMFR was degraded by forest fire and encroachment • illegal settlers were evicted; structures and agriculture crops were destroyed • the first RMFR community based rehabilitation programme initiated
2009	Forest Fire Forest Rehabilitation and hydrology management	• 29 ha of RMFR area destroyed by forest fire • About 25,000 saplings planted.
2010	Forest Fire Forest Rehabilitation and hydrology management	• GEC has been appointed by the Selangor State Government to facilitate engagement of private sector stakeholders in the protection and rehabilitation of the North Selangor Peat Swamp Forest initially for the period 2010-2013 through a formal Memorandum of Understanding (MOU). • ASEAN Peatland Forests Project (APFP) for *Rehabilitation and Sustainable Use of Peatland Forests in South East Asia* started this year

		• About 30,000 saplings planted at FC 99 & 100
2011	Forest Fire Forest Rehabilitation and hydrology management	• Peatswamp Rehabilitation at Raja Musa Forest Reserve through community participation from HSBC Bank Malaysia Berhad & Bridgestone Tyre Sale (Malaysia) Sdn. Bhd started this year • About 7,000 saplings planted at FC 99 & 100 (12 ha)
2012	Forest Fire Forest Rehabilitation and hydrology management	• 407 ha of RMFR area destroyed by forest fire. • About 8,500 saplings planted at FC 99 & 100 (15 ha)

1.3 Methodology

1.3.1 Techniques of Data Collection

Two techniques were used to gather primary data, namely rapid rural appraisal and survey research. The rapid rural appraisal technique enabled a quick general assessment of the existing environment and the possible impacts of forest resources utilisation on the local socio-economic livelihood. The technique involved group discussion, mapping & interviews.The rapid rural appraisal technique aided in questionnaire preparation, by which the survey research was carried out. The survey was done face to face (whereby the interviewers ask the questionnaire orally and record the respondent's answers).

Respondents were selected based on a male:female gender ratio of 70:30. This ratio was chosen because men are more involved with the peatland activities such as agricultural, fishing, hunting and many other activities.Only a minority of females who live in vicinity of RMFR work with peatland. Correlation analysis of the data was done using SPSS version 16.

1.3.2 Selection of Study Area

The survey was carried in four villages, namely Bestari Jaya, Raja Musa, Ampangan and Sri Tiram Jaya. These villages are located in the vicinity of RMFR. Surveys were carried out over three months starting from Bestari Jaya and ending at Sri Tiram.

Map 1 : Location of the four villages studied (*Source from Kuala Selangor District Office*)

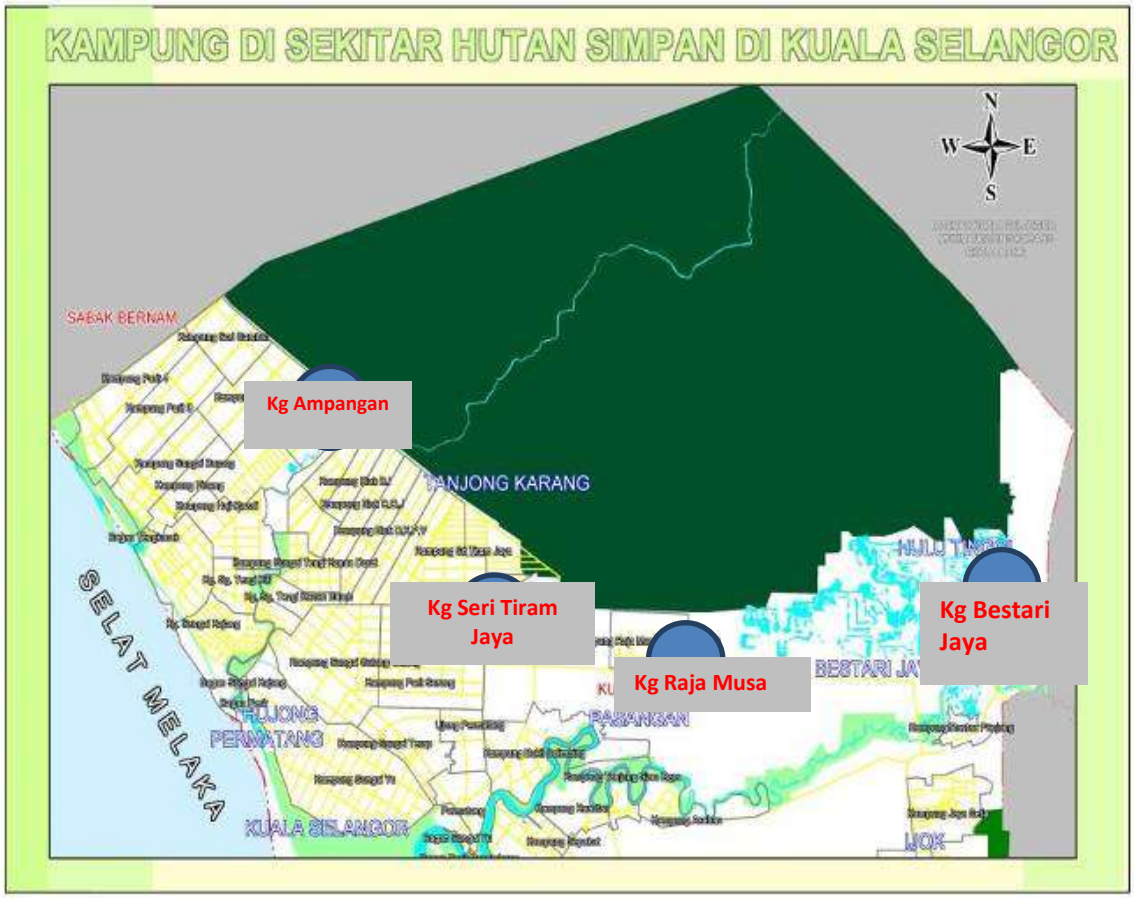


Table 2 below show the profile of the villages selected for this study, as of 2012;

i) Profile of Bestari Jaya Village

Village' name : Bestari Jaya
Mukim : Bestari Jaya
Parliament : Kuala Selangor
Dun : Ijok
Total Population : 3172 people

Table 2.1 : Age distribution of Bestari Jaya Village

No.	Age catogory	Percentage of total Population
1	Senior citizens (60 Years and Over)	25%
2	Adults (41 Yr , 59 Yr)	34%
3	Youth (15 Yr, 40 Yr)	26%
4	Children (14 and below)	15%

Table 2.2 : Economic activities of Bestari Jaya Village

No.	Economic activities	Type of economic activities
1	Services	Teachers, civil employees (Unisel), working at provide companies (Segi Niaga)
2	Business	Food stall, retail and others
3	Agricultural	Cassava, palm oil, banana and vegetables
4	Livestock	Cat fish, lobster and goat
5	Non-Timber Forest Products	Fishing, harvesting of lotus flower and others

ii) Profile of Raja Musa Village

Village' name : Raja Musa
Mukim : Pasangan
Parliament : Tanjong Karang
Dun : Permatang
Total Population : 886 people

Table 2.3 : Age distribution of Raja Musa Village

No.	Age category	Total Population (%)
1	Senior citizen(60 Years and Over)	10%
2	Adult (41 Yr, 59 Yr)	17%
3	Youth (15 Yr, 40 Yr)	43%
4	Children (14 and below)	30%

Table 2.4 : Economic activities of Raja Musa Village

No.	Economic activities	Type of economic activities
1	Agricultural	Vegetables, pineapple and yam
2	Livestock	Cattle, goat, chicken and "burung walit"
3	Services	Teachers, civil employee and others
4	Business	Food stall, retail and others
5	Non-Timber Forest Products	Fishing and others

iii) Profile of Ampangan Village

Village' name : Ampangan
Mukim : Tanjong Karang 1
Parliament : Tanjong Karang
Dun : Sungai Burong
Total Population : 1625 people

Table 2.5 : Age distribution of Ampangan Village.

No.	Age category	Total Population (%)
1	Senior citizens (60 Years and Over)	10%
2	Adults (41 Yr, 59 Yr)	40%
3	Youth (15 Yr, 40 Yr)	35%
4	Children (14 and below)	15%

Table 2.6 : Economic activities of Ampangan Village

No.	Economic activities	Type of economic activities
1	Agricultural	Paddy and coconut
2	Services	Teachers, civil employee and others
3	Business	Food stall, retail, homestay programme and others
4	Non-Timber Forest Products	Fishing, and others
5	Livestock	Cattle along the IADA bund

iv) Profile of Sri Tiram Jaya Village

Village' name : Sri Tiram Jaya
Mukim : Tanjung Karang 2
Parliament : Kuala Selangor
Dun : Permatang
Total Population : 2808 people

Table 2.7 : Age distribution of Sri Tiram Jaya Village

No.	Categories	Total Population (%)
1	Senior citizens (60 Years and Over)	10%
2	Adult (41 Yr, 59 Yr)	23%
3	Youth (15 Yr, 40 Yr)	32%
4	Children (14 and below)	35%

Table 2.8 : Economic activities of Sri Tiram Jaya Village

No.	Economic activities	Type of economic activities
1	Agricultural	Paddy and palm iol
2	Livestock	Cattle and goat
3	Services	Teachers, civil employee and others
4	Business	Food stall, retail and others
5	Non-Timber Forest Products	Fishing, and others

Table 2.9 : Other villagers interviewed inthe vicinity of the Raja Musa Forest Reserve

No.	Village
1	Ijok Village
2	Rawang Village
3	Sri Gambut Village
4	Rantau Panjang Village

2. RESULTS AND DISCUSSIONS

2.1 Section A

2.1.1 Respondents Details

a) Respondents

The research team targeted to interview 100 people from each village meaning that a total of 400 people would be interviewed in the four villages. In general, the target for three villages was achieved while Sri Tiram village was below target. Table 3 below, shows the number of respondents successfully interviewed by interviewers. The total numbers of respondents was 393 of which 250 were male and 142 were female.

Table 3 : Interviewed respondents

Gender Total	**Target respondents**	**Villages**					**Total**
		Bestari Jaya	**Raja Musa**	**Ampangan**	**Sri Tiram**	**Others**	
Male	70	73	71	51	45	11	250
Female	30	31	31	48	32	0	142
Total	100	104	102	99	77	11	393

According to table 3, Sri Tiram village was the lowest respondents compared to other villages. During the survey, majority of Sri Tiram villagers were not that cooperative for answering the questionnaire and try to linkage this survey aims to their own conflict of interest (Example conflict of interest, this survey has to support the respondents application of land title with Kuala Selangor Land and District Office for the on-going agricultural activities in the forest reserve boundaries). It was bigger challenge to the interviewers.

b) Age distribution

As shown in table 4, the majority of respondents were between 31 to 50 years old. The survey's target respondent age was 27 years old above (or farmers, private land owners, experience workers in peatlands, senior citizen & etc. within the selected villages).

Table 4 : Age differences of respondent of each village

Age Group	Village										Total
	Bestari Jaya		Raja Musa		Ampangan		Sri Tiram		Others		
	M	F	M	F	M	F	M	F	M	F	
< 20	3	1	8	3	1	0	1	2	0	0	19
21- 30	13	10	16	2	8	11	7	3	0	0	70
31 – 49	21	17	25	14	22	22	18	13	6	0	158
>50	39	2	21	12	20	15	19	14	5	0	147

c) Employment

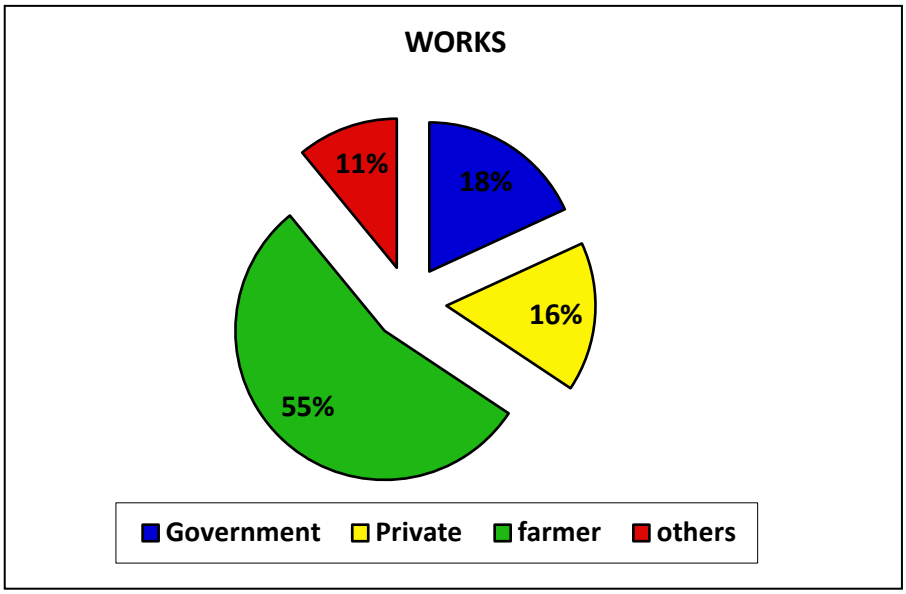
Many respondents were involved in work which is not related to the Raja Musa Forest Reserve,such as growing oil palm, and farming outside the forest reserve. Self-employment in Business and employment in the private sector were also significant sources of income.

Most respondents knew the existence of RMFR and its location. The main economic activities in these villages involves agriculture. Most respondents work on farms or palm oil plantations.

Table 5 : Employment by sector of respondents of each village

Employment sector	Village										Total
	Bestari Jaya		Raja Musa		Ampangan		Sri Tiram		Others		
	M	F	M	F	M	F	M	F	M	F	
Government	3	1	3	0	8	4	8	3	1	0	31
Private	16	10	19	4	5	4	8	3	2	0	71
Agriculture	52	18	32	26	29	36	16	24	7	0	240
Others	2	1	16	1	7	5	13	2	1	0	48
Total	73	30	70	31	49	49	45	32	11	0	390

Figure 1 : Employment sector of respondents



2.2 Section B (perception & views)

The survey also looked into the type of problems respondents perceive in relation to the peat swamp forest, and how the forest in their view could be used in the future.

a) Perception towards usefulness of peat swamp forest

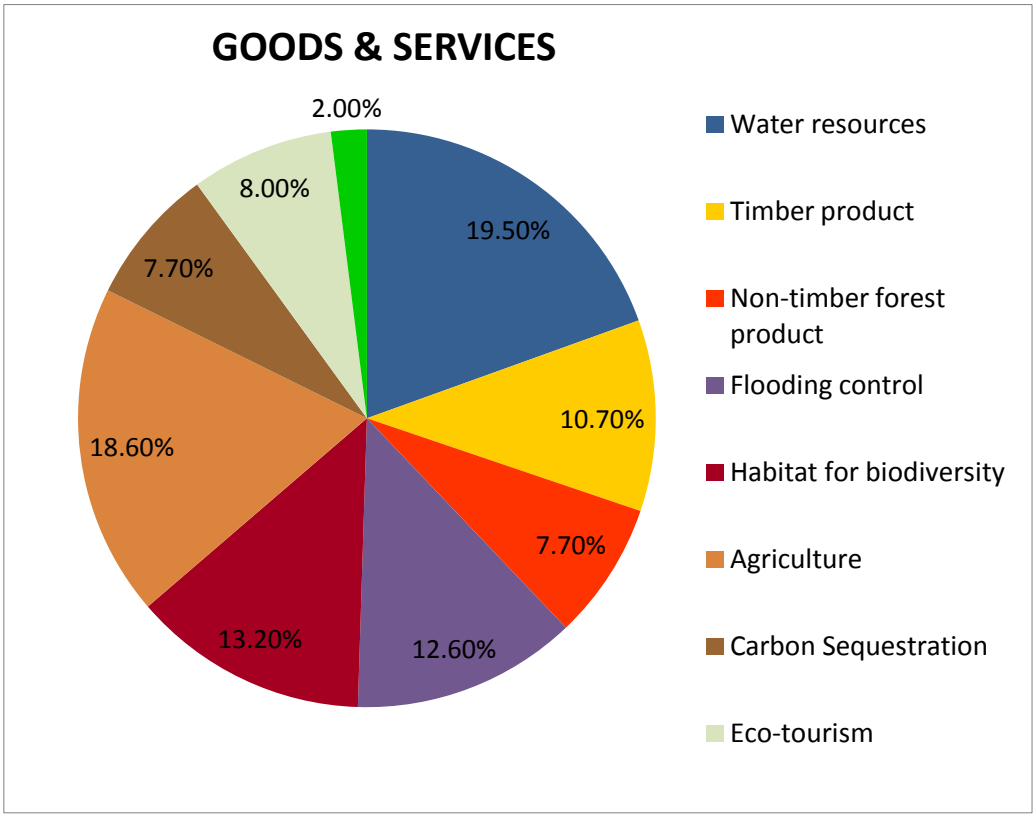
Local communities use and benefit from the peat swamp forest in different ways. Some of the uses take places inside the forest, while other activities are carried out outside the forest, using non-timber forest products from the peat swamp forest.

Respondents were asked to identify the uses and benefits of peat swamp forest.

Table 6 : Identification of uses and benefits of peat swamp forest

No.	Goods & Services	Villages										Total
		Bestari Jaya		Raja Musa		Ampangan		Sri Tiram		Others		
		M	F	M	F	M	F	M	F	M	F	
1	Water resources / Sumber air	44	14	38	23	45	44	38	29	5	0	280
2	Timbers resources / Sumber kayu balak	15	5	30	11	30	28	14	18	3	0	154
3	Non-Timber Forest Products / Produk hutan tidak berasaskan kayu	10	9	15	12	18	16	12	16	2	0	110
4	Flood control / Kawalan banjir	18	10	37	14	28	28	22	19	5	0	181
5	Biodiversity habitats / Habitat bagi kepelbagaian biologi	25	18	29	16	29	26	21	21	5	0	190
6	Agricultural area / Kawasan pertanian	54	22	41	27	31	37	26	20	9	0	267
7	Carbon Sequestration / Penyimpanan karbon	19	10	16	13	13	15	12	7	5	0	110
8	Eco-Tourism / Recreational (Kawasan pelancongan / rekreasi)	6	6	14	13	26	29	11	8	2	0	115
9	Others (peat soil, etc.)	9	2	2	1	1	4	3	4	1	0	27
	Total	200	96	222	130	221	227	159	142	37	0	1434

Figure 2 : Percentage of Goods & Services of the Raja Musa Forest Reserve (RMFR) by local communities (respondents) in the four villages



i. Water resource

According to figure 2, respondents identified water resource as the most important service provided by peat swamp forest.

The hydrological services provided by the RMFR are in the form of :

- Irrigation water to paddy and oil palm cultivation
- Domestic water supply for residential
- Flood control

The above result therefore suggests that most respondents are aware of the role of peat swamp forest in providing them with a reliable supply of water necessary for their livelihood.

ii. Habitat for biodiversity

According to respondents, peat swamp forests are found to have a high biodiversity value for both plant and animal species. Peat swamp forest also provides a habitat for several rare and endangered species, and it is in the interest of the local community that such species are not extinguished.

iii. Timber product

According to respondents, RMFR was designated production forest and available for logging in the 1990 to 2006. The forest harvesting operations have been discontinued in 2007.

iv. Non-timber forest product

According to respondents, non-timber forest products such as fish, fruit, 'Palas', rattan, and 'ulam-ulaman' were being harvested by villagers in the vicinity of RMFR. The villagers also mentioned that a fresh water fish called Tapah caught within the peat swamp forest has high market value. Some villagers also used to collect fruit and 'Palas' to sell in market. 'Palas' was used as cover for making traditional food named 'ketupat'.

Some plants of the peat swamp forest are sources of natural chemical compounds with the potential to be developed into modern medicine. But most of these compounds have not proceeded into the bio-prospecting stage. There are some respondents known to collect plants parts for use as traditional medicines or food (salad or ulam-ulam).

v. Eco-Tourism / Recreation

According to respondents, RMFR can be used to generate revenue for the local community through Eco-. RMFR is rich in many nature elements which can be a major attraction of the area. RMFR is accessed mainly by rivers and canals and as such, visitors will have to use boats as mean of transportation. Kayaking can be introduced as a recreation activity. Another major activity is that of bird watching. The area is located along the route of migratory birds and used as a stop-over for these birds. Fishing is also another major activity in the area. In addition to that, traditional houses of villagers located in the vicinity of RMFR can be used in a homestay programme which would support the local communities.

vi. Carbon Sequestration

According to respondents, large quantities of organic matter are accumulated in the peat swamp forest, and so the RMFR functions as carbon storage. Above ground, carbon is primarily stored in the tree trunks, while below ground carbon is fixated in the peat. If the peat swamp forest is converted to other uses; that entail clearing the tree crop and depleting the peat, by burning, mining or natural decomposition, this carbon will be released into the atmosphere. Hence, the global environment and the global community benefit from keeping the peat swamp forest in a condition, where the level of stored carbon is maintained *(Based on manual Malaysian-DANCED Project on Sustainable Management of Peat Swamp Forest, Peninsular Malaysia, 2000)*.

vii. Agriculture

According to respondents, peat soils are remarkably versatile in their suitability for crop growth. They have few inherent qualities which limit growth, although they require intensive and often costly improvement to natural conditions to make cropping profitable. Profitability is again largely dictated by the local economy. Peat is a good stoneless rooting medium; it has large moisture retention capacity and hence transplanted crops establish themselves much faster than on mineral soils. Cultivations are easier than on mineral soil, even under exceptionally wet conditions.

Table 7 : Goods & Services Valued at Raja Musa Forest Reserve

Types of good & services	Product / function	Types of values
Hydrological	Domestic water supply (residential & industrial uses)	Direct
	Agricultural	Effect on production
	Flood mitigation	Indirect
	Fire prevention (haze or loss forest elements)	Direct
Timber	Wood	Direct
Non-Timber Forest Products	Fish, rattan, bamboo, ornamental plants, asam kelubi, medicinal plants, etc.	Direct
Carbon Sequestration	Carbon sink	Indirect
Biodiversity habitats	Wildlife, fishes, birds, flora, etc.	Direct / Endangered

- **Direct Use values**
  These are values that accrue from the direct human use of peat swamp forest

- **Indirect use values**
  Peat swamp forest has an important role in the maintenance of ecological and environmental function. Humans do not have obtained any direct use in this capacity. But with these functions uninterrupted, various related uses and services can continuously be supplied such as regulated water flow into farmland. These benefits that accrued, as a result of the ecological and environmental functions are termed indirect use values *(Based on Malaysian-DANCED Project on Sustainable Management of Peat Swamp Forest, Peninsular Malaysia.1999).*

The major benefit and services derived from the RMFR are shown in Table 7. Of these, water resources and agricultural aspects are considered to the most important benefits derived from the RMFR. Potential of eco-tourism is large and it is fast becoming an important economic activity in North Selangor (especially in Raja Musa Forest Reserve).

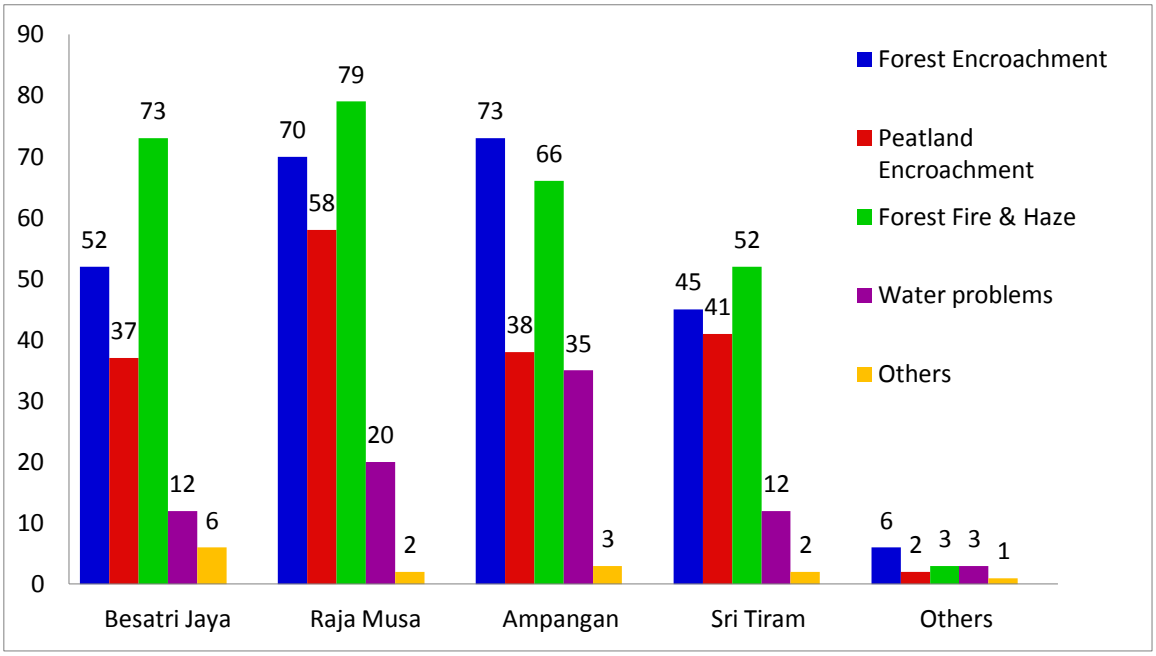
b) Problems Identified

According to observations by the respondents, the main problems facing RMFR were encroachment of forest reserve/ logging, clearing of land for agriculture, forest fire & haze and water problems

Table 8 : Problems observed at Raja Musa Forest Reserve

Problems	Village									
	Besatari Jaya		Raja Musa		Ampangan		Sri Tiram		Others	
	M	F	M	F	M	F	M	F	M	F
Encroachment of forest reserve/ logging	35	17	50	20	39	34	21	24	6	0
Clearing of land for agriculture	26	11	36	22	22	16	24	17	5	0
Forest Fire & Haze	51	22	53	26	32	34	29	23	6	0
Water problems	7	5	10	10	19	17	9	10	2	0
Others	6	0	2	0	1	2	2	1	1	0

Figure 3 : Problems observed at Raja Musa Forest Reserve



According to the respondents, the forest and state land encroachments (land clearing) are carried out at the vicinity of forest reserve. However this encroachment, causes several negative impacts to local communities and environmental services (natural benefits) including:

- Forest Fire and associated haze
- Flooding
- Water problems
- Other - Loss of environmental services (subsidence, water supply & non-timber forest product).

i. Forest Fires & Associated haze

Drainage of the peat swamp forest will lead to draining out of the peat and increased fire risk. Most of these fires were deliberately started as part of legal or illegal land development activities – primarily for oil palm. Fires were able to spread as a result of the development of drainage systems which drained out water from the forest reserves during dry season.

ii. Flooding

According to respondents, uncontrolled encroachment or land clearance partly contributed to local flooding after heavy rain downpour, especially in the months of November & December. According to the respondents, their oil palm plantations were flooded even in January and February 2013, which is normally a relatively dry period. They could not harvest the fruit because of the relatively high water level of about one metre. The trees are surviving but not growing well.

iii. Water problems

According to respondents, in recent years the rice scheme has faced some water shortage periodically. Diverting all the water from the 70,000ha PSF into the sea will necessarily reduce the water supply further and may cause severe water shortage problem to the farmers during the drought seasons – when there is insufficient flow in the Sg Bernam. Other than that, water quality

has been declining. There was high sedimentation in river channels, water treatment, recreational services, fishing and domestic water use. Unsupervised canal construction may drain water from the peat swamp forest affecting ground water level and regulation of water supply

iv. Others

According to respondents, peat swamp forest may provide sustainable timber & non –timber forest products to local communities and environmental services to other natural systems. Converting peat swamp forest into agricultural farming generally produces impacts which are as listed:

- Loss or alteration to the productivity of the peat swamp forest resources at the site such as quantitative and qualitative decline in stocking of timber and non-timber forest products. This may contribute to a decline in opportunities for future bio-prospecting.
- Loss of peat swamp forest resource in turn may affect environmental function.

2.3 Section C (Investigation on proposed future development in PFR)

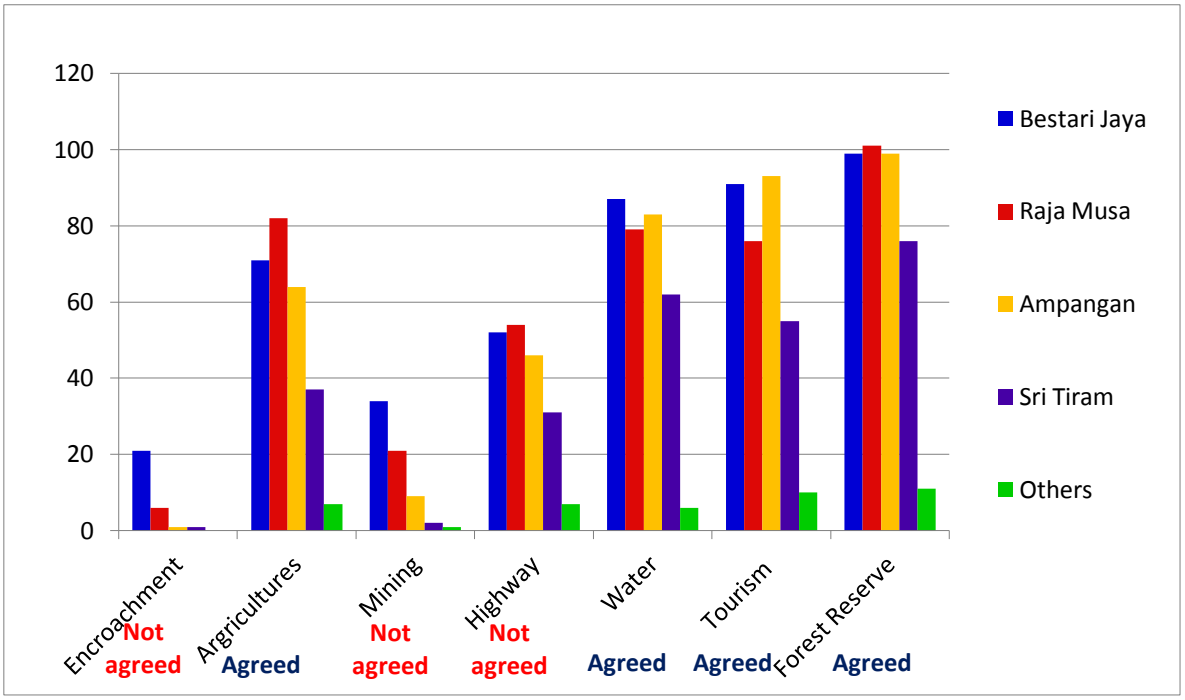
a) Investigation on proposed future development in PFR

The survey also investigated how respondents view different future uses of the peat swamp forest. The uses examined were logging/ land clearing, agricultural project, mining, highway development, water reservoir project, eco-tourism and preservation of Raja Musa Forest Reserve. The survey also looked into the type of problems respondents perceive in relation to the peat swamp forest, and how the forest in their view could be used in the future.

Table 9 : The respondents' views towards different future uses of the peat swamp forest

	VILLAGES																	
	BESTARI JAYA				RAJA MUSA				AMPANGAN				SRI TIRAM				OTHERS	
	YES		NO		YES		NO		YES		NO		YES		NO		YES	NO
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	
Encroachment	20	1	53	30	6	0	65	31	1	0	50	48	1	0	44	32	0	11
Agricultures	50	21	23	10	56	26	15	5	36	28	15	20	20	17	25	15	7	4
Mining	24	10	49	21	15	6	56	25	6	3	45	45	2	0	43	32	1	10
Highway	41	11	30	20	40	14	31	16	22	24	29	24	15	16	30	16	7	4
Water	60	27	13	4	54	25	17	6	45	38	6	10	34	28	11	4	6	5
Tourism	64	27	9	4	52	24	19	7	47	46	4	2	30	25	15	7	10	1
Forest reserved (RMFR)	68	31	5	0	70	31	1	0	51	48	0	0	44	32	1	0	11	0

Figure 4 : The respondent's views different future uses of the peat swamp forest



i. Preservation of Raja Musa Forest Reserve(RMFR/ Forest Reserve)

The respondents were asked if they would agree to totally preserve the RMFR, meaning that the forest area should be kept intact with minimum disturbance. Two-thirds of the respondents agreed to this. The main reasons for agreeing were to ensure adequate supply of irrigation for rice scheme project and to continue existing oil palm cultivation and farming activities.

ii. Eco-tourism

Kuala Selangor is famous for eco-tourism destination. The respondents were asked if development of eco-tourism should be promoted in the RMFR. Two –thirds of the respondents responded positively, mainly because they expect eco-tourism to boost local employment and income.

iii. Water reservoir project

RMFR is adjacent to the Tanjung Karang irrigation project. The peat swamp forest already functions as a buffer for the water supply for this scheme, and it was recognised that to sustain this function, encroachment in RMFR had to stop. The yield in the paddy fields under the irrigation scheme is significantly higher than that is achievable without irrigation. Paddy is cultivated 5 times per 2 years and harvests of more than 5 tonnes per ha is common *(Based on manual Malaysian-DANCED Project on Sustainable Management of Peat Swamp Forest, Peninsular Malaysia, 2000)*.

iv. Highway development

The respondents were asked if highway development should be allowed in the vicinity of forest reserve. The majority of the respondents were disagreed with the idea of highway development. They expected it to cause major environmental impacts.

v. Mining

The respondents were asked if mining should be allowed in the forest reserve. Two-thirds of the respondents disagreed with allowing mining. The opposition was greatest among farmers, again because of their interest in protecting the forest as a source of irrigation water.

vi. Agricultural development

The respondents were asked if they agree to use of RMFR for agricultural production. 60% of all the respondents agreed to this. However, most paddy farmers disagreed because they expected that further conversions of the peat swamp forest would worsen the shortage of irrigation water.

vii. Logging/ land clearing

The respondents were asked if they agree to use of RMFR for logging/ land clearing. 85% of all the respondents disagreed as they expected that further conversions of the peat swamp forest would worsen the forest fire and shortage of irrigation water.

2.4 Section D (Respondents option in General)

a) Best Management Practices/ BMPs

Best management practices (BMPs) is a basic guide for the sustainable use of peatland soils for vegetable production while at the same time reducing the environmental impacts especially GHG emissions and subsidence (Lim *et. al*. 2012).

This guide examines:

I. the selection and development of peat bogs for vegetable production;
II. the maintenance of drainage systems after development;
III. the management practices used in vegetable production on peat soils, including the management of water, soil, crops, fertility, and pests; and
IV. the conservation practices available to peatland vegetable producers to ensure agronomic, economic and environmental sustainability.

Most of the respondents were having problems with their agricultural practices. They also were looking for some training for optimizing sustainably the oil palm yield. Interviewers have explained to them the Best Management Practices (BMP). The respondents requested to organise BMP training workshops under the project.

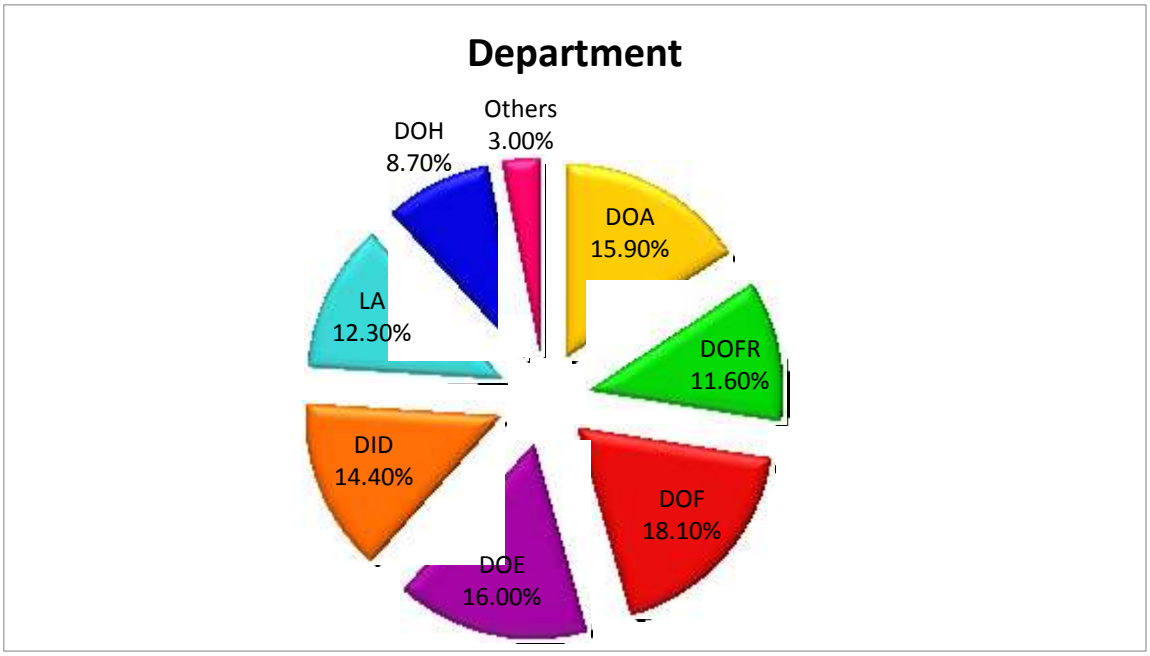
b) Multi sectorial participation and co-operation

Respondents were asked to select the government agencies that they felt were should be responsible for handling the issues and problems of RMFR. The results are shown in table 10.

Table 10 : The list of Government Departments of importance for protection of the RMFR

Department	Village									
	Besatari Jaya		Raja Musa		Ampangan		Sri Tiram		Others	
	M	F	M	F	M	F	M	F	M	F
DOA	59	25	51	19	48	44	35	26	10	0
DOFR	55	14	39	17	28	29	26	17	9	0
SFD	67	27	65	28	49	47	40	26	11	0
DOE	59	24	49	25	49	47	37	25	7	0
DID	51	16	46	21	46	39	35	25	9	0
DLO	47	10	35	11	45	46	27	17	6	0
DOH	43	15	22	4	34	36	11	12	7	0
Others	12	4	11	6	5	6	4	1	2	0

Figure 5 : The percentage of Government Departments participation for protection of the RMFR



The results showed that majority of respondents felt that handling the issues of RMFR required the participation and coordination of all the listed agencies.

This result suggests that respondents recognised that the RMFR is affected by plans and interventions carried out on the land surrounding it, under the supervision and control of other government bodies. To ensure that plans to protect the RMFR are not undermined or offset by actions and events beyond the forest reserve boundaries and vice versa, plans and interventions in the RMFR should be co-ordinated with those of relevant authorities. It is especially important that activities are co-ordinated with SFD, DOE, DOA, DID, F&RD (Bomba), DLO, DOH and other relevant authorities (see below).

i. Selangor Forest Department (SFD)

SFD is responsible for preparation and revision of management plans for the NSPSF and management, administration and supervision of activities carried out inside the forest reserve.

ii. Department of Environment (DOE)

DOE's mission is to promote, enhance, and sustain sound environmental management in the process of state development and building. A key activity is to study and assess development projects subject to the Environmental Impact Assessment order. DOE also provides environmental inputs to state agencies to ensure that use of land and other natural resources is carried out in a manner that complies with the concept of sustainable development.

iii. Department of Agriculture (DOA)

DOA provides services to farmers and private sectors on farming technology, agro-based industries, and regulatory services to increase state agricultural productivity. Of special relevance is the Information Technology Unit that produces maps covering: soil survey; land use; and agro-climatic zoning for Selangor state.

iv. Department of Irrigation & Drainage (DID)

DID is responsible for management of water resources, including the irrigation water for the neighbouring Tanjung Karang Irrigation Scheme. Interventions related to hydrology of the NSPSF should be co-ordinated with sustainable management plans of the area.

v. Department of Fire & Rescue (DFR)

DFR is responsible for suppressing fire and providing training for small-holder famers on the fire fighting operation on peatland.

vi. District Land Office (DLO)

The DLO is responsible for the processing land development proposals, including distribution of the proposal to relevant Government Departments. It is the lowest administrative level for the management of forest habitats on state land and information on land ownership.

vii. Department of Health (DOH)

DOH is responsible for a healthy community through:-

- ✓ Provision of high quality, affordable and accessible healthcare service
- ✓ Prevention and control disease
- ✓ Protection of health of the population
- ✓ Sustainable and continual health promotion in smart partnership with various agencies, organizations and the community

viii. Other relevant authorities

UPEN – responsible for economic planning at state level. To be effective, the planned activities in the NSPFR must be co-ordinated with development proposals and plan, for example for land development in the state land.

Department of Wildlife & National Park (DWNP)

DWNP is responsible for the management of the neighbouring Sungai Dusun Wildlife Reserve. Conservation measures and monitoring of wildlife in the NSPSF should be co-ordinated with the activities and plans of DWNP in Sungai Dusun Wildlife Reserve and elsewhere.

Interested parties (NGOs, JKK kampong, Head of Village, CBOs)

Work together with government and others agencies to protect and support the government in conserving the forest reserved.

c) Proposed Immediate Measures Should Be Taken By The Concerned Agencies (action plan)

Apart from the relevant government agencies, local community involvement and support is important for a successful management programme that will involve the protection, monitoring, development, conservation and the promotion of the RMFR. Below are listed some of the respondents proposed immediate measures should be taken by the concerned agencies to protect RMFR from external threats. Figure 6 have shown the percentage of proposed immediate measures that were suggested and agreed by respondents during the survey.

Table 11 : Proposed immediate measures should be taken

	Village									
	Besatari Jaya		Raja Musa		Ampangan		Sri Tiram		Others	
Action Plan	M	F	M	F	M	F	M	F	M	F
Monitoring	68	27	59	26	48	45	38	27	11	0
Awareness campaign	54	22	46	28	44	43	33	25	9	0
Legal action	58	22	50	27	47	46	35	24	11	0
conservation	47	14	44	20	45	46	35	25	10	0

Figure 6 : The percentage of proposed immediate measures

i) Monitoring

According to the respondents, there has been some weakness in the monitoring of the state land & forestry land. Lack of monitoring results in the proliferation of illegal activities. Respondents proposed that the relevant government agencies have to play an important role in monitoring their own respective areas from further encroachment (such as DOKS, DOHS, PKPS, KDEB and others). Therefore, the respondents have suggested for an increase in frequency of field inspections. To maintain the geographical extent of the RMFR and to prevent encroachment and other illegal

activities, external & internal boundaries must be stable. The measures required for maintaining external & internal boundaries are to clearly mark the boundaries with signboards at regular intervals and filed inspections. The specific activities needed for boundary control depend on the nature of the boundary and the land use and ownership of neighbouring land. However, boundaries and demarcation should be inspected in connection with Forestry Department supervision and monitoring of field operation such as agricultural activities.

ii) Awareness campaign

According to the respondents, education and public awareness programmes should also be encouraged to attract community participation in the protection and conservation of the RMFR. Organised recreation and outdoor activities, such as tree planting, fishing activities, involving local community will provide opportunities for local residents to understand the importance of this forest reserve. Public education and awareness programmes can also be implemented by the dissemination of information through mass media, the website, seminars, local magazine (publications), posters, and brochures related to the preservation and importance of the RMFR.

During the survey, a specific question has been discussed with the respondents on public education and fire awareness campaigns to decrease fire risk at RMFR. Below are listed some of the answers:-

- Signs and warning boards (fire index risk) should be erected along the roads and on places with high fire risk (bridges, rubbish belts, fishing points, concession roads, main transport canals, popular fishing places)
- At beginning of the dry season, fire awareness campaign should be organised to motivate the local stakeholders and communities tobe careful with use of fire

iii) Legal action

According to the respondents, agro-industrial companies or land owners often do not comply with the basic legal regulations by inappropriately employing cost effective yet environmentally damaging deforestation methods such as forest fires to clear the land for agricultural purposes. Preparation of rules and regulations to be followed by groups using the forest, including the development of signboards explaining the rules and regulations to be placed at strategic locations. Those who break the rules and regulations must face serious legal action according to the government legislation and regulation.

iv) Conservation

According to the respondents, forest encroachment should not be allowed in the Raja Musa Forest Reserve and focus should be on conservation. An important task of the management is, therefore, to ensure that the conservation areas are protected from external threats. Block selected drainage canals in and adjacent to RMFR and enhance water management in the forest and adjacent farmlands and plantations to reduce fire risk. Rehabilitation of degraded peat swamp forest in RMFR should be done in partnership with local communities and other stakeholders.

3. RECOMMENDATION AND CONCLUSION

Managing the RMFR under the sustainable forest management system is one of the better options available to enhance its economic values. In order to manage the RMFR in a suitable manner, a number of steps must and should be taken. In this regards, the State Forestry Department being the agency responsible for the management of the state forest should give due consideration to all of the following recommendations that are listed below.

3.1 Summary of the socio-economic survey

- The villagers living in the vicinity of the RMFR gain some benefits from the forest in terms of irrigation water for farming, fishing, fruit collection, etc. however, for the majority of villagers, the main source of household income is generated from activities that are not related to the peat swamp forest. Still, the villagers hold strong opinions about the use of the forest.
- The forest is also used for tourism and recreation. The present level of use of the forest for such purposes is very low, but the demand for tourism and recreational facilities in adjacent forest and park area suggests that there is a potential to develop recreational and eco-tourism facilities.
- Presently, the main economic benefits from the RMFR are related to the impacts the forest has on its surroundings. At the local level, the adjacent Tanjong Karang Irrigation Project is by far the biggest beneficiary, as the peat swamp forest provides irrigation water for the project.

3.2 Future work

In the course of this study, it has been found that there is a general lack of detailed data pertaining to the social and environmental aspects of the RMFR. A clear understanding of these aspects is required to enable an economic valuation of such benefits to be carried out. For example, to what extent the RMFR contributes to the irrigation water needs of the IADP Project is still an area of debate. In this regard, it is recommended that the following research areas in the RMFR should be given more attention:

- Impact of forest fires.
- Potential of eco-tourism activities and its wider impact of the socio-economy
- Wildlife conservation within the peat swamp
- Contribution of the RMFR (irrigation water) to the IADP Project and as a source of drinking water.
- Sources of carbon sink and its contribution to reduction in global warming

4. CONCLUSION

The peat swamp forest provides services to the communities living in or around the forest. The most important social value of the peat swamp forest is the environmental benefits derived from the NSPSF in terms of water for irrigation and domestic use. Other environmental services include flood control and prevention of saline intrusion. Eco-tourism and harvesting of Non-Timber Products (NTP) constitute another type of social benefits from the peat swamp forest.

Managing the RMFR under the sustainable forest management system is one of the better options available to enhance its economic values. The importance of the social and environmental benefits that the RMFR can offer has been shown to be substantial and much larger than the benefits provided by timber production. The importance of the adjacent IADA Project in the nation's food security strategy offers a persuasive factor to ensure that the RMFR is not being converted to other land uses. This is further enhanced at the global level considering its role as a net carbon sink that contributes to mitigation effort to reduce global climate change.

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www.gec.org.my.

Questionare "*Soalselidik kajian kepentingan sosio-ekonomi ekosistem hutan paya gambut kepada penduduk tempatan di daerah Kuala Selangor"*

Interview session with the villagers from 8 villages adjacent to Raja Musa Forest Reserve (RMFR) which are Bestari Jaya Village, Raja Musa Village, Ampangan Village, Sri Tiram Village, Ijok Village, Rawang Village, Sri Gambut Village and Rantau Panjang Village.

Assessment of North Selangor Peat Swamp Forest for Forest Tourism

MOHD JINIS ABDULLAH & ZAIDAH ZAKARIA[3]

Abstract : Peat swamp forest is one of the three tropical forests type beside the mangrove and dry inland forests. It is a waterlogged forest growing on a layer of dead leaves and plant material up to 20 metres thick (UNDP, 2006). In Malaysia, it is estimated that about 1.54 million hectares of Peat swamp forests are still remaining (UNDP, 2006). As for Peninsular Malaysia, a total of 242,906 hectares of peat swamp forests are gazetted as Permanent Reserved Forest (FDPM Annual Report 2012) and part of these gazetted forests lies in the northern region state of Selangor which in this seminar known as North Selangor Peat Swamp Forests (NSPSF). The NSPSF is surrounded by human settlement and agriculture activities. The local community living around the NSPSF has a general understanding that peat swamp forest ecosystem plays a substantial role in their livelihood and one of the roles is in promoting forest tourism. Hence, the objectives of this paper are to gather initial information on forest resources as an enabler in forest tourism activities and to identify the possible NSPSF resources for forest tourism activities by local community. The framework for assessment is based on the interviewed with local community tourism operator and field visits.

[3] Jabatan Perhutanan Semenanjung Malaysia


ASSESSMENT OF
NORTH SELANGOR PEAT SWAMP FOREST
FOR FOREST TOURISM
By:
MOHD JINIS ABDULLAH
ZAIDA ZAKARIA
Seminar on
North Selangor Peat Swamp Forest Expedition


PRESENTATION OUTLINE
1. INTRODUCTION
• Background of The Area
• Objectives
• Assessment Methodology
2. TOURISM ACTIVITIES OF LOCAL COMMUNITY
• Current activities
• Issues
3. PEAT SWAMP FOREST TOURISM ASSESSMENT
• Current facilities
• Current activities
• Forest Resources
• Local Community Participation
4. DISSCUSSION AND RECOMMENDATIONS
5. ACKNOWLEDGEMENT


INTRODUCTION
Background of The Area
• The Raja Musa Peat Swamp Forest Reserve (RMFR) covers 23,000 ha and is part of the North Selangor Peat Swamp Forest.
• Located near Batang Berjuntai/Berjuntai Bestari in the northern region of the Selangor State, Malaysia.
• It is a significant block of remaining peat forest in Peninsular Malaysia and is an important ecosystem for freshwater sources and carbon storage.


INTRODUCTION (cont...)
• Homestay Kg. Sg. Sireh is a tourist area of Agro tourism concept
• These Homestay is surrounded by paddy fields and agricultural activities as the main attraction
• Water body and forest reserve for visitors recreational activities like jungle trekking, kayaking and activities along the river by boat


INTRODUCTION (cont...)


INTRODUCTION (cont...)
Objectives
• To collect database in tourism activities of the local community
• To identify the forest resources for forest tourism activities


INTRODUCTION (cont...)
Assessment Methodology
• Interview Local Community
• Field Observation


TOURISM ACTIVITIES OF LOCAL COMMUNITY
Agro-tourism Activities
Village Visit
Night Walk
Recreation – Jungle Treking
CURRENT ACTIVITIES
Camping
Modern Wedding
Kayaking
Hari Raya korban


TOURISM ACTIVITIES OF LOCAL COMMUNITY
(cont…)


TOURISM ACTIVITIES OF LOCAL COMMUNITY
(CONT…)
• Facilities
Facilities for the activities provided by the operator


TOURISM ACTIVITIES OF LOCAL COMMUNITY
(CONT…)
Issues
• Local community to diversify the tourism activities
• Promoting forest tourism / ecotourism
• No proper infrastructure
• Approval from the Selangor Forestry Department


PEAT SWAMP FOREST TOURISM ASSESSMENT
• Current facilities
- Agro tourism
- Homestay
- package


PEAT SWAMP FOREST TOURISM ASSESSMENT (CONT…)
Forest Resources
No built infrastructure access to the forest
Access by canoe
Warding the swamp


PEAT SWAMP FOREST TOURISM ASSESSMENT (CONT…)
Forest Resources
Forest trail
Campnosperma coriaceum
(Terentang simpoh)
Peat Swamp Forest environment - very flat, damp, etc.


PEAT SWAMP FOREST TOURISM ASSESSMENT (CONT…)
Forest Resources
Forest litter mostly leaves of
Campnosperma coriaceum
(Terentang simpoh)
Black/dark brownish water
Peat Swamp Forest environment - Forest Trail


PEAT SWAMP FOREST TOURISM ASSESSMENT (CONT…)
Forest Resources
Leaf and fruit of Campnosperma
coriaceum
(Terentang simpoh)
Elelodoxa conferta
(Asam Kelubi/Paya)
Among flora observed

PEAT SWAMP FOREST TOURISM ASSESSMENT (CONT…)

Forest Resources

Pandanus spp (Mengkuang)

Survival roots- respiration and achorage

Among flora observed

PEAT SWAMP FOREST TOURISM ASSESSMENT

- Local Community Participation
  - Homestay
  - Transports
  - Camp site
  - Guiding
  - Other services
  - Committed

DISSCUSSION AND RECOMMENDATIONS

- Local community experienced in handling tourist
- Track record in agro-tourism
- Facilities sufficient and in good maintenance
- Experienced and committed guide

DISSCUSSION AND RECOMMENDATIONS

- In cooperate safety measures
- Apply to SSFD for usage of forest area for activities
- Look for continues training among operators and guide
- Support the forest tourism activities to sustain peat swamp forest


ACKNOWLEDGEMENT
• Director General of FDPM and secretariat
• SSFD and all the staffs
• MNS
• Local community
• Others – directly or indirectly


THANK YOU
Terima kasih

Developing a Preliminary Checklist of Birds at NSPSF

ANDREW SEBASTIAN[1]

Abstract : Birds, among other natural entities have always been used by wildlife managers, academics, governmental bodies, naturalists and conservation groups as an indicator on the health and profile of a certain eco system and/or site. Following some comprehensive work by Prentice and Aikanathan (1989) and surveys by Perhilitan in 1997, it was perhaps overdue that the avifauna of NSPSF is revisited albeit via a short 10 day line of sight and audio survey. The output for such an exercise is to add on the information through the publication of a Preliminary Checklist of Birds at NSPSF and perhaps at some point for a more thorough analysis be conducted to ascertain the state of the forest complex using our beautiful birds as one of its elements.

Through a regime of line transects and morning/evening/night surveys, the team of about 10 birdwatchers spread ourselves into two team each day along 6 different sites. For purposes of practicality, the original site 5 or Sg Dusun area was not surveyed due to access issues and was replaced by our team with a non systematic survey along the western boundary of the NSPSF. Weather and in some parts (namely the north west), haze from local paddy field burning was some of the challenges faced.

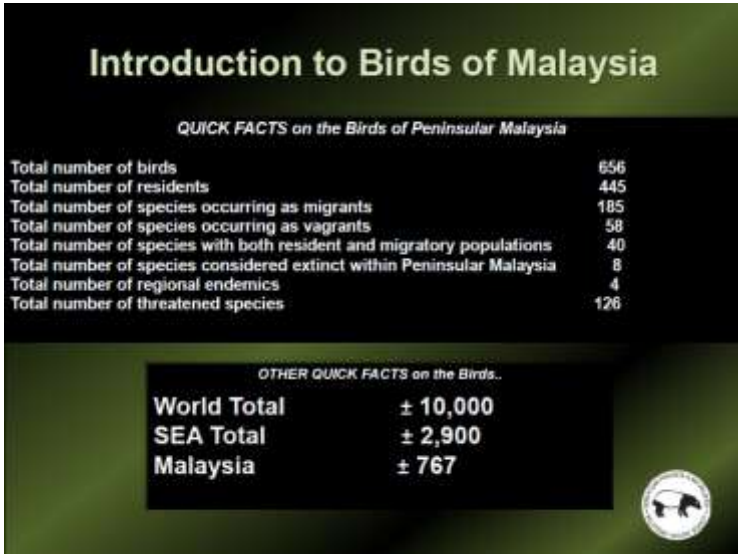
The team acknowledges that quite a few 'common' species recorded in previous informal field trips by MNS members and previous studies, were not recoded simply due to bad timing, off season for migratory birds and the lack of resources to put in a larger team of observers.

The team recorded a total list of 92 species consisting of 44 families. 85 species is classified as residents with 6 with both resident and migrant status. 14 birds are listed as Near Threatened by IUCN. The The family of birds 'dominated' the list as expected i.e. 6 from Accipitridae, 6 representing Pycnonotidae and 8 representing the Timsliidae family respectively. The abundance of the family classes overlaps with the obvious forest cover as expected. The team discovered more mixed diversity in 3 sites namely Sg Tengi, Western Trail and Rimba Trail. Rimba Trail specifically is of importance to birdwatchers with the existence of beautiful forest cover, a watch tower and easy access. The MNS team hopes that this site will be developed in the future for birdwatchers as it has the potential to be an active and new site for birdwatching.

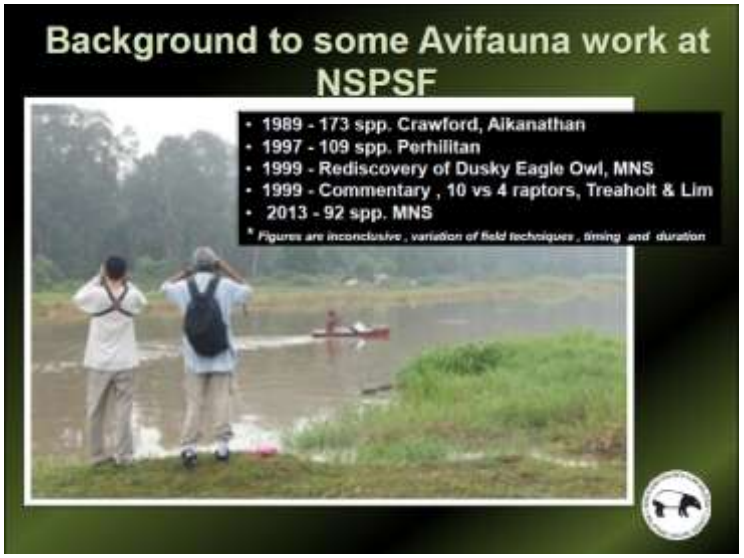
[1] Malaysian Nature Society (MNS)

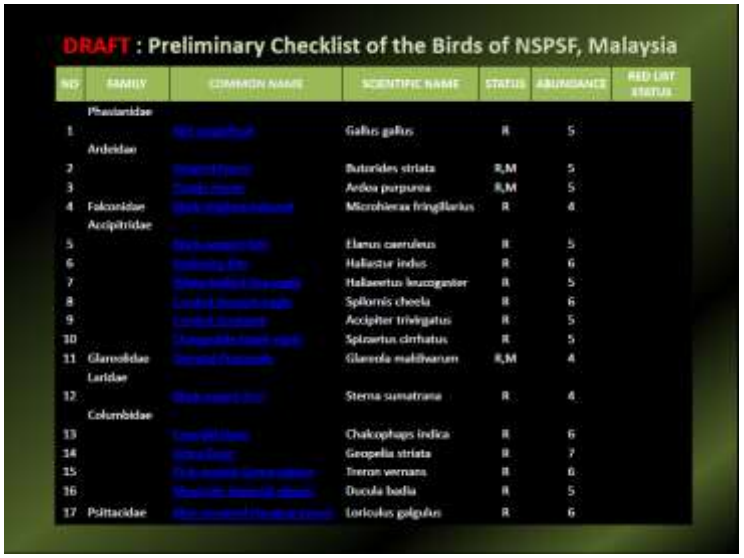

SEMINAR:
North Selangor Peat Swamp Forest
(NSPSF) Expedition 2013
A Preliminary Checklist of Birds at NSPSF
By Andrew Sebastian, Malaysian Nature Society (MNS)

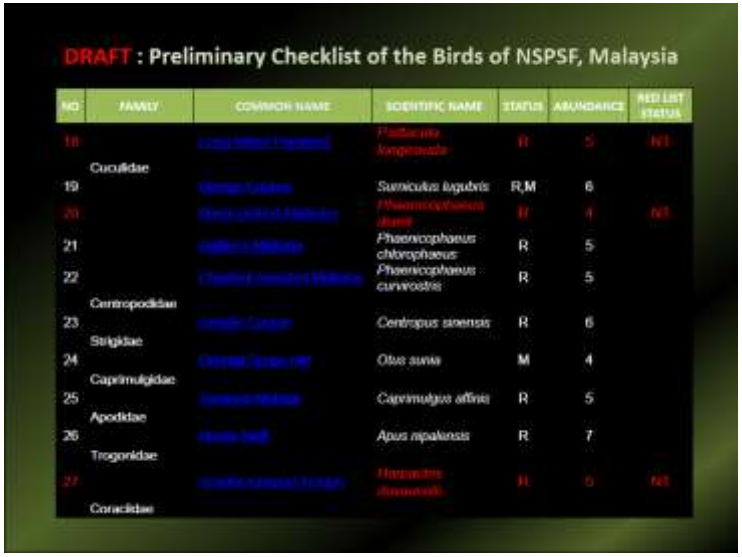

Map Overview

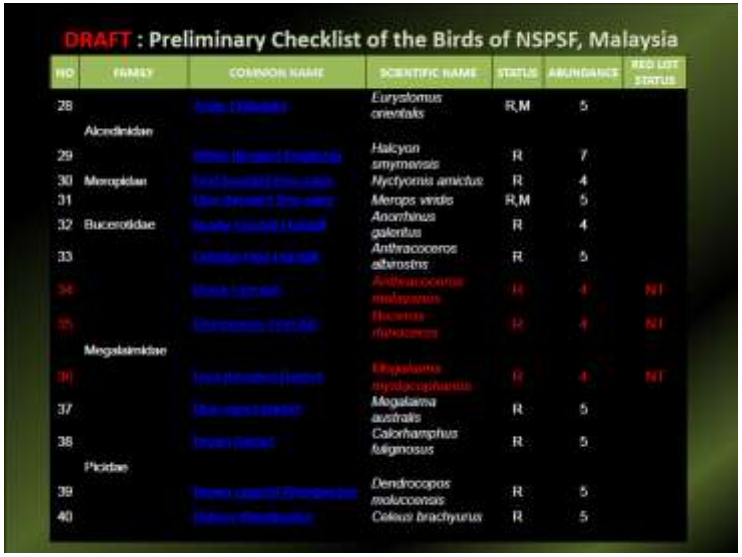

Introduction to Birds of Malaysia
QUICK FACTS on the Birds of Peninsular Malaysia
Total number of birds 656
Total number of residents 445
Total number of species occurring as migrants 185
Total number of species occurring as vagrants 58
Total number of species with both resident and migratory populations 40
Total number of species considered extinct within Peninsular Malaysia 8
Total number of regional endemics 4
Total number of threatened species 126
OTHER QUICK FACTS on the Birds..
World Total ± 10,000
SEA Total ± 2,900
Malaysia ± 767

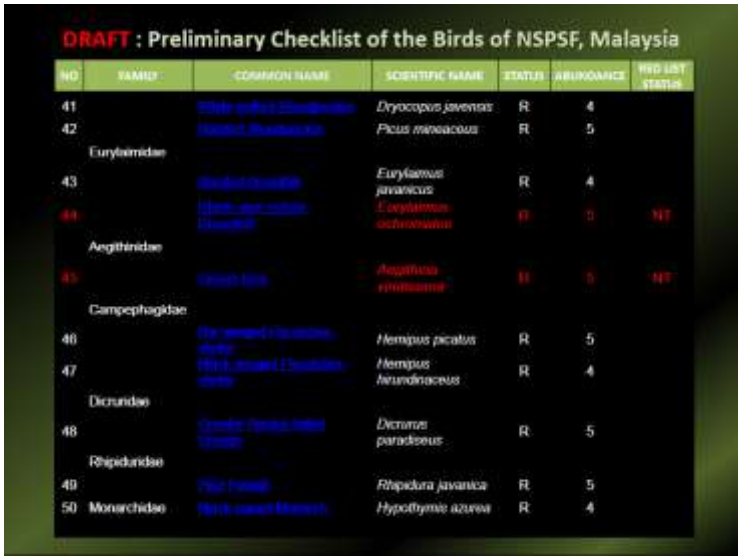

Why are Birds important?
• They keep systems in balance: they pollinate plants, disperse seeds, scavenge carcasses and recycle nutrients back into the earth.
•They are important biological indicators
• They are now a big part of Tourism - Ecotourism - Birdwatching
• They also feed our spirits, marking for us the passage of the seasons, moving us to create art and poetry, inspiring us to flight and reminding us that we are not only on, but of, this earth
Asian Open Billed Storks


Background to some Avifauna work at NSPSF
• 1989 - 173 spp. Crawford, Aikanathan
• 1997 - 109 spp. Perhilitan
• 1999 - Rediscovery of Dusky Eagle Owl, MNS
• 1999 - Commentary , 10 vs 4 raptors, Treaholt & Lim
• 2013 - 92 spp. MNS
* Figures are inconclusive , variation of field techniques , timing and duration


DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia
NO FAMILY COMMON NAME SCIENTIFIC NAME STATUS ABUNDANCE RED LIST STATUS
Phasianidae
1 Gallus gallus R 5
Ardeidae
2 Butorides striata R,M 5
3 Ardea purpurea R,M 5
4 Falconidae Microhierax fringillarius R 4
Accipitridae
5 Elanus caeruleus R 5
6 Haliastur indus R 6
7 Haliaeetus leucogaster R 5
8 Spilornis cheela R 6
9 Accipiter trivirgatus R 5
10 Spizaetus cirrhatus R 5
11 Glareolidae Glareola maldivarum R,M 4
Laridae
12 Sterna sumatrana R 4
Columbidae
13 Chalcophaps indica R 6
14 Geopelia striata R 7
15 Treron vernans R 6
16 Ducula badia R 5
17 Psittacidae Loriculus galgulus R 6


DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia
NO FAMILY COMMON NAME SCIENTIFIC NAME STATUS ABUNDANCE RED LIST STATUS
18 Platlarcta longicauda R 5 NT
Cuculidae
19 Surniculus lugubris R,M 6
20 Phaenicophaeus diardi R 4 NT
21 Phaenicophaeus chlorophaeus R 5
22 Phaenicophaeus curvirostris R 5
Centropodidae
23 Centropus sinensis R 6
Strigidae
24 Otus sunia M 4
Caprimulgidae
25 Caprimulgus affinis R 5
Apodidae
26 Apus nipalensis R 7
Trogonidae
27 Harpactes duvaucelii R 5 NT
Coraciidae


DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia
NO FAMILY COMMON NAME SCIENTIFIC NAME STATUS ABUNDANCE RED LIST STATUS
28 Eurystomus orientalis R,M 5
Alcedinidae
29 Halcyon smyrnensis R 7
30 Meropidae Nyctyornis amictus R 4
31 Merops viridis R,M 5
32 Bucerotidae Anorrhinus galeritus R 4
33 Anthracoceros albirostris R 5
34 Anthracoceros malayanus R 4 NT
35 Buceros rhinoceros R 4 NT
Megalaimidae
36 Megalaima mystacophanos R 4 NT
37 Megalaima australis R 5
38 Calorhamphus fuliginosus R 5
Picidae
39 Dendrocopos moluccensis R 5
40 Celeus brachyurus R 5

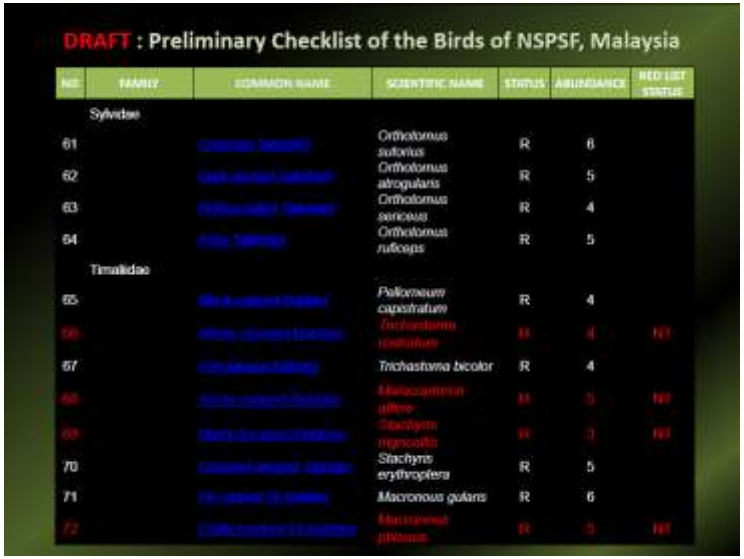


DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia

NO	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE	RED LIST STATUS
41			*Dryocopus javensis*	R	4	
42			*Picus miniaceus*	R	5	
	Eurylaimidae					
43			*Eurylaimus javanicus*	R	4	
44			*Eurylaimus ochromalus*	R	5	NT
	Aegithinidae					
45			*Aegithina viridissima*	R	5	NT
	Campephagidae					
46			*Hemipus picatus*	R	5	
47			*Hemipus hirundinaceus*	R	4	
	Dicruridae					
48			*Dicrurus paradiseus*	R	5	
	Rhipiduridae					
49			*Rhipidura javanica*	R	5	
50	Monarchidae		*Hypothymis azurea*	R	4	

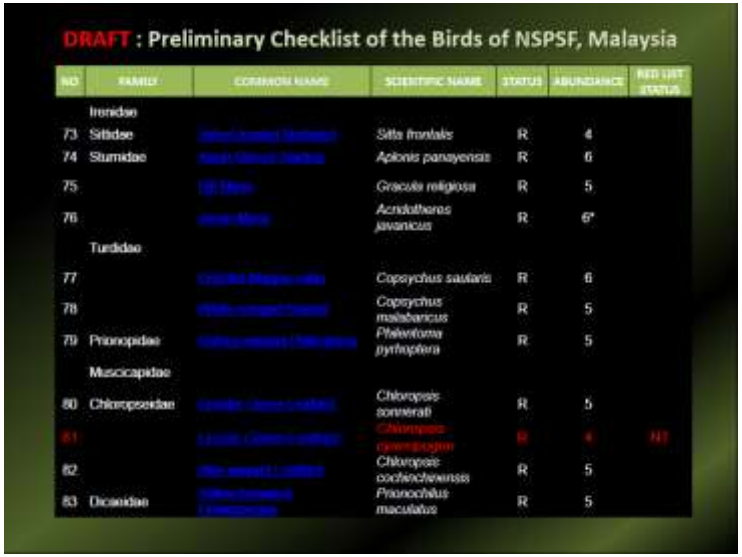
DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia

NO	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE	RED LIST STATUS
	Corvidae					
51			*Corvus macrorhynchos*	R	5	
	Hirundinidae					
52			*Hirundo tahitica*	R	7	
53	Cisticolidae		*Cisticola juncidis*	R	4	
54			*Prinia flaviventris*	R	5	
	Pycnonotidae					
55			*Pycnonotus cruthifus*	R	3	NT
56			*Pycnonotus goavier*	R	7	
57			*Pycnonotus plumosus*	R	5	
58			*Pycnonotus simplex*	R	4	
59			*Pycnonotus brunneus*	R	5	
60			*Pycnonotus erythrophthalmos*	R	5	



DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia

NO	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE	RED LIST STATUS
	Sylvidae					
61			*Orthotomus sutorius*	R	6	
62			*Orthotomus atrogularis*	R	5	
63			*Orthotomus sericeus*	R	4	
64			*Orthotomus ruficeps*	R	5	
	Timalidae					
65			*Pellorneum capistratum*	R	4	
66			*Trichastoma cinereiceps*	R	4	NT
67			*Trichastoma bicolor*	R	4	
68			*Malacocincla affine*	R	5	NT
69			*Stachyris nigriceps*	R	3	NT
70			*Stachyris erythroptera*	R	5	
71			*Macronous gularis*	R	6	
72			*Macronous ptilosus*	R	3	NT



DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia

NO	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE	RED LIST STATUS
	Ironidae					
73	Sittidae		*Sitta frontalis*	R	4	
74	Sturnidae		*Aplonis panayensis*	R	6	
75			*Gracula religiosa*	R	5	
76			*Acridotheres javanicus*	R	6*	
	Turdidae					
77			*Copsychus saularis*	R	6	
78			*Copsychus malabaricus*	R	5	
79	Pronopidae		*Pteleforna pyrhoptera*	R	5	
	Muscicapidae					
80	Chloropseidae		*Chloropsis sonnerati*	R	5	
81			*Chloropsis cyanopogon*	R	4	NT
82			*Chloropsis cochinchinensis*	R	5	
83	Dicaeidae		*Prionochilus maculatus*	R	5	

DRAFT : Preliminary Checklist of the Birds of NSPSF, Malaysia

NO	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE	RED LIST STATUS
84			*Dicaeum chrysorrheum*	R	4	
85			*Dicaeum trigonostigma*	R	5	
86	Nectariniidae		*Anthreptes simplex*	R	5	
87			*Anthreptes malaccensis*	R	6	
88			*Anthreptes singalensis*	R	5	
89			*Aethopyga siparaja*	R	4	
	Passeridae					
90			*Passer montanus*	R	7	
91	Ploceidae		*Ploceus philippinus*	R	5	
	Estrildidae					
92			*Lonchura punctulata*	R	6	

Qualifier:!!

List is not exhaustive, methodology, duration, & timing used differs, no real conclusion should be drawn

Preliminary Analysis

Using the 1989 checklist of 173 bird spp as the baseline (qualifiers apply):

1. MNS recorded 92 spp, 4 spp being reviewed, 44 families, 85 residents, 14 NT spp.
2. Perhilitan in 1997 reported a 33% drop in bird figures
3. Using the same approach, we now report a drop of 47%
4. Globally NT birds, out of 36 spp. recorded previously, now on 15 spp.
5. This survey adds 21 new spp to the list but about 3 birds are now in question!

Preliminary Observations

1. 3 sites were identified as a potential site for birdwatching i.e. Sg. Tengi, Western Trail & Rimba Trail.
2. 3 bird families dominate these sites/habitat i.e. *Accipiters (6)*, *Pycnonotidae* (6) & *Timsliidae (8)*
3. Sg Tengi with its boat access and wildlife heavy presence should be developed as ecotourism/birdwatching site while Rimba Trail has great potentials for a purely birdwatching site
4. Malaysia's newest bird record i.e. Open-billed Storks (2012) is now a regular sight and could be used as a birdwatching icon for this area.
5. More surveys needed ☺

Image Gallery (NT Species)

Long-tailed Parakeet


Image Gallery
Black-bellied Malkoha


Image Gallery
Scarlet-rumped Trogon


Image Gallery
Black Hornbill


Image Gallery
Rhinoceros Hornbill


Image Gallery
ARKIVE
Red-throated Barbet


Image Gallery
Black-and-yellow Broadbill


Image Gallery
Green Iora
Aegithina viridissima
Green Iora


Image Gallery
Puff-backed Bulbul


Image Gallery
White-chested Babbler


Image Gallery
Sooty-capped Babbler


Image Gallery
ARKive
www.arkive.org
Black-throated Babbler


Image Gallery
Fluffy-backed Tit Babbler

Image Gallery

Greater Green Leafbird

Image Gallery

Dusky Eagle Owl

Appreciation & Credits

Expedition Team:

Andrew Sebastian, Khoo Swee Seng, Caroline Ho, Mohd Rafi Kudus, Angela Mary Francombe, Henry Goh, Lim Shy Tean, John Paul, Terence Ang, Pasupathy J., Selangor Forestry Department Officers & Rangers

Photographs (web sourced, with appreciation) :

Susan Myers, Laurence Poh, Con Foley, Henry Goh, Adrian Lim, Gary Albert, Wong Tsu Shi, Alan Ng, Dave Bakewell, Morten Strange, CK Leong

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PERSATUAN PENCINTA ALAM MALAYSIA
MALAYSIAN NATURE SOCIETY
Thank you

The Southern Pied Hornbill of Sungai Panjang, Sabak Bernam, Selangor

AHMAD ISMAIL, FAID RAHMAN & NURUL HUDHA MOHD JAMIL[1]

Abstract : The Sungai Karang Forest Reserve (SKFR) is an important hornbill area in Selangor that houses at least five hornbill species. The Southern pied hornbill is the smallest among the hornbills that can be found and is now adapting and benefitting from agricultural activity nearby, in Sg. Panjang. The movement of the species between SKFR and Sg. Panjang was first observed in late 2008 and prompted the study to highlight the bird's activity in the area. The Southern pied is known to have high adaptability to anthropogenic activity and has been reported to utilized logged forest for nesting and foraging purposes. However, the study findings suggest that the bird's ability to habituate to new environment could be underestimated by many. This study highlights the Southern pied hornbill unique nesting adaptation, challenges they faced as well as educational program that has been carried out to help protect and conserve the species particularly in Sg. Panjang.

[1] Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

The Southern Pied Hornbill of Sg. Panjang, Sabak Bernam, Selangor

Sungai Karang Forest Reserve

- Part of The North Selangor Peat Swamp Forest (NSPSF).
- 50, 106 hectares.

Hornbills of SKFR

- Rhinoceros hornbill
- Bushy-crested hornbill
- Black hornbill
- Oriental pied hornbill
- Southern pied hornbill

Southern Pied Hornbill

- *Anthracoceros albirostris convexus*
- Population trend is stable
- Considered as the most adaptable of the hornbills to landscape modification.
- Utilized logged forest for nesting and foraging purposes.

Sungai Panjang

- Movement of the Southern pied hornbill is common between SKFR and Sg. Panjang.
- Foraging activity was observed throughout the area.
- The first breeding couple was found in early 2009- further surveys - 4 more nesting locations in the area.

- The hornbills are well-known for its cavity-nesting on tall trees.
- potential nest cavity and its availability were higher in trees with larger diameter.
- Tall trees- is more secure and also provides good vantage point particularly for the male while feeding its partner.
- In some areas, the Southern pied population has decreased in large numbers and is linked to indiscriminate deforestation that limits their breeding requirements.
- Installing artificial nest on tall trees have been a major trend in conserving the Southern pied population.
- Still, it is not easy to predict whether the hornbills will use them- it is suggested that artificial nest be installed for at least a year or more before the hornbills may start using them

- The southern pied hornbills in Sg. Panjang have shifted to ground nesting in jars.



Issues

- Forest degradation
- Forest fire
- Illegal clearing
- Forest burning
- Other encroachment activities
- Poaching activity
- Predators

- The jar's opening is patched leaving a small opening or slit.
- Use for breathing, retrieving food from the male and to excrete.
- Breeding completes: 81-85 days.
- Successful couples will re-use the same sites/ jars.

Selected clay jars have a typical measurement of 58cm in length, 39cm in width and 12-15 cm opening d

- Dirt or soil layering the jar's internal
- It plays an important role in the Southern pied breeding activity.
- Soil heap formed and gaining volume as breeding progress.
- What happened to other waste that is not covered?

1. The first record of the SP hornbill nesting on ground in the wild
2. Largely dependent on agricultural developed land for food

- More than 80% of the foraging activity occurred in orchards & palm oil plantations.
- In total, 5 different types of fruits and 7 types of animals
- Betel nut (*Areca catechu),* palm oil seed (*Elaeis guineensis jacq*) to small animals such as insects, arthropods and small reptiles.

- Breeding success percentage- less than 50 %
- Highest turnover and mortality at sites close to paddy fields.
- The use of heavy machineries nearby, removal of shade and direct disturbance by human are some e.g.

- Due to the nest locations and their surrounding environment, the breeding hornbills are prone to anthropogenic activity and disturbances.
- But the number of attempts made are increasing.


thestar
Hornbills become a common sight in Kg Sg Panjang


Ini adalah aktiviti ketiga dalam usaha bertemusan program sokongan awam konservasi burung enggang di Sungai Panjang Sabak Bernam Selangor. Program sejak 2006 telah berjaya menambah bilangan burung yang berjaya populasinya di habitat semulajadi. Tiga tahap program konservasi dilaksanakan; pertama kajian ekologi burung dan interaksi dengan manusia, kedua kempen kesedaran dan sokongan awam, ketiga penerimaan awam dan konservasi burung. Pemantauan akan ditemukan bersama Jabatan Perhilitan bagi memastikan sokongan awam berterusan dan populasi burung enggang berterusan. Terima Kasih Prof. Dr. Ahmad Ismail dari Universiti Putra Malaysia.
A new home for the hornbills
Hornbills' playground


The End

Fish Diversity in North Selangor Peat Swamp Forest

ISMAIL, A., AMAL, M.N.A., ABDULLAH, T., JOHARI, S., AZIZUL, A.,
NUR-ILLIANI, H. & AMIRUDDIN, M.H.[1]

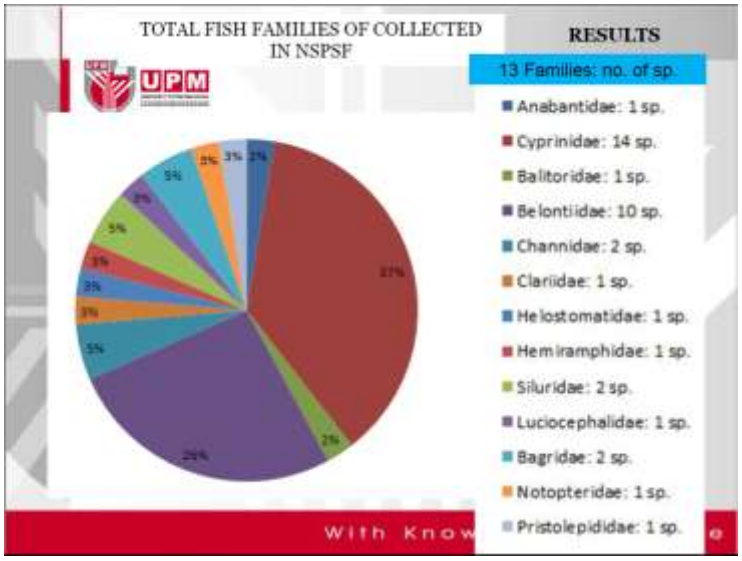
Abstract : A survey was conducted in order to identify and update the fish diversity in North Selangor peat swamp forest. Sungai Karang and Raja Musa Forest Reserve were selected as sampling locations with 2 and 3 sampling points in each forest, respectively. The survey was conducted during the North Selangor Peat Swamp Forest Scientific Expedition from 15th – 25th May and 24rd June – 5th July of 2013. Sampling equipment such as scoop and fishing nets with various mesh sizes were used during this survey. A total of 13 fish families (Anabantidae, Cyprinidae, Balitoridae, Belontidae, Channidae, Clariidae, Helostomatidae, Hemiramphidae, Siluridae, Luciocephalidae, Bagridae, Notopteridae and Pristolepididae), with comprising of 38 species of fishes have been identified from the survey. The family of Cyprinidae recorded the highest species of fish with 14 species, followed with Belontiidae with 10 species. The rest of the fish families recorded between one to two species of fish/es. The water temperature, dissolved oxygen and pH water measured during the survey were ranged from 26.18-27.48^{o}C, 0.06-2.24 mg/L and 3.5-6.34, respectively. Several endangered fish species listed by IUCN were also identified such as Betta livida and Parosphromenus harveyi, while most of the identified fish genera were commercial ornamental fishes such as Puntius, Rasbora, Trichogaster and Betta. The findings suggest that the North Selangor.

[1] Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43300 UPM Serdang, Selangor, Malaysia


FISH DIVERSITY IN NORTH SELANGOR PEAT SWAMP FOREST
Ismail, A., Amal, M.N.A., Abdullah, T., Johari, S., Azizul, A., Nur-Illiani, H. and Amiruddin, M.H.
Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43300 UPM Serdang, Selangor, Malaysia.
With Knowledge We Serve


OBJECTIVES
1) To update the current fish diversity in north Selangor peat swamp forest
With Knowledge We Serve


15-18 May 2013 (1st phase) and 25-28 June 2013 (2nd phase)
SELANGOR SCIENTIFIC AND BIODIVERSITY PEATLAND EXPEDITION 2013
Research locations within the NSPSF
Legend
With Knowledge We Serve


TOTAL FISH FAMILIES OF COLLECTED IN NSPSF
RESULTS
13 Families: no. of sp.
Anabantidae: 1 sp.
Cyprinidae: 14 sp.
Balitoridae: 1 sp.
Belontiidae: 10 sp.
Channidae: 2 sp.
Clariidae: 1 sp.
Helostomatidae: 1 sp.
Hemiramphidae: 1 sp.
Siluridae: 2 sp.
Luciocephalidae: 1 sp.
Bagridae: 2 sp.
Notopteridae: 1 sp.
Pristolepididae: 1 sp.
With Know

RESULTS

TOTAL FISH SPECIES COLLECTED IN NSPSF

Anabantidae
1. *Anabas testudineus* (Bloch, 1792)

Cyprinidae
2. *Barbodes schwanenfeldii* (Bleeker, 1853)
3. *Cyclocheilichthys apogon* (Valenciennes, 1842)
4. *Hampala macrolepidota* (Kuhl and van Hasselt, 1823)
5. *Parachela oxygastroides* (Bleeker, 1852)
6. *Puntius hexazona* (Weber & de Beaufort, 1912)
7. *Puntius johorensis* (Duncker, 1904)
8. *Puntius lateristriga* (Valenciennes, 1842)
9. *Puntius lineatus* (Duncker, 1904)
10. *Rasbora cephalotaenia* (Bleeker, 1852)
11. *Rasbora dorsiocellata* (Duncker, 1904)
12. *Rasbora dusonensis* (Bleeker, 1851)
13. *Rasbora einthovenii* (Bleeker, 1851)
14. *Rasbora gracilis* (Kottelat, 1991)
15. *Rasbora kalochroma* (Bleeker, 1851)

Belitoridae
16. *Nemacheilus selangoricus* (Duncker, 1904)

Belontidae
17. *Belontia hasselti* (Cuvier, 1831)
18. *Betta bellica* (Sauvage, 1884)
19. *Betta hipposideros* (Ng & Kottelat, 1994)
20. *Betta livida* (Ng & Kottelat, 1992)
21. *Betta pugnax* (Cantor, 1849)
22. *Parasphaerichthys harveyi* (Brown, 1987)
23. *Sphaerichthys osphromenoides* (Canestrini, 1860)
24. *Trichogaster leeri* (Bleeker, 1852)
25. *Trichogaster trichopterus* (Pallas, 1770)
26. *Trichopsis vittata* (Cuvier, 1831)

With Knowledge We Serve

RESULTS

TOTAL FISH SPECIES COLLECTED IN NSPSF

Channidae
27. *Channa bankanensis* (Bleeker, 1852)
28. *Channa lucius* (Cuvier, 1831)

Clariidae
29. *Clarias melanoderma* (Bleeker, 1864)

Helostomatidae
30. *Helostoma temminkii* (Cuvier, 1829)

Hemiramphidae
31. *Hemirhamphodon pogonognathus* (Bleeker, 1853)

Siluridae
32. *Kryptopterus macrocephalus* (Bleeker, 1858)
33. *Silurichthys indragiriensis* (Volz, 1904)

Luciocephalidae
34. *Luciocephalus pulcher* (Gray, 1830)

Bagridae
35. *Mystus bimaculatus* (Volz, 1904)
36. *Mystus nigriceps* (Valenciennes, 1839)

Notopteridae
37. *Notopterus notopterus* (Pallas, 1976)

Pristolepididae
38. *Pristolepis grootii* (Bleeker, 1876)

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RESULTS

FISHES OF NSPSF

Anabantidae
Anabas testudineus (Bloch, 1792)
Climbing perch
Puyu

With Knowledge We Serve

RESULTS

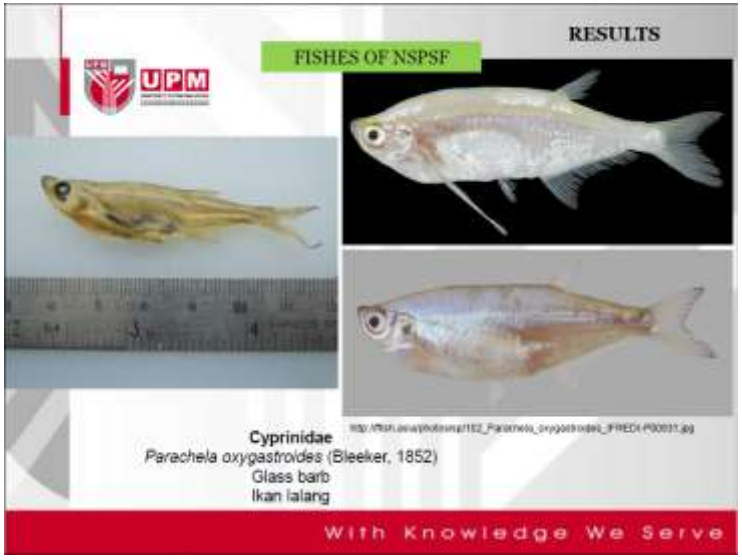
FISHES OF NSPSF

Cyprinidae
Barbodes schwanenfeldii (Bleeker, 1853)
Tinfoil barb
Lampam sungai

With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Cyclocheilichthys apogon (Valenciennes, 1842)
Beardless Barb
Temperas
With Knowledge We Serve

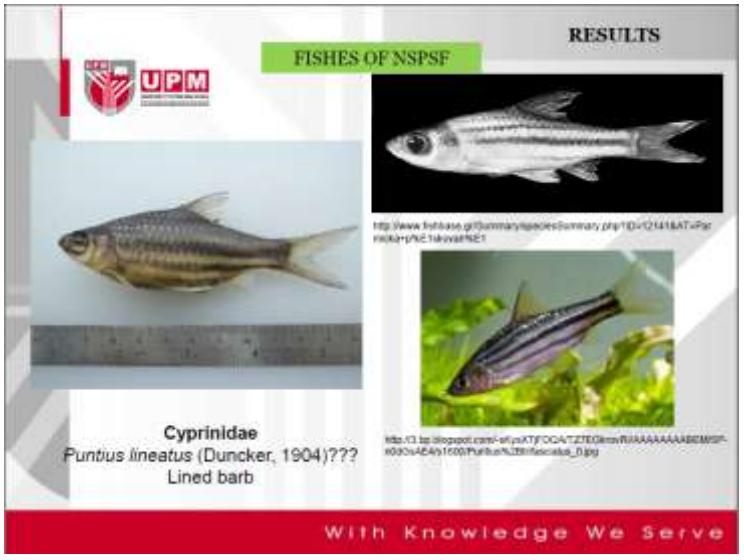

RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Hampala macrolepidota (Kuhl and van Hasselt, 1823)
Hampala barb
Sebarau
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Parachela oxygastroides (Bleeker, 1852)
Glass barb
Ikan lalang
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Puntius hexazona (Weber & de Beaufort, 1912)
Six-banded tiger barb
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Puntius johorensis (Duncker, 1904)
Striped barb
With Knowledge We Serve

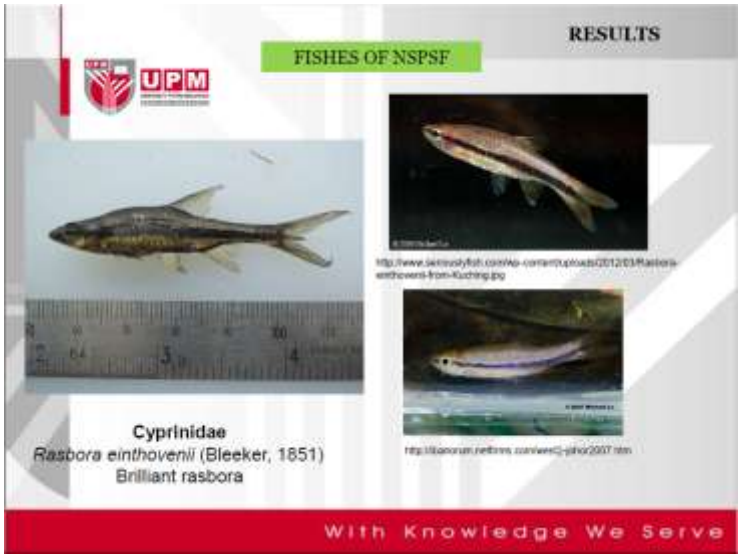

RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Puntius lateristriga (Valenciennes, 1842)???
Spanner barb
Bagoh
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Puntius lineatus (Duncker, 1904)???
Lined barb
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Rasbora cephalotaenia (Bleeker, 1852)
Porthole rasbora
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Rasbora dorsiocellata (Duncker, 1904)
Eyespot rasbora
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
a
Cyprinidae
Rasbora dusonensis (Bleeker, 1851)
Rosefin rasbora
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Rasbora einthovenii (Bleeker, 1851)
Brilliant rasbora
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Rasbora gracilis (Kottelat, 1991)
Blackstripe rasbora
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Cyprinidae
Rasbora kalochroma (Bleeker, 1851)
Clown rasbora
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
© Piscesilim 2012
Balitoridae
Nemacheilus selangoricus (Duncker, 1904)
Grey-banded loach
Loc pasir belang
With Knowledge We Serve

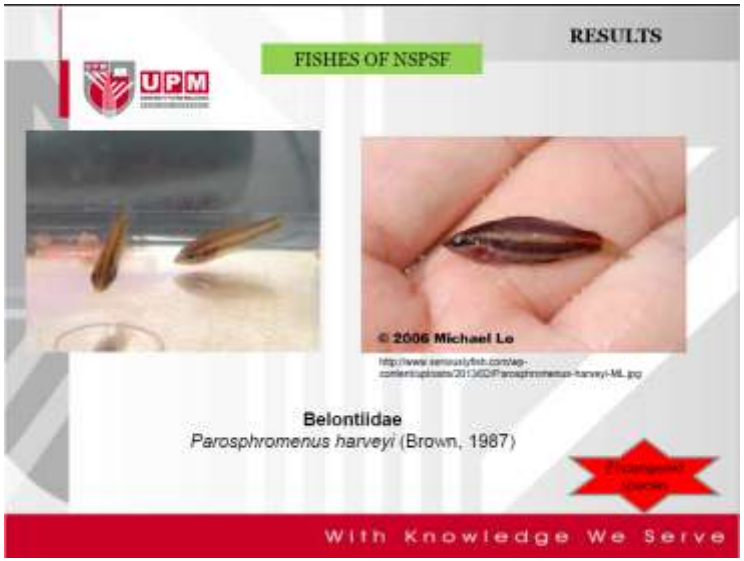

RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Belontia hasselti (Cuvier, 1831)
Malay combtail
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Betta bellica (Sauvage, 1884)
Slim betta, Slender betta
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Betta hipposideros (Ng & Kottelat, 1994)
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Betta livida (Ng & Kottelat, 1992)
Selangor red betta
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Betta pugnax (Cantor, 1849)
Penang betta
Sepilai
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
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Belontiidae
Parosphromenus harveyi (Brown, 1987)
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Sphaerichthys osphromenoides (Cantestrini, 1860)
Chocolate gourami
Biji durian
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Trichogaster leeri (Bleeker, 1852)
Pearl gourami
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Trichogaster trichopterus (Pallas, 1770)
Three spot gourami
Sepat padi, sepat minyak, sepat ronggeng
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Belontiidae
Trichopsis vittata (Cuvier, 1831)
Croaking gourami
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
Channidae
Channa bankanensis (Bleeker, 1852)
Bangka snakehead
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
Channidae
Channa lucius (Cuvier, 1831)
Splendid snakehead
Bujuk
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
Clariidae
Clarias meladerma (Bleeker, 1864)
Blackskin catfish
Keli akar
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
Helostomatidae
Helostoma temminki (Cuvier, 1829)
Kissing gourami
Tembakang
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Hemiramphidae
Hemirhamphodon pogonognathus (Bleeker, 1853)
Forest halfbeak
Jolong pelangi, jolong sungai
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Siluridae
Kryptopterus macrocephalus (Bleeker, 1858)
Striped glass catfish
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Siluridae
Silurichthys indragiriensis (Volz, 1904)???
or S. hasselti, S. phaiosoma, S. schneideri???
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Luciocephalidae
Luciocephalus pulcher (Gray, 1830)
Pikehead
Tembok tebing
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Bagridae
Mystus bimaculatus (Volz, 1904)
Two spot mytus
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Bagridae
Mystus nigriceps (Valenciennes, 1840)
Catfish
Ikan baung misai
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Notopteridae
Notopterus notopterus (Pallas, 1976)
Bronze featherback
Ikan belida selat
With Knowledge We Serve


RESULTS
FISHES OF NSPSF
UPM
Pristolepididae
Pristolepis grootii (Bleeker, 1876)
Indonesian leffish
Kepar, patung
With Knowledge We Serve

WATER QUALITY OF THE SAMPLING SITES **RESULTS**

The water temperature, dissolved oxygen and pH water measured during the survey were ranged from 26.18-27.48°C, 0.06-2.24 mg/L and 3.5-6.34, respectively.

SITE 3: Sg. Tengi Trail

SITE 4: Western Trail

SITE 6: Rimba Trail

Sungai Tengi near Sg. Sireh Homestay

With Know e

DISCUSSION

- Several endangered fish species listed by IUCN were also identified such as *Betta livida* and *Parosphromenus harveyi*.
- Most of the identified fish genera were commercial ornamental fishes such as *Puntius*, *Rasbora* and *Trichogaster*.

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CONCLUSION

- The findings suggest that the North Selangor peat swamp forests should be conserved in order to preserve the richness of its fish diversity.

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ACKNOWLEDGEMENT
• Forestry Department of Peninsular Malaysia
• Malaysian Nature Society
With Knowledge We Serve


THANK YOU

Freshwater Fishes Recorded from North Selangor Peat Swamp Forest, Selangor

AMIRRUDIN B. AHMAD, MUHAMMAD FAHMI AHMAD & SYED AHMAD RIZAL TN. NEK[1]

Abstract : A 2-day survey on the freshwater fishes in small roadside ditches of the North Selangor peat swamp forest recorded a total of 30 species. Many of these were stenotopic to acid waters species. Fishes were mostly from the family Osphornimidae, followed by Cyprinidae and Channidae. Rapid survey using limited sampling gear manages to record most of the common fishes previously reported thriving in the swamp. We hope this finding can help conservation managers in protecting one of the unique ecosystem in the tropics.

[1] School of Marine Science and Environment, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia
* Corresponding author: amirrudin@umt.edu.my

INTRODUCTION

The North Selangor peat swamp forest (NSPSF) is one of the important blackwater peat swamps in Peninsular Malaysia. In general, the blackwater peat swamps were regarded as one of the most unique ecosystem in the tropic, obtain its name from the peaty substrate peat consisting of plant materials that gradually decomposing and releasing tannins and organic acids into poorly buffered water and contribute to its characteristically low pH. This area may also be deficient in dissolved oxygen, as a result of plant decay. Interestingly, contradict to the popular believe, this area support a diverse fish fauna (see Furtado & Mori (1982), Ng et al. (1992), Ng (1994), Ng et al. (1994)) and, most recently, Beamish et al. (2003).

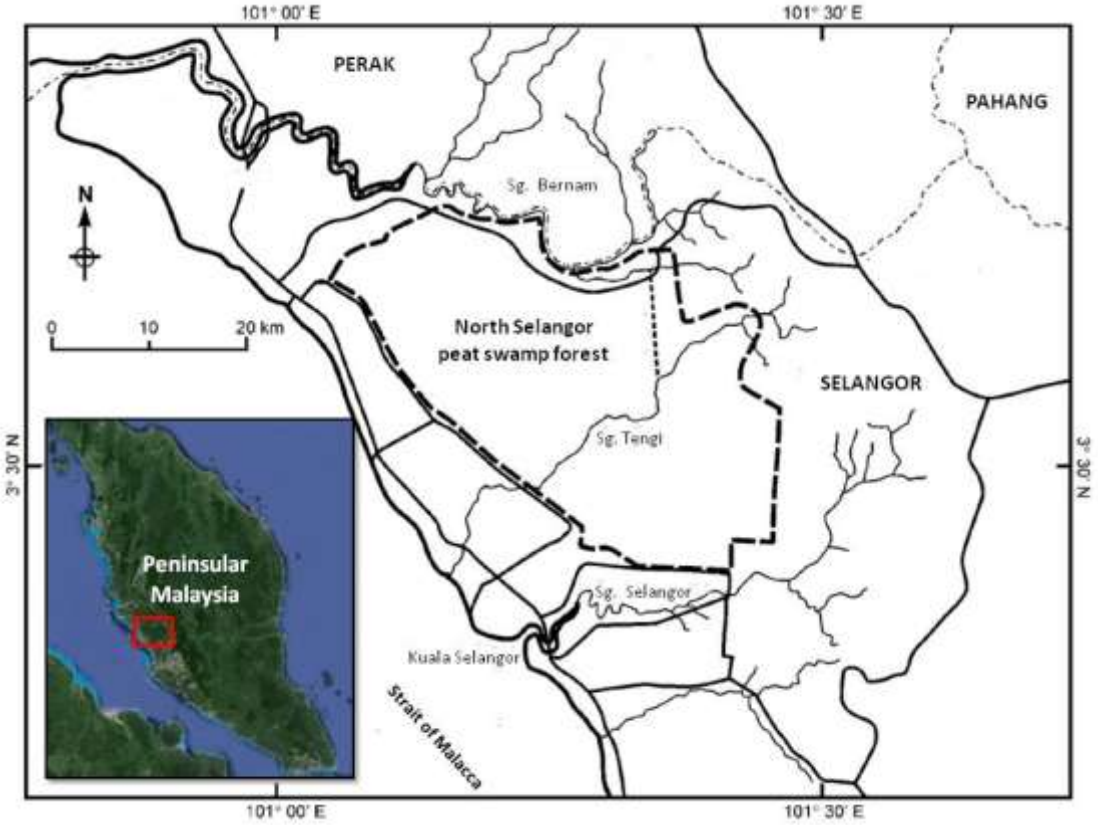
The North Selangor peat swamp forest is located at the northern part of the state of Selangor, lying south to the Bernam, and north of Selangor River at the west coast of Peninsular Malaysia (Figure 1). Its fish fauna has been documented in studies by Johnson (1968), Davies & Abdullah (1989), Ng (1994), Lee (2001) and Beamish et al. (2003). Johnson (1967) made some limnological studies at this area. The objective of the present study was to re-examine the fish species richness in ditches along the road bordering the North Selangor peat swamp.

METHODOLOGY

Site visited

The main collection was made in ditches along the roadside between km 34 to 39 from Sg. Besar to Tg. Malim. Other sites visited including peat swamp outside PERHILITAN Sg. Dusun, canal off Sg. Tengi near bridge and Track 1 within Raja Musa Forest Reserved. Fishes recorded from the canal off Sg. Tengi were not from the peat swamp and were not reported here. No fish was recorded at Track 1.

Figure 1 : Map of Peninsular Malaysia (inset) showing the location of the NSPSF



Sampling method

Fishes were collected mainly using the hand-held push nets with stretchable mesh of about 3mm. Sampling was performed by 2-3 person for about 1 hr at each site. All fishes were identified *in-situ* and released upon identification.

RESULTS AND DISCUSSION

A total of 30 species of primary freshwater fishes were recorded in 2-day survey at selected localities in ditches along the road sides between Sg. Besar and Tanjung Malim (Table 1). Families Osphronemidae, Cyprinidae and Channidae represent the most common families with 10, six and three species, respectively. Nine families were represented by a single species and the other (Family Siluridae) with two species. The findings were similar to Ng et al. (1994) and Beamish et al. (2003) which both studies listed more species from the family Osphronemidae [Note. Previously listed in Families Belontiidae and Luciocephalidae] and Cyprinidae. Two species from the family Cyprinidae did not recorded in the recent survey namely *Osteochilus spilurus* (listed in both Ng et al. 1994 and Beamish et al. 2003) and *Boraras maculata* (listed by Ng et al. 1994). Both Ng et al. (1994) and Beamish et al. (2003) listed four snakeheads in their studies bring the total channiid species to five but only three were recorded in this study. We did not recorded *Channa gachua* (listed by Ng et al. 1994) and *Channa melasoma* (listed in both Ng et al. 1994 and Beamish et al. 2003). The disappearance of these species was probably due to sampling factors as these species were common to many blackwater swamps in the country.

Most of the species collected were stenotopic to acid waters (A, 19), followed by stenotopic to acid blackwaters (S, seven) and eurytopic (E, 4). Several stenotopic to acid waters species were not reported here but were recorded in either Ng et al. (1994) or Beamish et al. (2003) (see Table 1 in both publications). Among the species that went missing in the recent survey, we believed their habitat preference were not like what we sample. Despite this, species such as *Osteochilus spilurus* (Family Cyprinidae) should be found within the studied area. We assume local variation might play a role in structuring local assemblages. However, fish such as *Encheloclarias curtisoma* and fish from the family Chaudhuriidae (*Bihunichthys monopteroides*) or *Chendol keelini* may be found in the more intact swamp deep in the forest reserve.

Our findings from the rapid survey plan should be used with caution. Several species that we recorded were mostly juveniles (e.g., *Channa bankanensis*) and we did not know where the adult fish were. Although this study using rapid sampling approach, we manage to record most of the common fishes inhabit blackwater swamp at the north Selangor but less two species than that reported by Beamish et al. (2003). Our findings did not added any new record to the currently known fishes of the area but we provide the most recent fish list constitute of many common blackwater species that still thriving well in ditches along the roadsides between Sg. Besar, Selangor and Tanjung Malim, Perak. We hope these findings will be useful for the conservation and management of the North Selangor peat swamp forest in general and fishes in particular for the future.

ACKNOWLEDGEMENT

We thank Malayan Nature Society (MNS) and Forestry Department Peninsular Malaysia (JPSM) for inviting us to conduct research at the North Selangor peat swamp forest. We are grateful to PERHILITAN Sg. Dusun for allowing us to visit swamps within their area. We also thank volunteers and helpers during the expedition. We thank Ayub and Izzat for their help during the field survey. Lastly, we acknowledge the Department of Biological Sciences for providing sampling equipment and allowing us (ABA and SAR) to participate in the expedition.

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Table 1 : Fish species recorded from ditches along the roadsides at NSPSF.

No.	Family	Species	Remarks	Status
1.	Cyprinidae	*Desmopuntius hexazona*	a, b	A
2.		*Desmopuntius johorensis*	a, b	A
3.		*Rasbora cephalotaenia*	a, b	A
4.		*Rasbora einthovenii*	a	A
5.		*Rasbora kalochroma*	a, b	A
6.		*Trigonopoma pauciperforatum*	b	A
7.	Cobitidae	*Lepidocephalichthys tomaculum*	a	A
8.	Balitoridae	*Neohomaloptera johorensis*	a	S
9.	Siluridae	*Kryptoterus macrocephalus*	b	A
10.		*Silurichthys indragiriensis*	a	A
11.	Clariidae	*Clarias* cf. *leiacanthus*	a, juvenile	A
12.	Bagridae	*Mystus bimaculatus*	a, b	S
13.	Zenarchopteridae	*Hemirhamphodon pogonognathus*	a	A
14.	Mastacembelidae	*Mastacembelus* cf*. circumcinctus*	a; juvenile	A
15.	Nandidae	*Nandus nebulosus*	a	A
16.	Anabantidae	*Anabas testudineus*	b	E
17.	Helostomatidae	*Helostoma temminckii*	a, b	A
18.	Osphronemidae	*Belontia hasselti*	a, b	A
19.		*Betta hipposideros*	a	S
20.		*Betta bellica*	a	A
21.		*Betta livida*	a	S
22.		*Luciocephalus pulcher*	a, b	A
23.		*Parosphromenus harveyi*	a	S
24.		*Sphaerichthys osphromenoides*	a, b	S
25.		*Trichopodus leeri*	a, b	A
26.		*Trichopodus trichopterus*	a	E
27.		*Trichopsis vittatus*	a, b	E
28.	Channidae	*Channa bankanensis*	a, b	S
29.		*Channa lucius*	a	A
30.		*Channa striatus*	b	E

Remarks:
a. roadside ditches along the road from Sg. Besar to Tg. Malim
b. peat swamp near PERHILITAN Sg. Dusun
A. Stenotopic to acid waters, E. Eurytopic (acid to neutral or slightly alkaline), S. Stenotopic to acid blackwaters

Fish Fauna Assemblages & Their Distribution Patterns in the North Selangor Peat Swamp Forest

RYON SIOW[1], MOHD NAJIB RAMLI[2], MOHAMAD HAFIZ MUSHIDI SHAKORI[2] & MUSTAFA ASMUNI[1]

Abstract : A fish inventory study was carried out to quantify the number of fish species and their distribution patterns in the North Selangor Peat Swamp Forest during the Selangor Scientific and Biodiversity Expedition 2013 (Phase 2). Fish sampling was undertaken using multiple types of gears such as drift nets, rods and lines and traps according to the suitability of the sampling locations. Four sites (Site 1 to Site 4) with various types of water bodies (canal, pool, stream, river) were investigated during the course of this study. Water quality of the study sites was also analyzed. A total of 24 species of fishes from 10 families were caught and identified. Labyrinth fishes (Anabantoids) formed nearly half (49%) of the total catch individuals, followed by small Cyprinids (18%) and Others (33%). The types of habitat and water quality play a great part in determining the distribution of fish species in the peat swamp forest. Near anoxic water condition and high acidity in many black water bodies in the peat swamp forest limit the diversity of fishes able to thrive in such conditions. However, fish species which are able to survive in such conditions have developed very specialized adaptations which enable them to thrive in the waters of the peat swamp forest.

[1] Freshwater Fisheries Research Centre, FRI Glami Lemi, 71650 Titi, Jelebu, N. SEMBILAN
[2] Resource Protection Division, Department of Fisheries Malaysia, Wisma Tani, Level 5, Blok Menara 4G2, Precinct 4, 62628 PUTRAJAYA
* Corresponding author: ryonsiow@dof.gov.my

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Ryon Siow,[1*], Mohd Najib Ramli[2], Mohamad Hafiz Mushidi Shakori[2] & Mustafa Asmuni[1]

[1]Freshwater Fisheries Research Centre, FRI Glami Lemi, 71650 Titi, Jelebu, N. SEMBILAN.
[2]Resource Protection Division, Department of Fisheries Malaysia, Wisma Tani, Level 5, Blok Menara 4G2, Precinct 4, 62628 PUTRAJAYA.

Introduction

- A fish inventory study was carried out in the North Selangor Peat Swamp Forest during the Selangor Scientific and Biodiversity Expedition 2013 (Phase 2, 25-28 June 2013).
- Fish sampling was undertaken using multiple types of gears according to the suitability of the sampling locations:
  - drift nets (soak time 24 hours)
  - Electroshocker
  - rods and lines
  - Traps (soak time overnight)
- Site 1 to Site 4 were investigated.
- Some water samples were collected and analyzed.

Sampling Site Locations

Results – Water Quality Analyses

Parameter	Site 2	Site 3	Site 4
Ammonium (NH4)	3.20	0.15	6.75
Nitrite (NO2)	0.037	0.005	0.074
Phosphate (PO4)	0.02	0.25	0.15
Sulfide (S2-)	0.021	0.002	0.041
Tannic Acid	9.50	0.50	27
TSS	0.6	44.4	3.6
pH	2.90	4.90	2.74
Dissolved Oxygen (Surface)	0.20	4.99	0.83
Dissolved Oxygen (Bottom)	0.07	5.20	

All values in mg/L except pH

List of Fish Species

Anabantidae
1. Puyu (*Anabas testudineus*)

Bagridae
2. Baung Sungai (*Hemibagrus nemurus*)
3. Baung Pisang (*Lexocassis poecilopterus*)
4. Engge-Engge (*Mystus nigriceps*)
5. Senggring Batu (*Bagrichthys macracanthus*)

Channidae
6. Haruan (*Channa striata*)

Clariidae
7. Keli Bunga (*Clarias macrocephalus*)
8. Keli Kayu (*Clarias batrachus*)

Cyprinidae
9. Lampam Jawa (*Barbonymus gonionotus*)
10. Seluang (*Rasbora kalochroma*)
11. Seluang (*Rasbora sumatrana*)
12. Seluang (*Trigonopoma gracile*)
13. Seluang Papan (*Puntius johorensis*)

Helostomatidae
14. Temakang (*Helostoma temminkii*)

Nandidae
15. Patong (*Pristolepis fasciata*)

Osphronemidae
16. Biji Durian (*Sphaerichthys osphromenoides*)
17. Pelaga (*Betta pugnax*)
18. Sepat Ronggeng (*Trichopodus trichopterus*)
19. Sepitai (*Trichopsis vittata*)
20. Tembok Tebing (*Luciocephalus pulcher*)

Siluridae
21. Lais (*Kryptopterus* sp.)
22. Lais (*Ompok fumidus*)
23. Tapah (*Wallago leerii*)

Synbranchidae
24. Belut (*Monopterus albus*)

Caridea
25. Udang Sungai

Fish Samples


Baung Sungai (*Hemibagrus nemurus*)


Baung Pisang (*Lexocassis poecilopterus*)


Belut (*Monopterus albus*)


Biji Durian (*Sphaerichthys osphromenoides*)

Fish Samples


Engge-Engge (*Mystus nigriceps*)


Haruan (*Channa striata*)


Keli Bunga (*Clarias macrocephalus*)


Keli Kayu (*Clarias batrachus*)

Fish Samples


Lais (*Kryptopterus* sp.)


Lais (*Ompok fumidus*)


Lampam Jawa (*Barbonymus gonionotus*)


Patong (*Pristolepis fasciata*)

Fish Samples


Tapah (*Wallago leeri*)


Temakung (*Helostoma temminkii*)


Seluang (*Rasbora sumatrana*)


Senggiring Batu (*Bagrichthys macracanthus*)

Fish Samples


Sepat Roriggeng (*Trichopodus trichopterus*)


Sepilar (*Trichopsis vittata*)


Pelaga (*Betta pugnax*)


Puyu (*Anabas testudineus*)

Fish Samples


Seluang (*Trigonopoma gracile*)


Tembok Tebing (*Lucicephalus pulcher*)


Seluang Papan (*Puntius johorensis*)

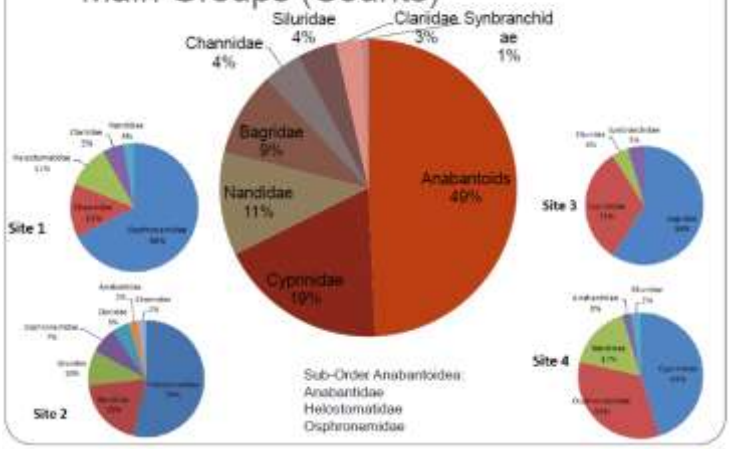

Seluang (*Rasbora kalochroma*)

Other Samples


River Shrimp


Elephant Trunk Snake (?)

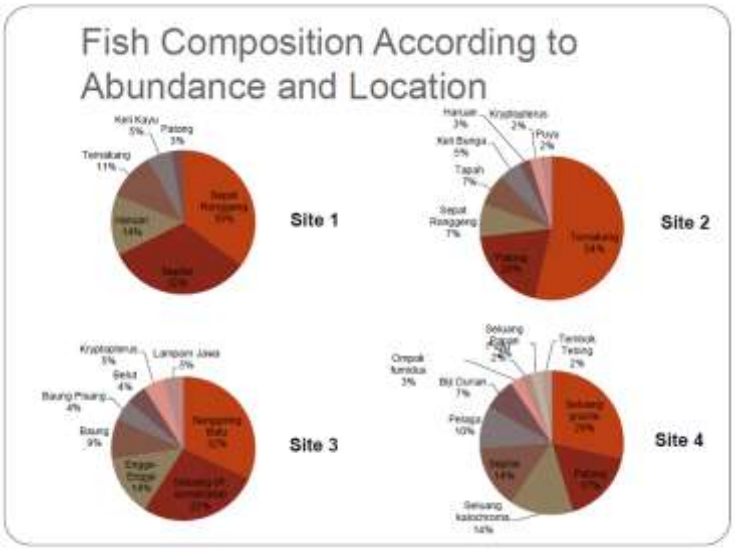
Fish Composition According to the Main Groups (Counts)



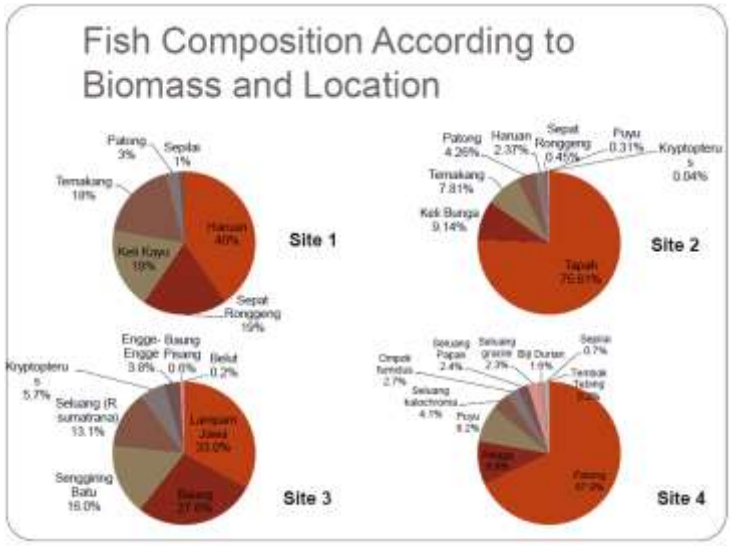
Fish Species Distributing and Abundance Ranking

Site 1	Site 2	Site 3	Site 4
Trichopodus trichopterus	*Helostoma temminkii*	*Bagrichthys macracanthus*	*Trigonopoma gracile*
Trichopsis vittata	*Pristolepis fasciata*	*Rasbora sumatrana*	*Pristolepis fasciata*
Channa striata	*Trichopodus trichopterus*	*Mystus nigriceps*	*Rasbora kalochroma*
Helostoma temminkii	*Wallago Leerii*	*Hemibagrus nemurus*	*Trichopsis vittata*
Clarias batrachus	*Clarias macrocephalus*	*Barbonymus gonionotus*	*Betta pugnax*
Pristolepis fasciata	*Anabas testudineus*	*Kryptopterus sp*	*Sphaerichthys osphromenoides*
	Channa striata	*Leiocassis poecilopterus*	*Anabas testudineus*
	Kryptopterus sp	*Monopterus albus*	*Luciocephalus pulcher*
			Ompok fumidus
			Puntius johorensis
6 species	***8 species***	***8 species***	**10 species**

Fish Composition According to Abundance and Location



Fish Composition According to Biomass and Location



Fish Diversity in the Peat Swamp

- Labyrinth fishes (Anabantoids) formed nearly half (49%) of the total catch individuals
- The types of habitat and water quality play a great part in determining the distribution of fish species in the peat swamp forest.
- The true diversity of Tengi River may be higher as the sampling was hampered by the wet weather the night before (heavy flushing caused the entrapment of debris in the nets)

Fish Diversity in the Peat Swamp

- Near anoxic water condition and high acidity in many black water bodies in the peat swamp forest limit the diversity of fishes able to thrive in such conditions.
- However, fish species which are able to survive in such conditions have very specialized adaptations which enable them to thrive in the waters of the peat swamp forest (i.e. air breathing organs, vascularized skin, body size, etc.).

Thank you

Contact: ryonsiow@dof.gov.my

A Camera Trap Survey of Mammals in NSPSF: Flat-Headed Cat & Malayan Tapir

BOYD SIMPSON[1,2] AND MARIANI BT RAMLI[1,2]

Abstract : A camera trapping study was undertaken in the NSPSF to assess the status of the flat-headed cat (*Prionailurus planiceps*) and Malayan tapir (*Tapirus indicus*). A total of 20 camera traps were placed at three locations (Track 3, 4 & 6) within the forest, and set to capture either video or still pictures. Cameras were operational for approximately 2 months, (from late June to mid-late August 2013) operating for 949 trap nights. More than 900 images were captured, from which we obtained 320 independent (1 hour separated) pictures of animals. Medium-large sized mammals were represented by 10 species (or types), of which the most common were pigs (79 pictures), mouse deer spp. (69 pictures) and sunbears (25 pictures). We only recorded 6 images of the Malayan tapir, which corresponds to a RAI of 0.63 pics/100TN. No photographs were obtained for the flat-headed cat. Track 6 was the most species diverse, being represented by 9 of the 10 larger mammal species. Camera placement seemed to greatly influence the species captured, both in respect to the site (Track) and microhabitat placement of the camera.

[1] Faculty of Science and Technology, Universiti Kebangsaan Malaysia
[2] Copenhagen Zoo, Department of Research & Conservation, Denmark (Malaysia Programme)


NSPSF Scientific Expedition
ZOO
COPENHAGEN
Mariani Ramli
Boyd Simpson
Universiti Kebangsaan Malaysia

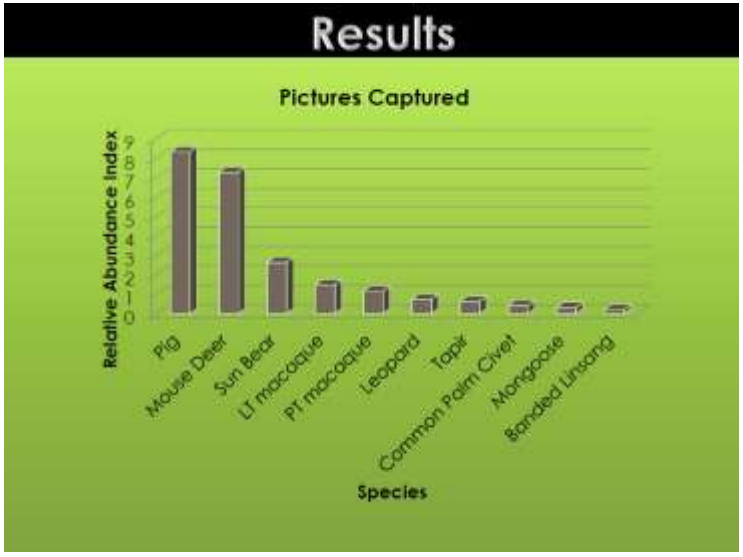

Camera Trapping
Setting up camera traps
20 traps
Trails 3, 4, 6
3 basic types of traps
IR still pics
IR video
Xeon (white) flash still pics


Camera Trapping
Leave cameras out for 6-8 weeks


Camera Trapping
Looking for mammal species:
Malayan Tapirs
Flat-headed cats


Malayan Tapir
Tapirs live in primary and old logged forests
LOWLANDS: Found mostly below about 1000m


Flat-headed cat
Restricted to Peninsular Malaysia, Thailand, Borneo, Sumatra
Endangered (habitat loss)
Patchy wetland distribution
Feeds on fish, other aquatic sp (frogs, prawns)
small birds, etc


Results
Pictures Captured
Relative Abundance Index
0
1
2
3
4
5
6
7
8
9
Pig
Mouse Deer
Sun Bear
LT macaque
PT macaque
Leopard
Tapir
Common Palm Civet
Mongoose
Banded Linsang
Species


Results
Tracks Richness
Relative Abundance Index
0
2
4
6
8
10
12
14
16
18
20
3
4
6
Tracks
pig
mouse deer
bear


Trail 3 – Sun Bear
Trail 6 – Mouse Deer
PICTURES
Trail 6 – Common Palm Civet
Trail 4 – Red Junglefowl


VIDEOS
Trail 3 – Tapir


Trail 6 – Sun Bear
07/05/2013 08:20:51
15 Sec


Trail 3 – Leopard

Conclusion

- Camera placement affects the species captured
  - Track
  - Microhabitat
- To get better understanding of the Biodiversity
  - More Cameras
  - Longer Times
  - More Tracks / Habitat
- No results for Flat-headed Cat. Require detailed study to obtain accuracy
- The density seems a bit low for Tapirs compared to other forest.

Crocodile Survey

- False Gharial or Tomistoma
- Buaya Jenjulong
- Start night survey at Trail #5
  - ~24km
  - Trail 3 is about half way
- *No crocodiles seen*
- *Local people – Crocodile still in the track 5 area*

Acknowledgement

- Department of Forestry
- Malaysian Nature Society
- Universiti Kebangsaan Malaysia
- Department of Wildlife and National Park
- Volunteers and students from MNS


Trail 4 – Cow


Trail 3 – Pig

An Assessment of Peat Depth and Carbon Content at North Selangor Peat Swamp Forest

HOLLY BARCLAY[1] & SONJA C. RAUB[1]

Abstract : The soils of tropical peat swamp forests contain large amounts of carbon (in the form of partially decomposed plant material) which accumulates over time under natural hydrological conditions. Southeast Asian peatlands contain an estimated 42,000 Million metric tonnes (Mt) of soil carbon. Land-use change, particularly drainage and logging, leads to changes in the soil environment so that large amounts of CO_2 are released due to burning and/or soil decomposition. The aim of our study was to carry out a preliminary survey to estimate the amount of carbon stored in the soil at North Selangor Peat Swamp Forest (NSPSF) as part of the Malaysian Nature Society (MNS) "NSPSF Scientific Biodiversity Expedition 2013". We collected peat cores at 18 locations in Raja Musa Forest Reserve and Sungai Karang Forest Reserve in order to determine the peat depth and composition at each sampling site. Mean peat depth across all our survey points was 3.0±0.95m, with the deepest peat occurring at site 2A (5.2m) and transect 3A (3.77m). Average bulk density was 0.14±0.06gcm^{-3} for the samples we collected and mean carbon content was 52.4±2.4%. Based on our survey results, the estimated carbon pool at NSPSF is 2200.8tCha^{-1} which is equal to a total carbon pool of 0.16GtC (= 1.6 x 10^8 tonnes of carbon) stored in peat across the entire NSPSF area (72,800 hectares). Our surveys provide only a very preliminary indication of the peat thickness and composition at NSPSF – more in-depth sampling is needed to describe the soil conditions across the forest. However, our data indicates that the deep peat around transect 2, an area which currently undergoes frequent burning, may be a particularly important site to target fire prevention and forest restoration activities in order to minimize CO_2 emissions and maximise long-term carbon storage at NSPSF. In addition, our results indicate that despite its extensive history of logging and soil drainage, NSPSF remains a regionally important site for carbon storage. Protecting this forest from further degradation and rehabilitating denuded sections of peat as in the Raja Musa Forest Reserve Rehabilitation Programme would be an effective strategy for the Selangor government to minimise CO_2 emissions at the same time as conserving biodiversity.

[1] Monash University Malaysia, Jalan Lagoon Selatan, Petaling Jaya, 47500 Selangor, Malaysia. Telephone: +603 5514 6000 ext. 61524, Fax: +603 5514 6099
* Corresponding author: holly.barclay@monash.edu

INTRODUCTION

Although Southeast Asia's largest remaining areas of tropical peat swamp forest are found in Indonesia, Malaysia also contains large areas of peat swamp forest which are of global significance for both biodiversity conservation and long-term carbon storage(Posa, Wijedasa & Corlett 2011).

The ecology of peat swamp forests is to a large extent determined by their soils – undrained peat consists of partially decomposed plant material (leaves, branches, roots, tree trunks) (approx. 10% by weight) and water (90%)(Hooijer *et al.* 2010). Tropical peat soils are formed over thousands or even tens of thousands of years from plant remains which break down slowly due to the waterlogged, low nutrient, anoxic conditions found in these soils (Page *et al.* 1999). In other types of tropical forest, the majority of the carbon which is taken up by plants during photosynthesis is stored in the living biomass (e.g. trees) and in a relatively thin layer of leaf litter on the surface of the forest floor (Davies, ASEAN & GEC 2011) - i.e. a large proportion of carbon storage occurs above the soil surface. In peat swamp forests, the carbon taken up by plants is stored not only in the living biomass and leaf litter on the soil surface but also in the deeper soil layers where the plant material decomposes very slowly – i.e. there is a large amount of carbon which is stored below-ground in addition to the above-ground carbon storage. For an Indonesian peat swamp forest growing on peat which is 5.5m deep, Page, Rieley & Banks (2011) estimated that for every 1 tonne of carbon stored in the above-ground forest biomass more than 18.5 tonnes of carbon is stored below-ground in the peat. Hence peat swamps serve as active carbon sinks where stored carbon in the form of detrital matter remains preserved as long as high peat water table levels are maintained.

Globally, peatlands (including tropical, temperate and boreal regions) cover only 3% of the Earth's land surface yet are estimated to store the equivalent of 75% of all the carbon contained in the atmosphere (Davies *et al.* 2011). Disruption to these natural carbon stores – particularly through burning and drainage (when the soil is no longer waterlogged microbial activity increases leading to higher rates of decomposition along with natural oxidation of organic matter) – releases CO_2 into the atmosphere. For this reason, drainage and burning of tropical peatlands is increasingly an issue of global concern due to the impact these emissions will have on the Earth's atmospheric composition and climate (Page *et al.* 2002; Hooijer *et al.* 2006).

Tropical peatlands store globally significant quantities of carbon due to the accumulation of organic matter that is recalcitrant (slow to decompose), high carbon content and rapid peat accumulation rates (Page *et al.* 2004). However the amount of carbon which is held within tropical peat soils is not well known even in relatively well studied parts of the tropics, such as Malaysia, due to the need to carry out extensive field surveys to determine the size of these below-ground carbon pools (Page *et al.* 2011). The key variables which are needed to calculate the peat carbon pool are: the peat volume (which depends on the extent and thickness of the peat) and the peat carbon content (which depends on the bulk density – i.e. the percentage solid material vs. water – and the carbon content of the solid matter)(Hooijer *et al.* 2006).

As part of the Malaysian Nature Society (MNS) "North Selangor Peat Swamp Forest (NSPSF) Scientific Biodiversity Expedition" we carried out a preliminary assessment of the peat depth and peat composition at selected sites within NSPSF in order to calculate a provisional estimate of the peat carbon pool in this forest.

METHODS

Peat samples were collected during 21st – 23rd May and 3rd – 5th July 2013. We sampled 18 sites across NSPSF: two areas in Sungai Karang Forest Reserve (MNS transects 4 and 6, plus site 3F) and two areas in Raja Musa Forest Reserve (MNS transects 2 and 3A-E) (Figure 1).

Peat samples were collected using a Russian peat core sampler with a sample volume capacity of 430cm^3 and the peat depth, water table depth and percentage canopy cover were measured and recorded in the field. A sub-sample of peat samples were collected and sealed in plastic bags for further analysis in the laboratory. Samples were oven-dried at 60°C until they reach a constant weight to determine the dry peat mass. Dry bulk density was calculated by dividing the dry peat mass by the fresh sample volume. Peat carbon content as a proportion of dry soil mass was measured by a TruMac CNS Analyzer (LECO Corporation).

The peat carbon pool for NSPSF was calculated using the following equation (modified from Page *et al.* 2011):

$C_p = V_p \times BD \times C_c / 10^9$

Where:

C_p is the total carbon pool in Gt (Gigatonnes = 10^9 tonnes)
V_p is the peat volume in m^3 (peat depth x area)
BD is the mean bulk density of the samples collected for laboratory analysis in gcm^{-3}
C_c is the carbon concentration in dry peat (as a decimal number)

RESULTS

The mean peat depth for the sites we surveyed across North Selangor Peat Swamp forest was 3.0m ± 0.95m (mean ± s.d.). The deepest peat depth was recorded at site 2A (the furthest point along MNS transect 2 which was accessible by boat) at 5.2m, and the shallowest peat was recorded at sites 4F (1.48m) and 6B (1.62m), both of which are located close to the forest edge. A complete list of peat depths, water table depths and percentage canopy cover at each of our sampling sites is listed in Table 1.

A subset of peat samples collected from a range of depths were analysed to determine their bulk density and percentage carbon content. Mean bulk density (± s.d.) was 0.14±0.06gcm^{-3}. Bulk density measurements were relatively variable sampling sites and between samples collected at the same site but at different peat depths (Figure 2). Mean carbon content (± s.d.) was 52.4±2.4% and showed little variation with depth (Figure 2).

Figure 1 : Location of sampling sites within North Selangor Peat Swamp Forest

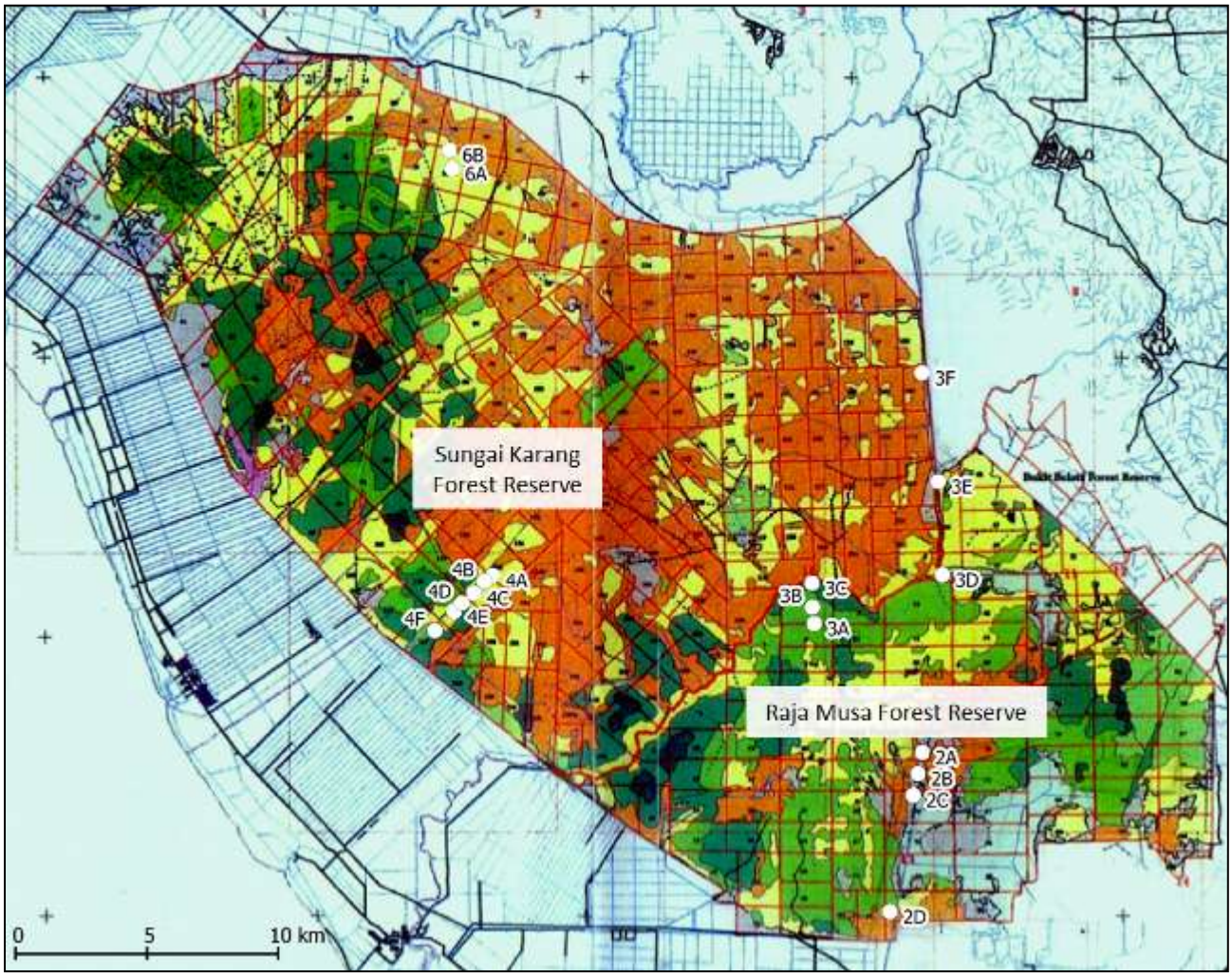
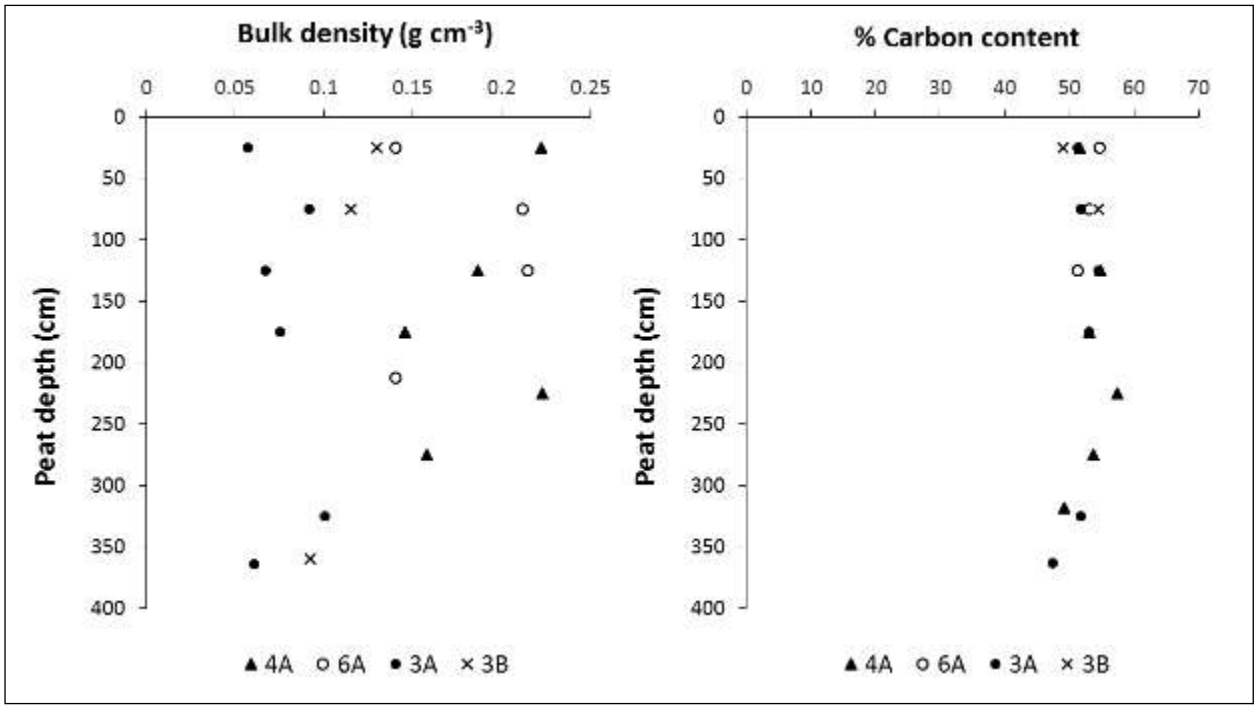


Table 1 : Peat depth, water table depth and canopy cover at different sampling sites across North Selangor Peat Swamp Forest. *Water table depth was measured from the surface of the peat to the surface of the water table on the day of sampling. We were unable to accurately determine the depth of water tables which were more than 57cm below the soil surface. **At site 2B the corer became obstructed by woody material at depths below 3m so the peat depth could not be determined at this site.

Sampling date	Site	Latitude	Longitude	Peat depth (m)	Water table depth* (m)	Canopy cover (%)
21/05/13	2A	3.48242	101.34728	5.2	-0.05	43
21/05/13	2B	3.47517	101.34581	>3**	-0.03	3
21/05/13	2C	3.46781	101.34419	3.75	-0.11	0
21/05/13	2D	3.42792	101.33622	2.83	0	75
04/07/13	3A	3.52653	101.31026	3.77	-0.25	76
04/07/13	3B	3.53210	101.30957	3.69	-0.29	81

04/07/13	3C	3.54039	101.30946	2.55	-0.53	77
23/05/13	3D	3.54319	101.35419	2.08	-0.12	77
23/05/13	3E	3.57514	101.35278	3.86	-0.40	85
23/05/13	3F	3.61231	101.34714	3.55	-0.10	86
05/07/13	4A	3.54301	101.19994	3.66	> -0.57	88
05/07/13	4B	3.54099	101.19707	2.82	-0.52	83
22/05/13	4C	3.53694	101.1935	2.95	-0.46	90
22/05/13	4D	3.53356	101.18933	2.5	-0.52	83
22/05/13	4E	3.53061	101.18675	2.55	> -0.57	81
22/05/13	4F	3.52411	101.18019	1.48	-0.36	81
03/07/13	6A	3.68219	101.18600	2.25	> -0.57	90
03/07/13	6B	3.68858	101.18507	1.62	> -0.57	83

Figure 2 : Peat bulk density and percentage carbon content at different coring sites (see Figure 1) and depths. Two samples (maximum peat depth at site 6A and 3B) are excluded from this analysis due to high mineral soil content (i.e. the peat sample also contains a significant level of underlying mineral soil which skews the % carbon analysis).



Based on the average values we recorded for peat depth (3m), bulk density (0.14gcm^{-3}) and carbon concentration (52.4%) we estimate the total amount of carbon stored within the peat at NSPSF as 2200.8tCha^{-1} (tonnes of carbon per hectare). If the aerial extent of Sungai Karang and Raja Musa Forest Reserves is 72,800ha (Yusop et al., 1999) then this average carbon pool per hectare of forest indicates a total carbon pool of 0.16GtC (= 1.6 x 10^8 tonnes of carbon) stored in the peat at NSPSF.

DISCUSSION

Tropical peat soils can reach depths of up to 20m (Anderson 1983) although the average peat depth in Malaysia and Brunei is probably closer to 7m (Page *et al.* 2011). Our surveys recorded a maximum peat depth of 5.2m at site 2A in the Raja Musa Forest Reserve. The average peat depth across the sites we surveyed was 3.0m.

More extensive surveys of peat depth at NSPSF were carried out in the early 1990s where peat depth was measured alongside the logging road which we called transect 4 in our surveys, but continuing further north into the forest. The maximum peat depth recorded in this study was 5.5m at a distance of 10km north of the main NSPSF drainage canal (Hahn-Schilling 1994). Peat depths of 4.5-5.5m were consistently recorded at coring sites beyond 7km north of forest edge (coring sites were described according to their logging license codes: PK7/66B Blocks 10 and 14 and PK10/66B Block O)(Hahn-Schilling 1994). The deepest peat according to Hahn-Schilling's surveys was recorded along a smaller drainage canal running East-West in logging license PK4/67B (which begins close to our sampling site 3F). Sampling at 600m intervals from East to West alongside this canal Hahn-Schilling (1994) recorded peat depths of 4.9m, 6.2m, 5.2m and 6m.

A second survey of peat depth in NSPSF was carried out in 1998 and recorded peat depths of approx. 3.0m at the northern edge of NSPSF and a maximum peat depth of 7.0m at a distance of 3.5km from the northern forest edge (Yusop *et al.* 1999).

Peat soils in coastal regions often form a 'dome' shape, with deeper peat layers towards the centre of the forest and shallower peat towards the edges (Anderson 1964; Davies *et al.* 2011). The deeper peat recorded by Hahn-Schilling (1994) and Yusop et al. (1999) towards the centre and north of the Sungai Karang Forest Reserve suggest that we may have found deeper peat if we had continued sampling further north along transect 4. A comparison can be made between our peat depths at sites 4A-4F which are located at approximately the same location (1.0-4.0km from the forest edge/main canal and travelling along the same logging road) as Hahn-Schilling's (1994) surveys. The peat depths we recorded at these sites were similar to Hahn-Schilling's values (1.5m peat depth at 1.0km along transect 4, increasing to 4.0m peat depth at 4km along this transect). This suggests that there may not have been a large amount of peat subsidence (soil loss due to consolidation, compaction and decomposition which occurs in drained peatlands) since Hahn-Schilling's (1994) surveys in the early 1990s. The extensive network of drainage channels around transect 4 and the low water table readings (0.36m to >0.57m below the soil surface during our surveys in May and June 2013) would be expected to cause a reduction in peat depth over time due to the loss of support from water within the peat and also due to peat decomposition. For drained forests (and plantations) with an average water table depth below 0.7m, Hooijer et al. (2012) recorded peat subsidence rates of 5cm per year after the initial 5 years following drainage channel construction (there is a faster subsidence rate during the first 5 years following peat drainage but this would have occurred prior to the 1990s at NSPSF).

It is difficult to determine the average peat depth (and therefore to calculate the below-ground carbon storage) with any degree of accuracy for NSPSF based on only 18 peat cores, even if the additional data from previous studies by Hahn-Schilling (1994) and Yusop et al. (1999) are added to our data. In particular, there remains limited information about the peat depth and composition in the northwest of Sungai Karang FR, although our limited survey (2 locations) of peat depth in the northwest of the forest (transect 6) suggests that the peat in this area may be relatively shallow (1.6m and 2.3m) compared to sites in the southeast of Sungai Karang FR and across Raja Musa FR.

The mean bulk density (0.14±0.06gcm^{-3}) and percentage carbon content (52.4±2.4%) of our samples are both close to the values reported by Page *et al.* (2011): 0.08-0.13gcm^{-3} for bulk density and 56±3% for carbon concentration. Their data is based on an extensive review of the scientific literature for global tropical peatlands. Our bulk density measurements show a relatively large degree of variation between different sites and depths. This may be due to the presence of different organic matter densities from different tree species at the different core locations. Alternatively, these bulk density readings may be unreliable due to soil compression which occurs when a vertical corer is used to collect samples. Hooijer et al. (2012) determined bulk density at different depths by excavating a soil pit, the walls of which can be cored horizontally to collect samples for analysis. This method is significantly more labour intensive than our approach but would have generated more reliable data about the peat bulk density at NSPSF.

Based on our survey data, the amount of carbon stored in the soil for each hectare of forest at NSPSF is estimated to be in the region of 2200.8tCha^{-1} (or 0.16GtC in total across NSPSF). Clearly these values need to be interpreted cautiously – a significant component of the carbon pool calculation is peat volume (in m^3) which is strongly influenced by the average peat depth (in meters) which cannot be deduced accurately based on only 18 peat cores. There are large areas of the forest (particularly in the northwest of Sungai Karang FR) where the peat depth is unknown. However, our results are similar to an estimate for the per hectare carbon pool in Indonesian peatlands: 2772tCha^{-1} (Page *et al.* 2011). Drainage of peat swamp forests leads to soil compaction (shrinkage) and also soil decomposition and/or burning. Both decomposition and burning will release much of this soil carbon into the atmosphere, typically as CO_2, with global consequences for the Earth's climate. The decomposition and burning of drained tropical peatlands is estimated to release 2Gt (= 2 x 10^9 tonnes) of CO_2 per year, which is equivalent to almost 8% of global CO_2 emissions caused by burning fossil fuels (Hooijer *et al.* 2006). Maintaining a natural hydrological regime in peat swamp forest soils is therefore key to protecting these carbon stores and minimising greenhouse gas emissions in SE Asia (Rieley *et al.* 2008).

The vegetation along transect 2 (an area which burns regularly during the dry season) is dominated by ferns and other herbaceous vegetation, with a low level of tree canopy cover. The deepest peat we sampled during our surveys (5.2m) was recorded at the end of this transect – site 2A – in an area with a low level of tree cover (43% canopy cover). To help conserve the relatively deep peat in this area it is important to, as far as possible, prevent further fires from developing, e.g. by restoring the water table and replanting or enhancing natural regeneration of tree seedlings in this area. Both these rehabilitation measures will also reduce the air and peat temperatures which reduces microbial decomposition rates and therefore slows down CO_2 release (Jauhiainen *et al.* 2005).

The global impacts of CO_2 release by degraded peatlands may represent an important opportunity for financing the conservation of peat swamp forests in Malaysia. Many developing countries, particularly Indonesia, are in the process of developing forest conservation schemes which are supported by REDD (Reducing Emissions from Deforestation and Forest Degradation). REDD is a mechanism developed by the United Nations which generates financial rewards for developing countries to reduce their CO_2 emissions through increasing forest protection and/or rehabilitating degraded forests, including peat swamp forests. REDD payments for reducing CO_2 emissions from peat swamp forests can be particularly valuable due to the large amount of carbon storage per hectare in peat swamp forest soils (i.e. a large amount of CO_2 emissions can be avoided by protecting and restoring peat swamp forests). REDD payments for peat swamp forests can be equally or even more profitable than growing oil palm on peat soils (Venter *et al.* 2009). By helping to pay for the long-term protection of peat swamp forests, carbon finance mechanisms such as REDD can play a role in conserving peat swamp biodiversity, in addition to the global benefits of reducing CO_2 emissions from peat soils.

ACKNOWLEDGEMENTS

We would like to thank both the Malaysian Nature Society, particularly Balu Perumal and Nur Atiqah Binti Tahir, as well as both the Forestry Department Peninsular Malaysia (JPSM) and the Selangor Forestry Department (JPNS) for giving us access to North Selangor Peat Swamp Forest and for providing much appreciated logistical support throughout the expedition. We would also like to thank our team of student helpers who assisted with data collection: Jing Ye Gan, Kong Ving Lee, Kah Mern Lee and Joanne Tong, as well as Nor Asma Mohd. Zaki at the Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia who carried out the carbon analysis for our peat samples. Dr Bernd Hahn-Schilling provided valuable information to help us determine the location of his (1994) survey sites.

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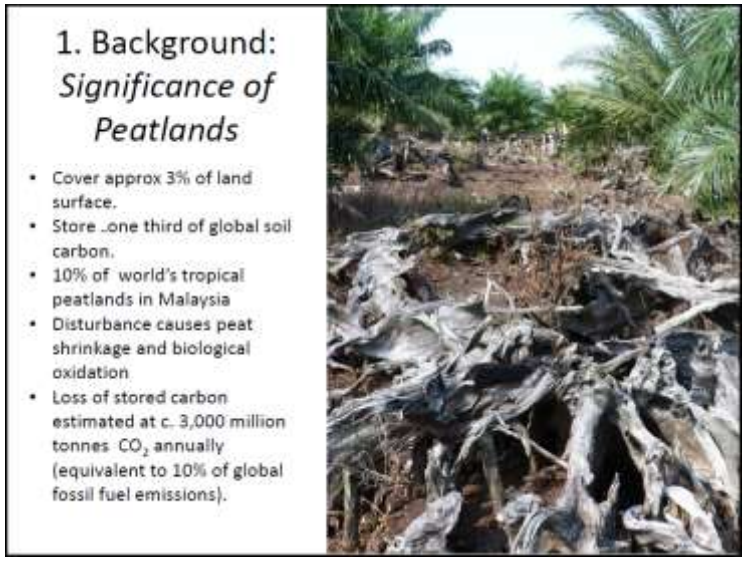
Seasonal Variation in Dissolved Organic Carbon (DOC) Concentrations within NSPSF

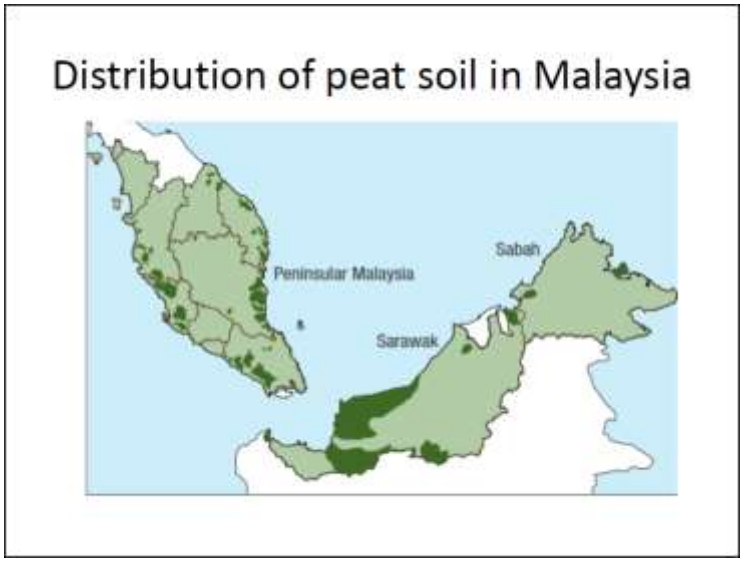
EVERS, S[1], WILLIAMS, P[2] AND PADFIELD, R[3]

Abstract : Tropical peatlands are globally significant environments that provide a range of valuable ecosystem services, including biodiversity, ground water recharge, surface water nutrient removal and, importantly, carbon sequestration. Indeed, tropical peatlands contain 3-4% (~89 Gt) of global soil carbon. However estimates on C emissions from peatlands vary greatly. Recent studies have shown that inclusion of fluvial carbon (i.e that from blackwaters) in carbon budgets increases carbon emissions by up to 20 percent of previous values. Furthermore preliminary findings suggests that this value increases with disturbed peat catchments. This paper will provide preliminary data on Dissolved organic carbon (DOC) from sites across NSPSF with the aim to determine both seasonal variation and also site-specific variation in dissolved organic carbon concentrations in blackwaters. Data will be compared to sites in S Selangor with different management strategies.

[1] University of Nottingham Malaysia Campus, Jalan Broga, 43500 Semenyih, Selangor
[2] Queens University Belfast, University Road Belfast, BT7 1NN, Northern Ireland, UK
[3] Universiti Teknologi Malaysia, Universiti Teknologi Malaysia Kuala Lumpur, Jalan Semarak, 54100 Kuala Lumpur


Seasonal Variation in Dissolved Organic Carbon (DOC) Concentrations within NSPSF
Evers, S [1], Williams, P [2] and Padfield, R [3]
The University of Nottingham
UTM
1: University of Nottingham Malaysia Campus, Jalan Broga, 43500 Semenyih, Selangor
2: Queens University Belfast, University Road Belfast, BT7 1NN, Northern Ireland, UK
3: Universiti Teknologi Malaysia, Universiti Teknologi Malaysia Kuala Lumpur, Jalan Semarak, 54100 Kuala Lumpur,
For more information on TROCARI, please visit the website (www.trocari.com) or email
Stephanie.Evers@nottingham.edu.my or rory@ic.utm.my


1. Background:
Significance of Peatlands
• Cover approx 3% of land surface.
• Store .one third of global soil carbon.
• 10% of world's tropical peatlands in Malaysia
• Disturbance causes peat shrinkage and biological oxidation
• Loss of stored carbon estimated at c. 3,000 million tonnes CO_2 annually (equivalent to 10% of global fossil fuel emissions).


Distribution of peat soil in Malaysia
Peninsular Malaysia
Sabah
Sarawak


Dissolved Organic Carbon (DOC) Losses
• Freshwaters contribute to losses via CO_2 degassing of DOC rich waters
• Limited research in tropics (mainly in temperate regions)
• Suggests DOC may represent a significant contribution to carbon flux
– How does land-use change influence the C balance within catchments?
– How does C export impact on the receiving catchment drainage waters?

NSPSF

Technology (i): Spectrolyser for DOC flux

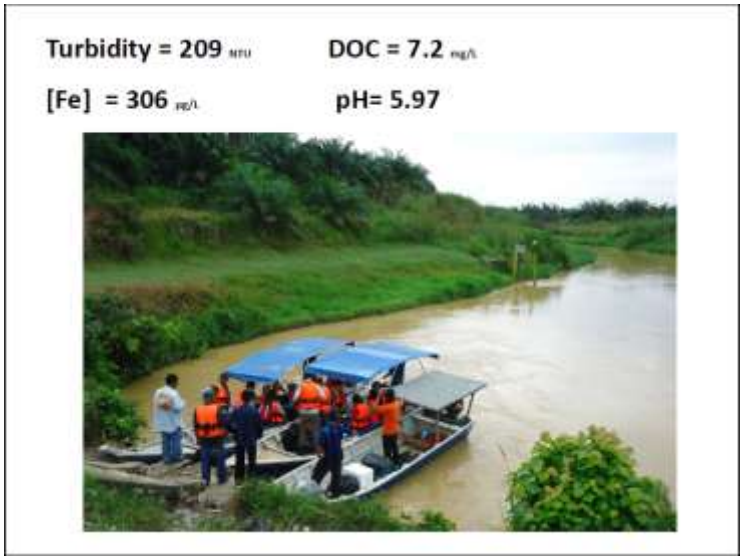
- Data logging of DOC release via associated discharge within the main catchment outflow
- Direct & instant DOC measurements (S::CAN Spectrolysor)
- Assessment of the quantity of carbon lost from the catchment via DOC over project duration period.
- Assessment against global carbon budgets & contribute towards national budgets.

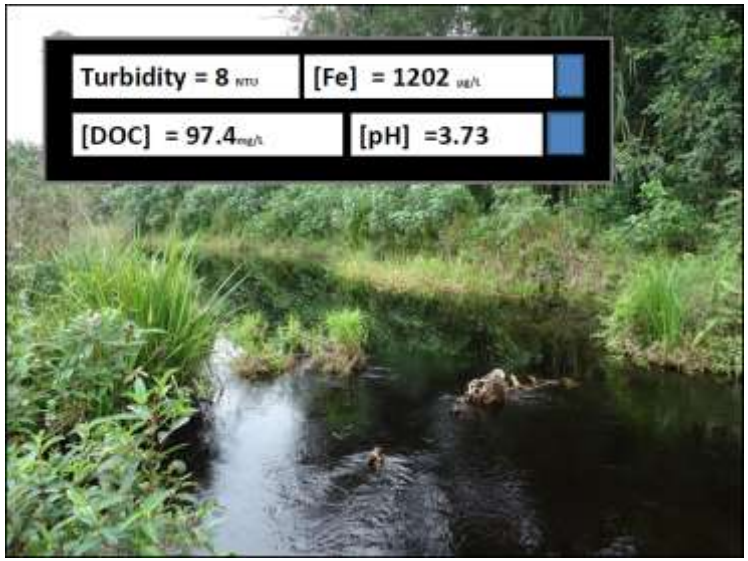
Spectrolyser: in-situ monitoring

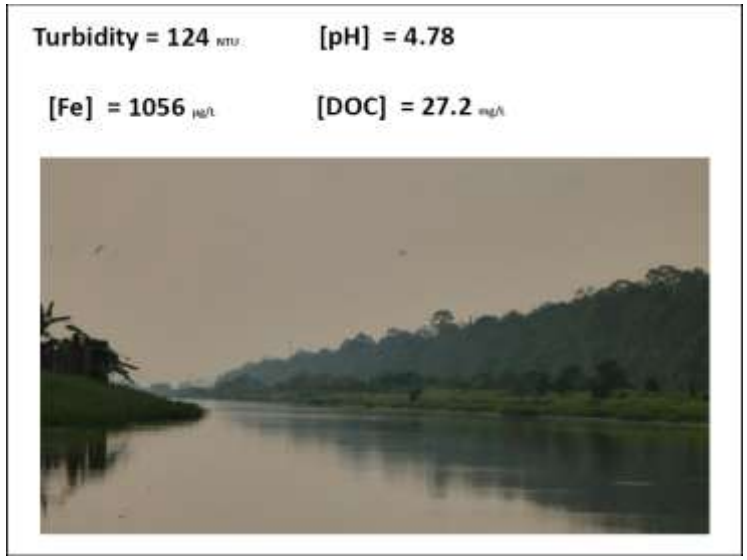
Step 1: Easy & rapid *in-situ or* lab-based monitoring

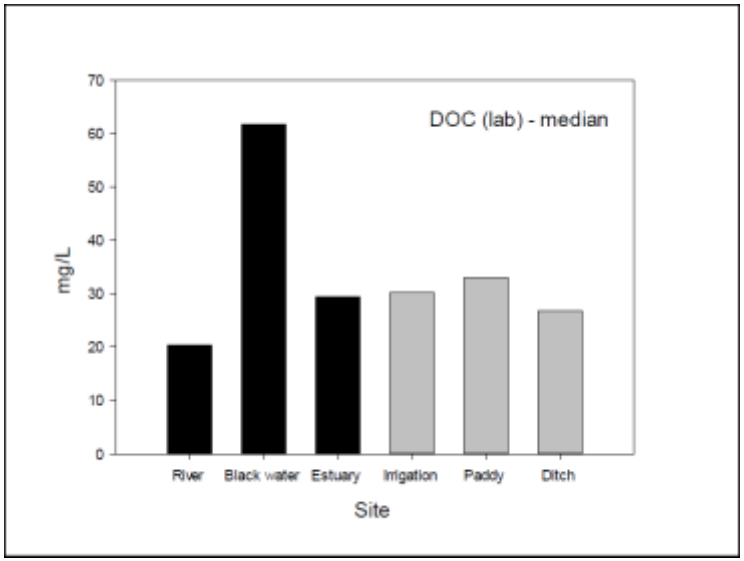
Step 2: Data digitally transferred to laptop and saved in excel file

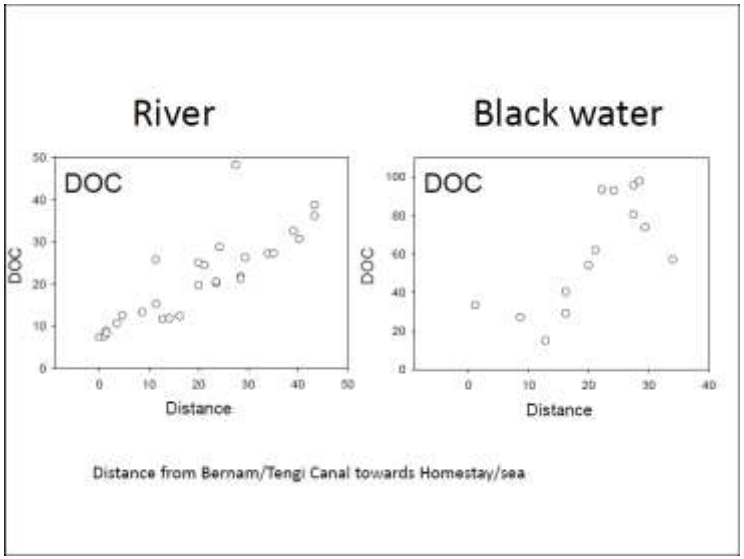
Sampling: Wet season (feb 2013)

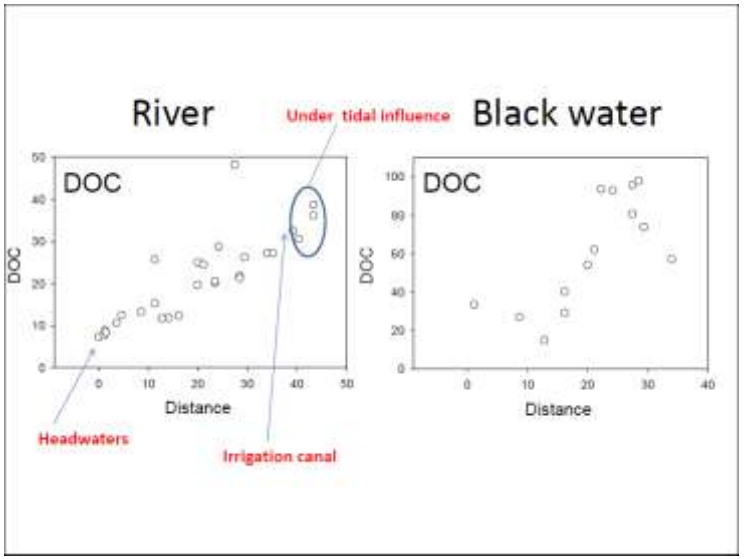

Turbidity = 209 NTU
DOC = 7.2 mg/l
[Fe] = 306 µg/l
pH= 5.97

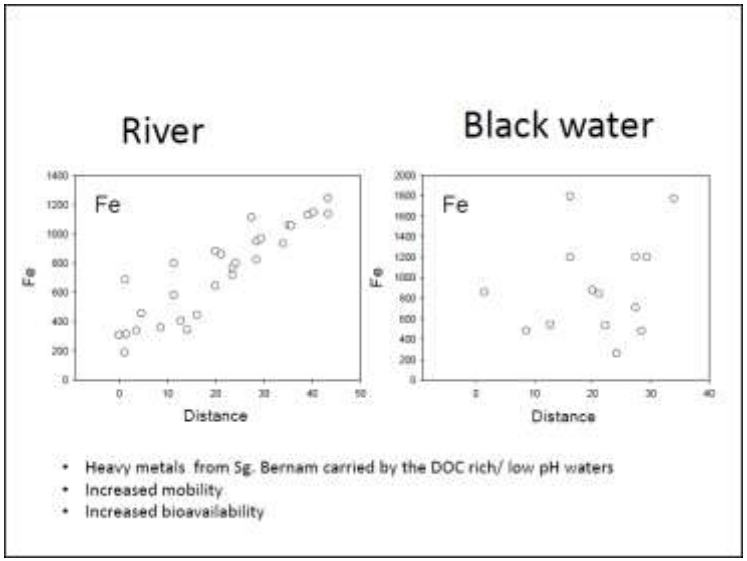

Turbidity = 8 NTU
[Fe] = 1202 µg/l
[DOC] = 97.4mg/l
[pH] =3.73


Turbidity = 124 NTU
[pH] = 4.78
[Fe] = 1056 µg/l
[DOC] = 27.2 mg/l

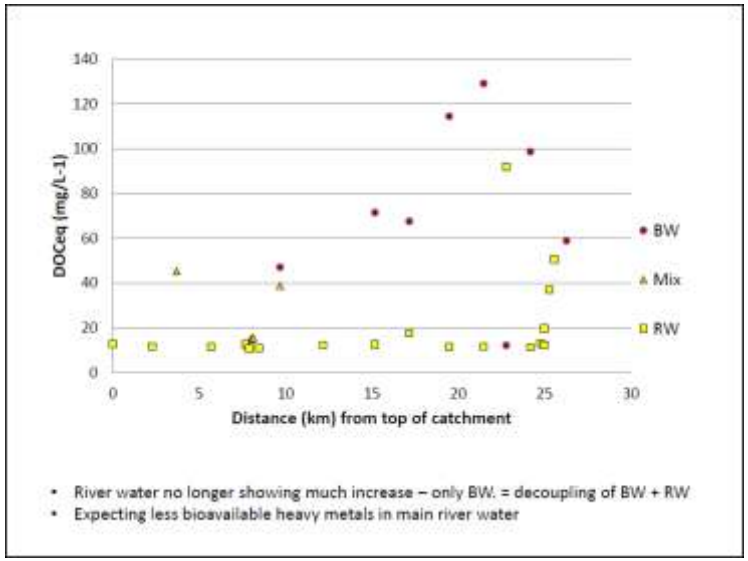

DOC (lab) - median
mg/L
70
60
50
40
30
20
10
0
River
Black water
Estuary
Irrigation
Paddy
Ditch
Site

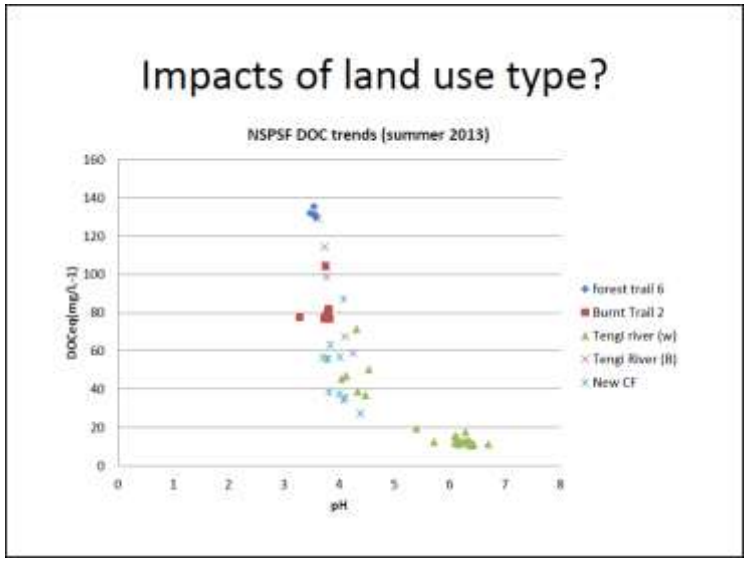

River
Black water
DOC
DOC
DOC
DOC
Distance
Distance
Distance from Bernam/Tengi Canal towards Homestay/sea

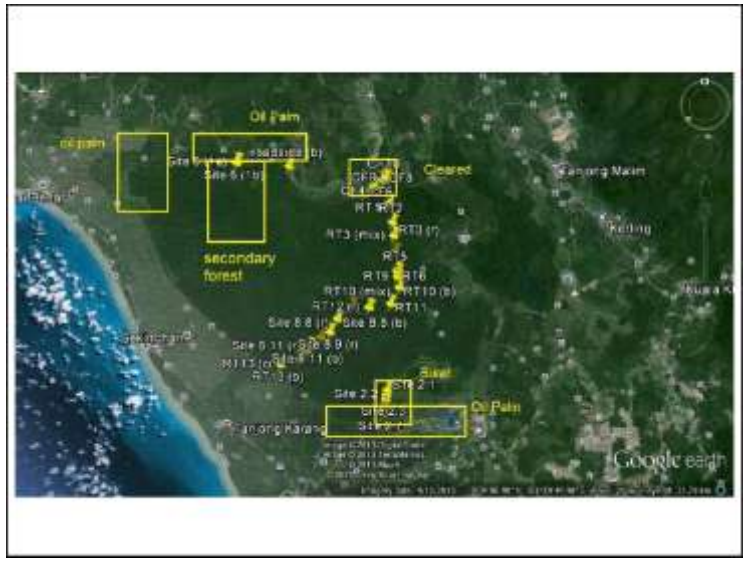

River
Under tidal influence
Black water
DOC
DOC
DOC
DOC
Distance
Distance
Headwaters
Irrigation canal


River
Black water
Fe
Fe
Fe
Fe
Distance
Distance
• Heavy metals from Sg. Bernam carried by the DOC rich/ low pH waters
• Increased mobility
• Increased bioavailability


Dry Season (July 2013)


DOCeq (mg/L-1)
Distance (km) from top of catchment
BW
Mix
RW
• River water no longer showing much increase – only BW. = decoupling of BW + RW
• Expecting less bioavailable heavy metals in main river water

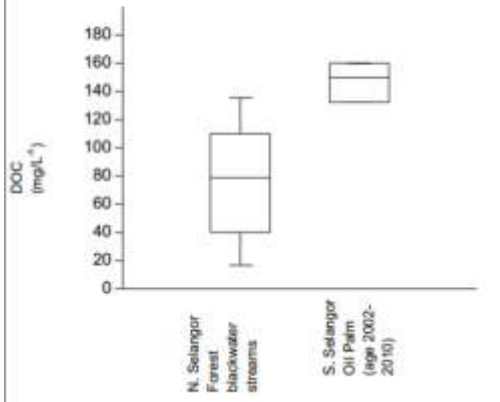

Impacts of land use type?
NSPSF DOC trends (summer 2013)
DOCeq(mg/L-1)
pH
forest trail 6
Burnt Trail 2
Tengi river (w)
Tengi River (B)
New CF


Oil palm
secondary forest
Cleared
Oil Palm
Google earth

OIL PALM ON PEAT

Over past two decades, approx. 5,861 of 21,306km^2 of peatlands in Malaysia have been converted to agriculture, oil palm plantation and infrastructure development (Wetlands International, 2010)

Comparisons with fully converted sites: KLIA



- Most recent KLIA values >200mg/L
- In comaprrison all NSPSF sites have low DOC
- Reserve status vital for this good status.

Conclusions

- Main Sg. Tengi has strong seasonality of water chemistry variations due to variations in BW influence
- Low pH/High DOC contribute to mobility and bioavailability of heavy metals which will be important to downstream rice/crop production.
- This impact likely to be reduced in dry season when Sg. Tengi chemistry 'decoupled' from BW.
- Greater C losses from S. Selangor (KLIA) OP sites
- Variation in DOC due to land use type.

Tropical Catchments Research Initiative (TROCARI)

TROCARI is a multi-stakeholder platform for the development of academic and society relevant research into tropical catchments.

www.trocari.com


TROCARI researchers would like to thank and congratulate all of the Forest Department and MNS staff involved in a fantastic 2013 biodiversity expedition. We hope there will be many more to come!!!
Thank you and any questions?

Tumbuhan Tinggi Dan Tumbuhan Ubatan Di Hutan Paya Gambut Selangor Utara, Selangor Darul Ehsan

SALLEH ENDOT, M. AZMAN YAHYA, AZIZ MAMAT, ZAILAN MOHD NOR, RAZALI AWANG HAMAT, ZULKIFLI RABI & NUR ATIQAH TAHIR

Abstrak : Sejumlah 76 spesies dalam 57 genus daripada 32 famili tumbuhan tinggi (Dipterokarpa dan bukan Dipterokarpa) telah direkodkan. Spesies komersil daripada famili dipterokarpa adalah Meranti bakau (*Shorea uliginosa*), Meranti paya (*Shorea platycarpa*) dan Mersawa paya (*Anisoptera marginata*). Spesies bukan dipterokarpa adalah Kempas (*Koompassia malaccensis*), Keranji paya (*Dialium indum*), Terentang simpoh (*Campnosperma coriaceum*), Kedondong kerantai licin (*Santiria laevigata*), Geronggang-geronggang (*Cratoxylum arborescens*) dan Nyatuh nangka merah (*Pouteria maingayi*). Lebih dari 60 spesies tumbuhan ubatan telah direkodkan.

PENGENALAN

Semasa Ekspidisi Saintifik Kepelbagaian Biologi Hutan Paya Gambut Selangor Utara pada Mei 2013 , lokasi kajian adalah di trek 3 , Hutan Simpan Raja Musa, trek 4, Hutan Simpan Sg Karang dan trek 5, Rezab Hidupan Liar Sg Dusun. Trek 3 (Kompatmen 6 HS Raja Musa) dan Trek 4 (Kompatmen 117 HS Sg Karang) merupaka kawasan hutan yang telah diusahasilkan.

KAEDAH KAJIAN

Tinjauan dan pemerhatian telah dilakukan di sepanjang trek yang telah disediakan. Pengecaman spesies pokok melalui rupa batang, takekan dan sampel daun. Merekod dan menyediakan senarai semak pokok-pokok dan tumbuhan ubatan. Semua nama-nama saintifik merujuk kepada Turner (1995).

SENARAI SEMAK

(TUMBUHAN TINGGI)

Bil	Famili	Nama Saintifik	Nama Tempatan
1.	Anacardiaceae	*Buchanania arborescens* (Blume) Blume	Otak udang daun tumpul
2.	Anacardiaceae	*Campnosperma auriculatum* (Blume) Hook. f.	Terentang daun besar
3.	Anacardiaceae	*Campnosperma coriaceum* (Jack) Hallier f. ex Steenis	Terentang simpoh
4.	Anacardiaceae	*Dracontomelon dao* (Blanco) Merr. & Rolfe	Sengkuang
5.	Anacardiaceae	*Gluta* sp	Rengas
6.	Annonaceae	*Monocarpia marginalis* (Scheff.) J. Sinclair	Mempisang
7.	Annonaceae	*Polyalthia glauca* (Hassk.) F. Muell.	Mempisang
8.	Annonaceae	*Polyalthia* sp	Mempisang
9.	Annonaceae	*Xylopia fusca* Maingay ex Hook. f. & Thomson var. *fusca*	Jangkang paya
10.	Apocynaceae	*Alstonia angustiloba* Miq.	Pulai
11.	Apocynaceae	*Alstonia scholaris* (L.) R.Br.	Pulai
12.	Apocynaceae	*Alstonia pneumatophora* Back. ex L.G. den Berger	Pulai basong
13.	Burseraceae	*Dacryodes macrocarpa* (King) H.J. Lam	Kedondong
14.	Burseraceae	*Santiria laevigata* Blume	Kedondong kerantai licin
15.	Burseraceae	*Santiria rubiginosa* Blume var. *nana* (H.J. Lam) Kalkman	Kedondong
16.	Combretaceae	*Terminalia phellocarpa* King	Jelawai mempelam babi
17.	Dipterocarpaceae	*Anisoptera marginata* Korth.	Mersawa paya
18.	Dipterocarpaceae	*Shorea platycarpa* F. Heim	Meranti paya
19.	Dipterocarpaceae	*Shorea uliginosa* Foxw.	Meranti bakau
20.	Dipterocarpaceae	*Vatica pauciflora* (Korth.) Blume	Resak laru
21.	Ebenaceae	*Diospyros lanceifolia* Roxb.	Kayu arang
22.	Ebenaceae	*Diospyros siamang* Bakh.	Kayu arang paya
23.	Elaeocarpaceae	*Elaeocarpus floribundus* Blume	Mendong

		var.*floribundus*	
24.	Elaeocarpaceae	*Elaeocarpus petiolatus* (Jack) Wall.	Mendong
25.	Euphorbiaceae	*Antidesma cuspidatum* M?ll. Arg.	Beruni
26.	Euphorbiaceae	*Baccaurea racemosa* (Reinw. ex Blume) M?ll. Arg.	Tampoi
27.	Euphorbiaceae	*Blumeodendron tokbrai* (Blume) J.J.Sm.	Gaham badak
28.	Euphorbiaceae	*Glochidion arborescens* Blume	Ubah-ubah
29.	Euphorbiaceae	*Macaranga gigantea* (Rchb. f. & Zoll.) M?ll. Arg.	Mahang gajah
30.	Euphorbiaceae	*Macaranga pruinosa* (Miq.) M?ll. Arg.	Mahang paya
31.	Euphorbiaceae	*Mallotus macrostachyus* (Miq.) M?ll. Arg.	Balik angin
32.	Fabaceae	*Adenanthera pavonina* L.	Saga daun tumpul
33.	Fabaceae	*Archidendron clypearia* (Jack) I.C. Nielsen ssp.*clypearia*	Jering monyet
34.	Fabaceae	*Callerya atropurpurea* (Wall.) Schot	Tulang daing
35.	Fabaceae	*Dialium indum* L.var.*bursa* (de Wit) Rojo	Keranji paya
36.	Fabaceae	*Koompassia malaccensis* Maing. ex Benth.	Kempas
37.	Guttiferae	*Calophyllum ferrugineum* Ridl.var.ferrugineum	Bintangor gambut
38.	Guttiferae	*Calophyllum sclerophyllum* Vesque	Bintangor paya
39.	Guttiferae	*Cratoxylum arborescens* (Vahl) Blume var.arborescens	Geronggang-geronggang
40.	Guttiferae	*Cratoxylum formosum* (Jack) Dyer	Geronggang
41.	Guttiferae	*Garcinia nigrolineata* Planch. ex T. Anderson	Kandis
42.	Guttiferae	*Garcinia parvifolia* (Miq.) Miq.	Kandis
43.	Guttiferae	*Mesua lepidota* T. Anderson var.*lepidota*	Penaga sabut
44.	Icacinaceae	*Stemonurus malaccensis* (Mast.) Sleumer	Sampul keris
45.	Icacinaceae	*Stemonurus secundiflorus* Blume	Sampul keris paya
46.	Lauraceae	*Cinnamomum altissimum* Kosterm.	Medang teja
47.	Lauraceae	*Litsea grandis* (Wall. ex Nees) Hook. f.	Medang daun lebar
48.	Lauraceae	*Litsea* sp	Medang
49.	Lythraceae	*Lagerstroemia speciosa* (L.) Pers.	Bungor
50.	Melastomataceae	*Memecylon* sp	Nipis kulit
51.	Meliaceae	*Aglaia rubiginosa* (Hiern) Pannell	Bekak
52.	Meliaceae	*Chisocheton amabilis* (Miq.) C. DC.	Pasak lingga
53.	Meliaceae	*Sandoricum beccarianum* Baill.	Sentol paya
54.	Moraceae	*Artocarpus elasticus* Reinw. ex Blume	Terap nasi
55.	Moraceae	*Ficus variegata* Blume	Ara lempong
56.	Moraceae	*Ficus* sp	Ara
57.	Myristicaceae	*Horsfieldia irya* (Gaertn.) Warb.	Penarahan pianggu

58.	Myristicaceae	*Knema plumulosa* J. Sinclair	Penarahan
59.	Myristicaceae	*Myristica lowiana* King	Penarahan arang gambut
60.	Myrtaceae	*Syzygium cerinum* (M.R. Hend.) I.M. Turner var.*cerinum*	Kelat
61.	Myrtaceae	*Syzygium subdecussatum* (Wall. ex Duthie) I.M. Turner var.*subdecussatum*	Kelat
62.	Myrtaceae	*Syzygium* sp	Kelat
63.	Ochnaceae	*Campylospermum serratum* (Gaertn.) Bittrich & M.C.E. Amaral	Lemak ketam
64.	Rhizophoraceae	*Carallia brachiata* (Lour.) Merr.	Meransi
65.	Rhizophoraceae	*Gynotroches axillaris* Blume	Mata keli
66.	Rubiaceae	*Gardenia tubifera* Wall.var.*tubifera*	Mentiong
67.	Rubiaceae	*Mitragyna speciosa* (Korth.) Havil.	Ketum /Biak
68.	Rubiaceae	*Neonauclea* sp	Mengkal
69.	Rutaceae	*Melicope glabra* (Blume) T.G. Hartley	Pepauh
70.	Rutaceae	*Melicope lunu-ankenda* (Gaertn.) T.G. Hartley	Pepauh /Tenggek burung
71.	Rutaceae	*Maclurodendron porteri* (Hook. f.) T.G. Hartley	Limau hutan
72.	Sapindaceae	*Nephelium lappaceum* L.var.pallens (Hiern) Leenh.	Rambutan hutan
73.	Sapotaceae	*Madhuca motleyana* (de Vriese) J.F. Macbr.	Nyatuh ketiau
74.	Sapotaceae	*Pouteria maingayi* (C.B. Clarke) Baehni	Nyatuh nangka merah
75.	Sterculiaceae	*Sterculia rubiginosa* Vent.var. rubiginosa	Kelumpang
76.	Thymelaeaceae	*Gonystylus bancanus* (Miq.) Kurz	Ramin melawis

(TUMBUHAN UBATAN)

Bil	Famili	Nama Saintifik	Nama Tempatan
1.	Rubiaceae	*Mitragyna speciosa* (Korth.) Havil.	Ketum / Biak
2.	Aquifoliaceae	*Ilex cymosa* Blume	Mensira
3.	Rubiaceae	*Uncaria cordata* (Lour.) Merr.var.cordata	Akar kekait
4.	Myrsinaceae	*Ardisia elliptica* hunb.	Mempenai
5.	Guttiferae	*Cratoxylum formosum* (Jack) Dyer	Geronggang derum
6.	Marattiaceae	*Angiopteris evecta* (G. Forst.) Hoffm.	Paku gajah
7.	Pandaceae	*Pandanus immersus* Ridl.	Mengkuang paya
8.	Dilleniaceae	*Tetracera indica* (Christm. & Panz.) Merr.	Akar mempelas
9.	Nepenthaceae	*Nepenthes gracilis* Korth.	Periok kera
10.	Cecropiaceae	*Poikilospermum suaveolens* (Blume) Merr.	Mera
11.	Rutaceae	*Maclurodendron porteri* (Hook. f.) T.G. Hartley	Limau hutan / Sejagung
12.	Rubiaceae	*Mussaenda glabra* Vahl	Balik adap

13.	Blechnaceae	*Stenochlaena palustris* (Burm. f.) Bedd.	Paku miding
14.	Palmae	*Licuala spinosa* Wurmb	Pokok palas
15.	Adiantaceae	*Pityrogramma calomelanos* (L.) Link	Paku hitam
16.	Myrsinaceae	*Ardisia crenata* Sims	Mata pelandok
17.	Gramineae	*Saccharum arundinaceum* Retz.	Teberau
18.	Palmae	*Eleiodoxa conferta* (Griff.) Burret	Asam paya / kelubi
19.	Melastomataceae	*Dissochaeta celebica* Blume	Senduduk akar
20.	Rutaceae	*Melicope lunu-ankenda* (Gaertn.) T.G. Hartley	Tenggek burung
21.	Leguminosae	*Senna alata* (L.) Roxb.	Gelenggang daun besar
22.	Melastomataceae	*Melastoma malabathricum* L.	Senduduk padang
23.	Leguminosae	*Mimosa pudica* L.var.*hispida* Brenan	Semalu renek
24.	Malvaceae	*Urena lobata* L.ssp.*lobata*	Pulut-pulut
25.	Solanaceae	*Solanum torvum* SW	Terong pipit
26.	Myrtaceae	*Psidium guava* L.	Jambu batu
27.	Leguminosae	*Uraria crinita* (L.) Desv. ex DC.	Serengan
28.	Rutaceae	*Citrus hystrix*	Limau purut
29.	Ulmaceae	*Trema cannabina* Lour.	Mengkirai
30.	Apocynaceae	*Urceola brachysepala* Hook. f.	Akar candik murai
31.	Schizaeaceae	*Lygodium salicifolium* C. Presl	Ribu-ribu
32.	Compositae	*Mikania cordata* (Burm. f.) B.L. Rob.	Selapok tunggul
33.	Piperaceae	*Piper macropiper* Pennant	Sireh hutan
34.	Ancistrocladaceae	*Ancistrocladus tectorius* (Lour.) Merr.	Jejulong akar
35.	Compositae	*Chromolaena odorata* (L.) R.M. King & H. Rob.	Pokok kapal terbang
36.	Woodsiaceae	*Diplazium esculentum* (Retz.) Sw.	Pokok Paku
37.	Gleicheniaceae	*Dicranopteris linearis* (Burm. f.) Underw.var.*linearis*	Resam
38.	Compositae	*Blumea balsamifera* (L.) DC.	Sembong / Chapa
39.	Schisandraceae	*Kadsura scandens* (Blume) Blume	Akar tengkok biawak
40.	Leeaceae	*Leea indica* (Burm. f.) Merr.	Mali-mali
41.	Melastomataceae	*Lantana camara* L.	Bunga tahi ayam
42.	Aspleniaceae	*Asplenium musifolium* J.Sm. ex Mett.	Paku langsuir
43.	Polypodiaceae	*Platycerium coronarium* (D. Koenig ex O.F. M?ll.) Desv.	Tanduk rusa
44.	Annonaceae	*Polyalthia glauca* (Hassk.) F. Muell.	Mempisang
45.	Rutaceae	*Melicope glabra* (Blume) T.G. Hartley	Pepauh
46.	Rutaceae	*Acronychia pedunculata* (L.) Miq.	Sejagung
47.	Ochnaceae	*Campylospermum serratum* (Gaertn.) Bittrich & M.C.E. Amaral	Lemak ketam
48.	Meliaceae	*Sandoricum beccarianum* Baill.	Sentol paya
49.	Gramineae	*Imperata cylindrica* (L.) P. Beauv.var.major (Nees) C.E. Hubb. ex C.E. Hubb.	Lalang
50.	Lythraceae	*Lagerstroemia speciosa* (L.) Pers.	Bungor
51.	Guttiferae	*Garcinia parvifolia* (Miq.) Miq.	Kandis
52.	Pandanaceae	*Pandanus immersus* Ridl.	Mengkuang paya
53.	Rubiaceae	*Morinda elliptica* (Hook. f.) Ridl.	Mengkudu

54.	Cyperaceae	*Mapania sumatrana* (Miq.) Benth. ssp. *pandanophylla* (F. Muell.) D.A. Simpson	Pandan biru
55.	Costaceae	*Costus speciosus* (J. K÷nig) Sm.	Setawar
56.	Piperaceae	*Piper ribesioides* Wall.	Sireh biak/sireh hutan
57.	Leguminosae	*Pterocarpus indicus* Willd.	Angsana /sena
58.	Moraceae	*Artocarpus elasticus* Reinw. ex Blume	Terap nasi
59.	Moraceae	*Ficus benjamina* L.	Ara waringin
60.	Loranthaceae	*Lepidaria kingii* (Scort. ex King) Danser	Dedalu api
61.	Asclepiadaceae	*Dischidia major* (Vahl) Merr.	Duit-duit
62.	Euphorbiaceae	*Macaranga amissa* Airy Shaw	Mesepat
63.	Apocynaceae	*Alstonia angustiloba* Miq.	Pulai
64.	Polypodiaceae	*Drynaria quercifolia* L.	Sakat lelipan
65.	Passifloraceae	*Passiflora foetida* L.	Ulat bulu

PENGHARGAAN

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GAMBAR-GAMBAR

MERANTI BAKAU
(*Shorea uliginosa*)

MERANTI PAYA
(Shorea platycarpa)

KERANJI PAYA
(Dialium indum)

NYATUH NANGKA MERAH
(Pouteria maingayi)

BEKAK
(Aglaia rubiginosa)

TUMBUHAN UBATAN

KETUM
(*Mitragyna speciosa*)

AKAR MEMPELAS
(*Tetracera indica*)

TENGGEK BURUNG
(*Melicope lunu-ankenda*)

MERA
(*Poikilospermum suaveolens*)

TERONG PIPIT
(*Solanum torvum*)

SERENGAN
(***Uraria crinita***)

Preliminary Result on the Floristic Composition of North Selangor Peat Swamp Forest and It's Correlation to Peat Depth

JULIA LO[1]

Abstract : Floristic composition of the plot in NSPSP was examined. 8 small plots were established in both Raja Musa FR and Sg. Karang FR to study the floristic composition/ aboveground biomass in relation to the peat depth of the areas. A total 44 species from 22 famili were identified. The most abundant species is *Macaranga pruinosa* with 55 individuals although more than half were concentrated at one transect where it was highly disturbed before. *Litsea gracilipes* and *Shorea uliginosa* were also well represented with more than 10 individuals. No single dominant family as all family was equally represented. Emergent trees species were represented by *Shorea uliginosa*, *Koompassia malaccense* and *Xylopia fusca*. No clear indication on the relationship between peat depth and floristic composition for flora on peat depth from 1m to 4m.

[1] Global Environment Facility (GEC)

INTRODUCTION

North Selangor Peat Swamp Forest or NSPSF is located in the north-west of Selangor State, with 73,000 hectares of land, representing the biggest peat swamp forest complex in Selangor and second largest after Southeast Pahang Peat Swamp Forest. Despite the huge area, limited studies had been carried out here except those conducted under the DANCED project (2000) and Sustainable Management of Peat Swamp Forest in Peninsular Malaysia (Chin & Havmoller, 1999).

Anderson (1963) had classified peat swamp forest of Sarawak and Brunei into 6 basic phasic communities based on above ground vegetation from the perimeter to the centre of a peat dome. Page (1999) and Mirmanto (2010) also shown that changes in vegetation or forest types in Sebangau Peat Swamp Forest are correlated in part to peat depth.

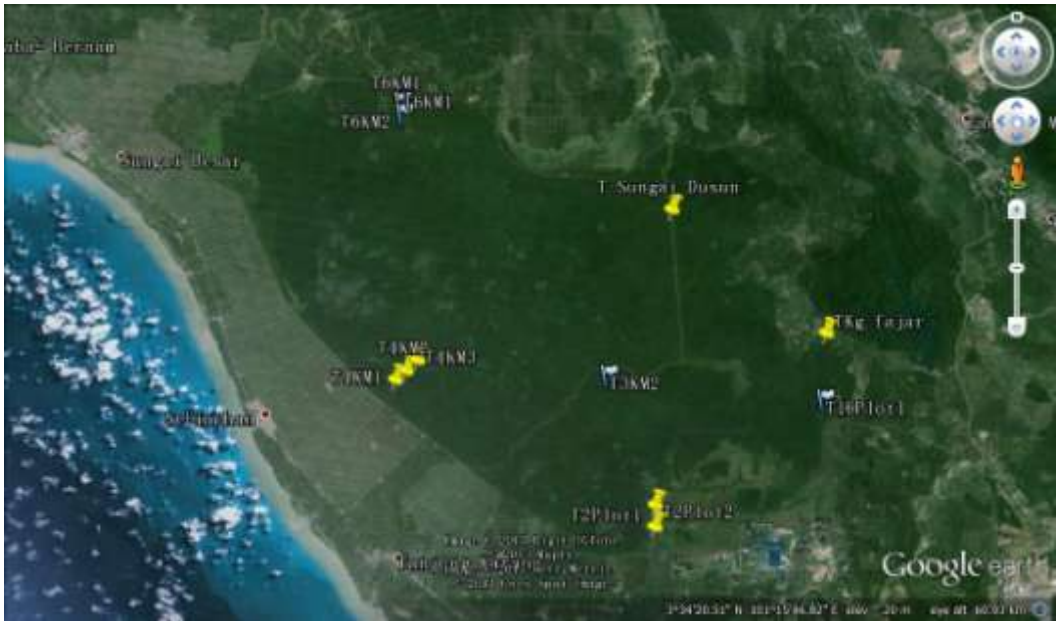
This paper attempted to find out if there is any correlation between peat depth and floristic composition of the NSPSF.

SITE DESCRIPTION AND METHODS

NSPSF, comprising of 2 forest reserves: Sg Karang Forest Reserve and Raja Musa Forest Reserve. The whole complex can be classified as logged over peat swamp forest, owing to extensive logging prior to 1990 when it was still under state land. The deepest peat depth that had been recorded is at 7m by Han-Schilling in 1994.

Owing the limitation of times, only 8 study plots, each measuring 20m x 50m was established in the pre-determined transect which was set up for the scientific expedition. Nested plot approach were used in this study; tree with dbh more than 30cm and above will be recorded in the 20m x 50m plot, tree with dbh between 15 to 30cm will be recorded inside the smaller plot of 20m x 20m, whereas tree with dbh between 5 to 15cm will be recorded in the smallest plot of 10m x 10m.

All the trees will be enumerated with their dbh taken. Voucher specimen were collected and the identification were followed those by Anderson (1972), Ng & Ibrahim (2001), Ng (1978, 1989) and Whitmore (1972a &b).



Map of Google earth with location of the plot

RESULT AND DISCUSSION

Based on a study conducted on a Virgin Jungle Forest, tree density of a peat swamp forest is found to be lower compare to those in lowland dipterocarp forest and hill dipterocarp forest (Ibrahim and Chong, 1992). NSPSF which has been subjected to extensive logging in the past would could record an even poor tree density. Of the 8 plot established, a total of 176 individuals were identified and enumerated within the plots. Total individuals in each plot range from 15 (lowest) to 30 (highest). (Table 1) This figure is lower compare to the figure from West Kalimantan (GEC unpublished data, 2010), which recorded 30-60 individuals in the plots of the same design.

Table 1 : Detail of trees individual by plots

Plot	Class A	Class B	Class C	total
Transect 4km1	22	5	3	30
Transect 4km2	12	5	4	21
Transect 4km3	14	6	9	29
Transect 6km1	12	9	8	29
Transect 6km2	10	5	3	18
Transect 3km2	4	8	8	20
Transect 2 plot1	4	2	8	14
Transect 2 plot2	9	5	1	15
	87	45	44	176

Class A: tree with dbh more than 30cm. Class B: tree with dbh between 15 to 30cm. Class C: tree with dbh between 5 to 15cm.

The most common species (Table 2) are *Macaranga pruinosa, Litsea gracilipes and Shorea uliginosa. Macaranga pruinosa* recorded the highest number of individuals. The presence of high densities pioneer species such as *Macaranga pruinosa* is an indicator that the area is heavily disturbed. From the field observation, this is certainly the case as all these plots are located nearby ex-logging bund, rail and drainage.

4 of the most of the common species: *Shorea uliginosa, Dialium patens, Xylopia fusca* and *Kompassia malaccense* are also the emergent layer. From the data, these trees are mostly found in the category A where the dbh is more than 30cm and above.

The most coveted species- Ramin is present, however it is not recorded in any of the plots.

Table 2 : commonest species in the plots

number	Common species
55	*Macaranga pruinosa*
14	*Litsea gracilipes*
12	*Shorea uliginosa*
7	*Dialium patens*
7	*Xylopia fusca*
6	*Cratoxylum arborescens*
6	*Santiria rubiginosa*
5	*Koompassia malaccense*

Peat depth and floristic composition

Of the 8 plots, 2 plots recorded peat depth between 1m to 2m, 2 plots recorded peat depth of 2m to 3m and 3 plots recorded peat depth of 3m to 4m. 1 plot without data.

Table 3 : Plots with peat depth details and species found in the respective plot (species in bold indicated dominant species)

Plot	Peat depth(m)	No of species	Species
Transect 4km1	1.48	10	*Aglaia rubiginosa, Euodia roxburgiana, Litsea crassifolia,* ***Litsea gracilipes****,* ***Macaranga pruinosa****, Santiria sp., Shorea uliginosa, Syzygium incarnatum, Timonius flavescens*
Transect 6km1	1.62	9	*Blumeodendron tokbrai,* ***Dialium patens****, Garcinia miqueli, Horsfieldia sp., Litsea gracilipes,* ***Macaranga pruinosa****, Santiria rubiginosa, Syzygium*
Transect 4km2	2.55	10	*Cratoxylum arborescens,* ***Litsea gracilipes****,* ***Macaranga pruinosa****, Madhuca sp., Shorea uliginosa, Stemonurus secundiflorus, Syzygium sp., Xylopia fusca*
Transect 6km2	2.25	12	*Campnosperma coriaceum, Cratoxylum arborescens, Diospyrus maingayi, Elaeocarpus griffithii, Euodia roxburgiana, Gonystylus bancanus,* ***Litsea gracilipes****,* ***Macaranga pruinosa****, Santiria rubiginosa, Shorea uliginosa, Syzygium sp.*
Transect 2 plot1	3.1	11	*Aglaia rubiginosa, Blumeodendron tokbrai, Dialium patens, Elaeocarpus sp.,* ***Koompassia malaccense****, Parastemon urophyllous, Polyalthia sclerophylla, Santiria rubiginosa, Stemonurus secundiflorus, Xylopia fusca*
Transect 2 plot2	3.7	9	*Anisoptera marginata, Dialium patens, Gymnacranthera eugeniifolia, Koompassia malaccense, Paratocarpus sp.,* ***Shorea uliginosa****, Syzygium havilandii, Tetractomia tetrandrum*
Transect 4km3	3.36	14	*Aglaia rubiginosa, Austrobuxus nitidus, Brackenridgea palustri, Diospyros siamang, Knema uliginosa, Koompassia malaccense, Litsea gracilipes,* ***Macaranga pruinosa****, Polyalthia hypoleuca, Shorea uliginosa, Stemonurus secundiflorus, Syzygium spp.,* ***Xylopia fusca***
Transect 3km2		7	*Blumeodendron tokbrai, Calophyllum sp.,* ***Cratoxylum arborescens****, Dialium patens,* ***Macaranga pruinosa****, Palaqium sp., Santiria laevigata F. glabrifolia,* ***Shorea uliginosa***

From the Table 3 above, the relationship between peat depth and flora is not clear. For area with peat depth from 1m to 4m, the forest type seemed similar. Species such as *Koompassia malaccense, Shorea uliginosa, Macaranga pruinosa and Cratoxylum arborescens* are the common species that can be found in most of the plots. While the emergent species are easily recognized as well as widely

distributed, the size class distribution of other species at dbh less than 30cm was found to be highly variable.

Although Anderson (1961) had classified the communities into different phasic communities, but his finding indicated that the vegetation may not correlate strongly to peat depth with two examples: a) only Phasic communities 1 type is found in Naman Forest Reserve in Rajang Delta despite the peat depth of 15m and b) at Loba Kabang Protected Forest, phasic communities 4 type is found covering the area with the shallowest peat.

On the other hand, Page et al., (1999) found that peat dome and increasing peat depth could be coincide partly with the changes in the vegetation i.e. marginal mixed forest are found on shallow peat (less than 2m) whereas thick peat support vegetation such as low pole, tall interior and very low canopy forest (ca. 10m). Mirmanto (2010) found that there is habitat preference among species to the class of peat depth. However, besides peat depth, other factors such as hydrology, chemistry and organic matter dynamics (Page, 1999) and distance to river (Mirmanto, 2010) may have influences on the type of vegetation.

Due to the locations and distance of the trails, there is no transects that cut across the either Sg Karang Forest Reserve or Raja Musa Forest Reserve. As a result of this, all the plots are located at the fringes of the 2 forest reserve, which explain the peat thickness result, where all the recorded peat depth is less 4m deep.

CONCLUSION

Past logging activities clearly played a key role in the density and diversity of the tree flora of NSPSF. The forest was quite depleted. From the result of the study, it is not possible to determine the clear relationship of peat depth and flora. More studies would be needed especially at peat dome area where peat depth is more than 4m and above before a conclusive result can be drawn.

ACKNOWLEDGEMENT

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A Brief Flora Survey of North Selangor Peat Swamp Forest

M.Y. CHEW[1], T.L. YAO[2], S. KAMARUDIN[3] & C.L. LIM[4]

Abstract : A brief flora survey was conducted along two old logging trails at the North Selangor Peat Swamp Forest. Plant specimen and voucher collection was performed for species listing, while plot sampling was conducted along a 200 m transect. The trails have relatively dry peat soil with lowered water table due to the many canals draining the forest. A total of 142 species from 115 genera and 67 families were recorded, with exceeding 46% being taxa non-specific to swampy habitats and more than 30% are common, widespread species. The trend of regeneration towards terrestrial dryland species is consistent with the lowered water table, where fast growing pioneers have an edge over swamp species more specialised to withstand waterlogging. About 54% are species known to occur naturally in peat swamps, of which 70% are trees. However, the canopy of this logged forest is mostly one-layered around 10–20 m with occasional emergents. Only 0.06 % of species recorded are endemic to Peninsular Malaysia. The total number of species per transect plot decreases 6–20% on average towards the forest edge, suspected to be caused by the canopy opening up, favouring light-demanding species that dominate and reduce the overall diversity.

Keywords. Plant survey, species list, plot sampling, peat swamp, regeneration, endemic.

[1] Botany Unit, Flora Biodiversity Program, Forest Biodiversity Division, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia. chew@frim.gov.my
[2] yaotzeleong@frim.gov.my
[3] kamarudins@frim.gov.my
[4] limchunglu@frim.gov.my

INTRODUCTION

The state of Selangor ranks a distant fourth in terms of total area of peat swamp forest in Malaysia with a total of 76,000 ha, after Sarawak (1,120,000 ha), Pahang (200,000 ha) and Sabah (120,000 ha). It exist mostly as a large continuous area at the North Selangor Peat Swamp Forest that consists of the Raja Musa (23,486 ha) and Sungai Karang (50,106 ha) Forest Reserves and part of the Sungai Dusun Wildlife Reserve. Locally, the peat swamp plays a vital role in supplying agriculture irrigation water to the Sungai Karang rice fields.

MATERIALS AND METHODS

The botany team of Forest Research Institute Malaysia (FRIM) conducted a brief survey from 1st to 4th July 2013 along two selected trails, namely the Rimba Restaurant Trail (trail no. 6) and Western Trail (trail no. 4). Both were old logging tracks with medium to closed canopy cover, stretching from the periphery boarder canal into the forest.

The team carried out general collecting of plant specimens in reproductive stage and voucher specimens of sterile trees and shrubs in both trails for species listing. Specimens with flowers or/and fruits as well as first sterile specimens marking the locality record were mounted and deposited as permanent reference collection at the Herbarium, FRIM. Specimen and associated habitat data were entered into the Botanical Research And Herbarium Management System (BRAHMS) database.

Plot sampling was conducted in 5 plots of 10 $\times$ 10 m each along Rimba Restaurant Trail at 50 m intervals, from the forest core towards the forest edge, where all trees, shrubs, climbers, herbs and epiphytes were collected and identified to species for mature plants and morpho-species level for seedlings. For trees above 10 cm, their diametres at breast height (DBH) were measured. Histograms of species number and species discovery curve were generated from plot data for analysis.

RESULTS AND DISCUSSIONS

In general, both trails have thick peat soil that is relatively dry with the water table observed at more than one metre below the ground level except in depressions. This is probably due to the many canals traversing the forest (Fig. 1) that are linked with the main periphery canal surrounding the entire North Selangor Peat Swamp Forest. Nevertheless, the period when the survey was carried out coincided with an extremely hazy dry spell. At several spots where the forest is close to the tarred road, underground peat fire was observed with the charred ground emitting intermittent puffs of smoke.

Species listing

A total of 142 species from 115 genera and 67 families were recorded, including 14 ferns and lycophytes, 25 monocots and 103 dicots. The most abundant plant life is tree and shrub, making up close to 60% of the total species, followed by climber and epiphyte that depend on the previous plant group for support. Terrestrial herb and small shrub make up less than 20% of the total species, since the two surveyed trails are largely wooded with medium to closed canopy cover (Fig. 2), allowing sunlight to penetrate only around gaps, forest edge and some inundated ponds and marshes that allow lush ground cover growth.

The species list shows that exceeding 46% of species recorded are non-specific to swampy habitats, mostly terrestrial herbs and climbers (*c*. 70%) or small, sub-canopy level trees, with more than 30% being common, widespread species usually of open, secondary growth. Examples of wasteland

species recorded are the thicket-forming fern, *Dicranopteris linearis var. linearis* (Gleicheniaceae); grass of open fields, *Imperata cylindrica* var. *major* (Gramineae); wayside weeds, the herbaceous *Asystasia gangetica* ssp. *micrantha* (Acanthaceae), the scrambling *Mikania cordata* (Compositae) and the shrubby *Melastoma malabathricum* (Melastomataceae); pioneer trees, *Mallotus macrostachyus* (Euphorbiaceae), *Archidendron clypearia* ssp. *clypearia* var. *clypearia* (Leguminosae), *Pternandra echinata* (Melastomataceae) and so on. Also present are eight naturalised species including the omni-present *Clidemia hirta* (Melastomataceae) along the trails and a feral oil palm, *Elaeis guineensis* (Palmae) that has attained an impressive height close to 20 m among a close canopied patch of forest. The trend of regeneration towards terrestrial dryland species is consistent with the lowered water table, where fast growing pioneers have an edge over swamp species more specialised to withstand waterlogging.

About 54% are species known to occur naturally in peat swamps. Of these, 70% are trees, of which 80% are main canopy trees able to attain 20–40 m or more in height. A pristine peat swamp forest has a three-layered canopy structure with emergent, middle and understorey trees (Saw, 2010). However, as the result of pass logging the current canopy is mostly one-layered around 10–20 m with occasional emergents and the tallest tree recorded at *c*. 35 m was *Cratoxylum arborescens* var. *arborescens* (Guttiferae), with a DBH close to 63 cm. None of the trees encountered has reached beyond one metre DBH, the biggest trees are mostly below 50 cm DBH. In places, pure stands of *Macaranga pruinosa* (Fig. 3) were observed.

Endemism is low with a mere 0.06 % of species recorded as endemic to Peninsular Malaysia, including three swamp specialist taxa (table 1)—*Calophyllum ferrugineum* var. *oblongifolium* (Guttiferae)*, Syzygium setosum* (Myrtaceae) and *Homalomena rostrata* (Araceae). Two new locality records are *Eucorymbia alba* (Apocynaceae), a liana (Fig. 4), and *Elettariopsis curtisii* (Zingiberaceae), a medium-sized ginger. The former has an endangered status in Peninsular Malaysia and was previously known only from fragmented forest in Johor. However, *E*. *alba* belongs to a plant group consisting of canopy-level climbers, creepers and lianas that are largely under collected in Peninsular Malaysia due to logistic difficulties in acquiring flowering or fruiting specimen, whereas immature plants are notoriously difficult to identified. Therefore, more studies are needed to ascertain for sure their status in the wild. Hence this particular collection that added a West Coast state to its previous distribution is a valuable find.

Plot sampling

The short transect of 200 m obtained a cumulative total of 90 species, covering about 63% of the total 142 species recorded. The species discovery curve (Fig. 5) from the plot data is only beginning to plateau slightly, indicating that more species, especially trees, are yet to be recorded.

The total number of tree and shrub species per plot (Fig. 6) is relatively constant, ranging from 21–23 species, only decreasing *c*. 6% (21 species) in comparison with the plot average (22.4 species) towards the edge. The number of species with only small trees, *i*.*e*. DBH below 10 cm, is two to five times more than the number of species with both big and small trees. Nonetheless, when the species list is scrutinised, close to 80% of these currently small trees can attain the main canopy level height of 20 m or more. This indicates that the forest is still at an early stage of regeneration, with most canopy level trees still at pole-size or smaller. Plot no. 2 has the least number of big trees species, this is due to the plot being dominated by *Litsea gracilipes* (Lauraceae), a common swamp species. It makes up *c*. 70% of the total individuals above 10 cm DBH, with DBH ranging from 24–43 cm. The species is not known to be gregarious, while the fruit structure shows typical animal dispersal syndrome. The phenomenon is probably a chance occurrence of a successful seed dispersal event followed by colonisation of a vacant niche in the then recently logged-over forest.

The diversity of non-tree species, including aerial climbers, creepers and epiphytes as well as terrestrial herbs and small shrubs, are slightly lower, with *c*. 20% less in species number. A typical peat swamp vegetation composition has poor ground cover and few large climbers (Saw, 2010). At this site some terrestrial herbs such as the ferns *Nephrolepis falciformis* (Nephrolepidaceae) and climbers such as Aeschynanthus parvifolius (Gesneriaceae) and *Piper macropiper* (Piperaceae) are atypically common. The total number of non-tree species (Fig. 7) decreases more than 20% on average near the edge; from a total of 25 to 14 species, the 5th plot has 40% less non-tree species than the 1st plot nearer to the core. It is suspected that as the canopy opens up towards the edge, light-demanding species dominate and reduce the overall diversity.

CONCLUSIONS AND RECOMMENDATIONS

Previous logging activities have had a marked effect on the structure as well as species composition of the North Selangor Peat Swamp forest, reducing the canopy covers, canopy layers and stand size. Nonetheless, most parts of the peat swamp is blissfully spared from further conversion, having an important role to serve —as the irrigation water catchment for the adjacent paddy fields, which are important rice production areas in Peninsular Malaysia. However, speedy regeneration to optimum state is observed to be hampered by the presence of many canals that still criss-crossed the forest, of which initially were constructed in order to lower the water table through drainage and thus facilitate the logging activities. It is hoped that these systems of drains be deactivated to better conserve the forest as a peat swamp community.

ACKNOWLEDGEMENTS

We thank Forestry Department Peninsular Malaysia and Malaysian Nature Society for inviting us to join the North Selangor Peat Swamp Expedition and their logistic support throughout the survey. The survey was funded by Forest Research Institute Malaysia (FRIM) through the Ministry of Science, Technology & Innovation (MOSTI). We are indebted to intent students C.L. Ng, S.C. Ng, Z.W. Ng and Z.Y. Shu as well as the staff of FRIM Herbarium for helping in specimens sorting & identification. Lastly we would like to thank Dr. Ruth Kiew and Dr. Richard Chung Cheng Kong for their invaluable comments on the text.

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Figure 1. The Rimba Restaurant Trail with lowered water table is traversed by many canals linked with the main periphery canal.

Figure 2 : The Western Trail stretches from the periphery boarder canal into the forest and has medium to closed canopy cover.

Figure 3 : *Macaranga pruinosa* is a facultative swamp species that dominates the forest edges of the North Selangor Peat Swamp Forest, at times forming pure stands.

Figure 4 : This unassuming seedling of a liana turned out to be *Eucorymbia alba*— an endangered liana previously known only from fragmented forest in Johor.

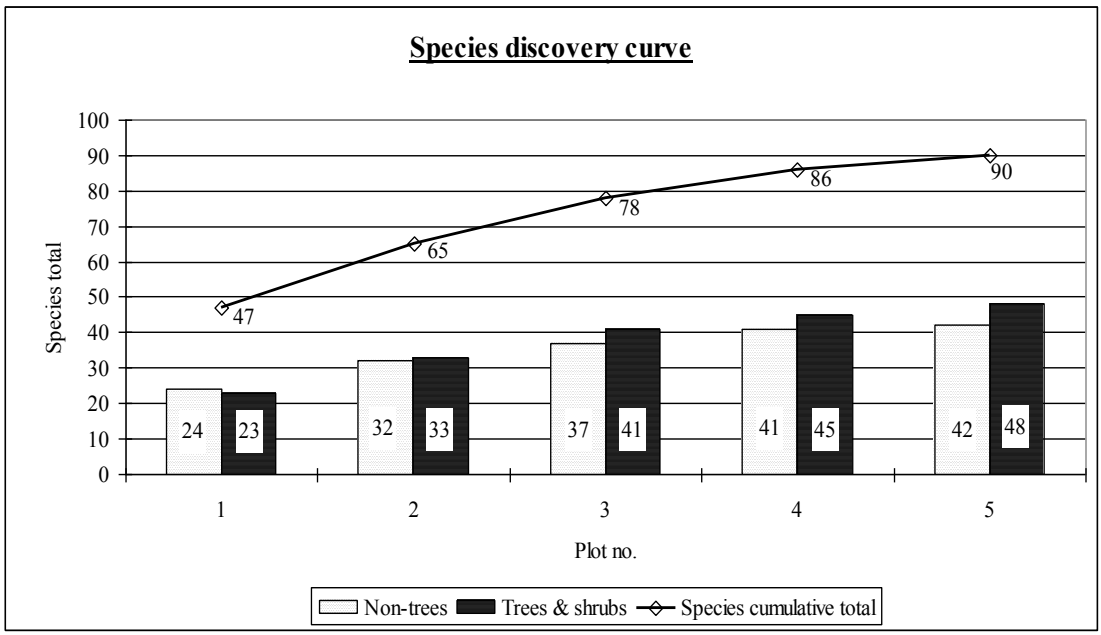


Figure 5 : The species discovery curve generated from plot data is only beginning to plateau slightly, showing that more species are yet to be recorded especially trees.

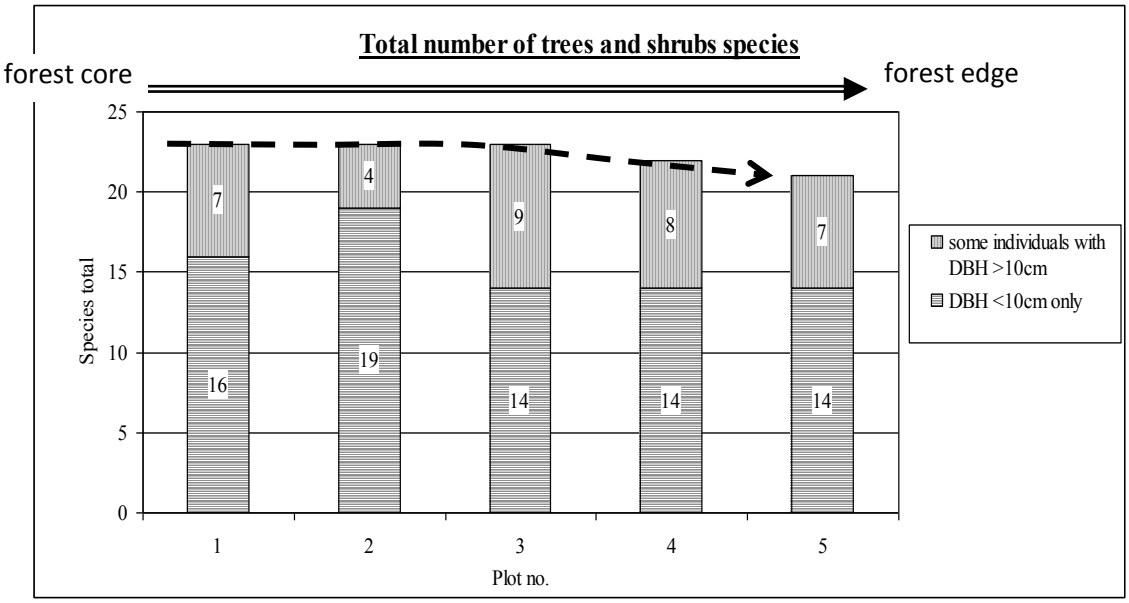


Figure 6 : The total number of tree and shrub species per plot is relatively constant, decreasing *c*. 6% in comparison with the average towards the edge (dotted arrow).

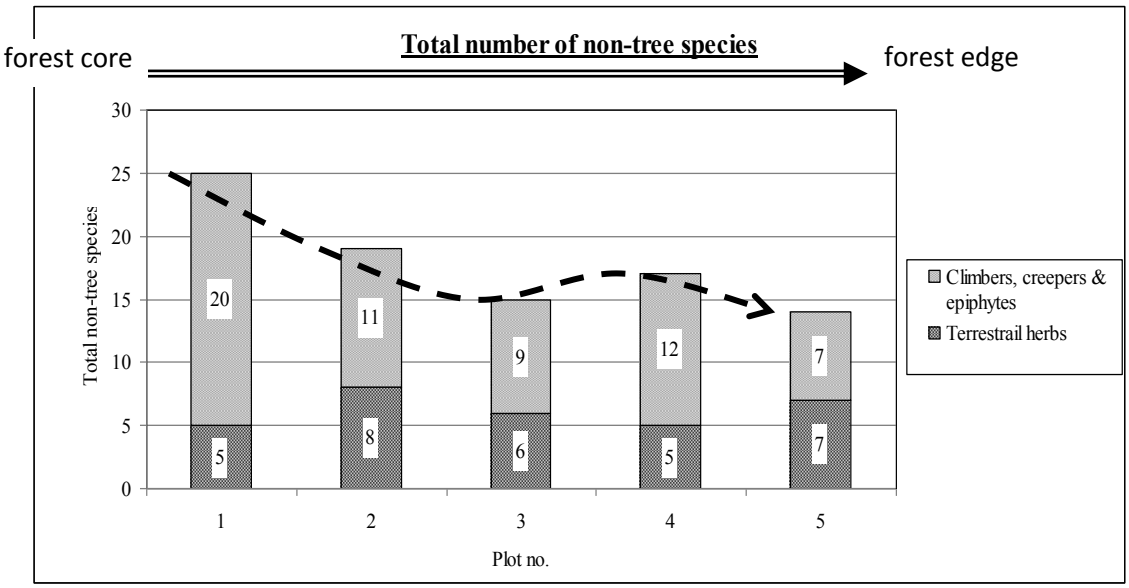


Figure 7 : The total number of non-tree species decreases significantly near the edge (dotted arrow), with the last plot having 40% less non-tree species than the first.

Table 1 : Note worthy plants of the North Selangor Peat Swamp Forest

No.	Species	Family	Habit	Status
1	*Homalomena rostrata*	Araceae	herb	endemic
2	*Calamus insignis* var. *insignis*	Palmae	climber	endemic
3	*Freycinetia confusa*	Pandanaceae	climber	endemic
4*	*Elettariopsis curtisii*	Zingiberaceae	herb	endemic
5	*Uvaria leptopoda*	Annonaceae	climber	endemic
6*	*Eucorymbia alba*	Apocynaceae	climber	endangered
7	*Calophyllum ferrugineum* var. *oblongifolium*	Guttiferae	tree	endemic
8	*Syzygium politum*	Myrtaceae	tree	endemic
9	*Syzygium setosum*	Myrtaceae	tree	endemic

*New locality record

Orchid Diversity in North Selangor Peat Swamp Forest

RUSEA GO[1], JANNA ONG ABDULLAH[2], WONG WEE NEE[1], NOR'IZZATI SHAIPUDIN[1], NUR ASHIKIN PSYQUAY ABDULLAH[3], MOHD AKMAL MOHD RAFFI[3], SITI FATIMAH MD ISA[1], NUR ADILAH AUYOB[1], CHRISTINA YONG SEOK YIEN [1] AND YOH KOK HON[1]

Abstract : The diversity of the largest family of flowering plant, Orchidaceae, in North Selangor Peat Swamp Forest (NSPSF) was represented by a total of 32 species from 21 genera. They were classified into the subfamilies of Apostasioideae and Epidendroideae and consisted of 19 epiphytic and 13 terrestrial plants. From this study, we were able to documented 31% of orchids species from the total number of orchid that have been recorded in Selangor, which was equivalence to 21% of the overall recorded species in the peat swamp forest in Peninsular Malaysia. Two species were the new records for Selangor, namely *Bulbophyllum corolliferum* and *Pomatocalpa spicatum*. The factors to the absence of several species that were common to peat swamp forest were also being discussed.

Keywords. Orchid, North Selangor Peat Swamp Forest, Peninsular Malaysia.

[1] Department of Biology, Faculty of Science, University Putra Malaysia, 43400, Serdang, Selangor Darul Ehsan
[2] Department of Microbiology, Faculty of Biotechnology and Biomolecular Sciences, 43400, Serdang, Selangor Darul Ehsan
[3] Biodiversity Unit, Institute of Bioscience, 43400, Serdang, Selangor Darul Ehsan
* Corresponding author: rusea@upm.edu.my or go_rusea@yahoo.com

INTRODUCTION

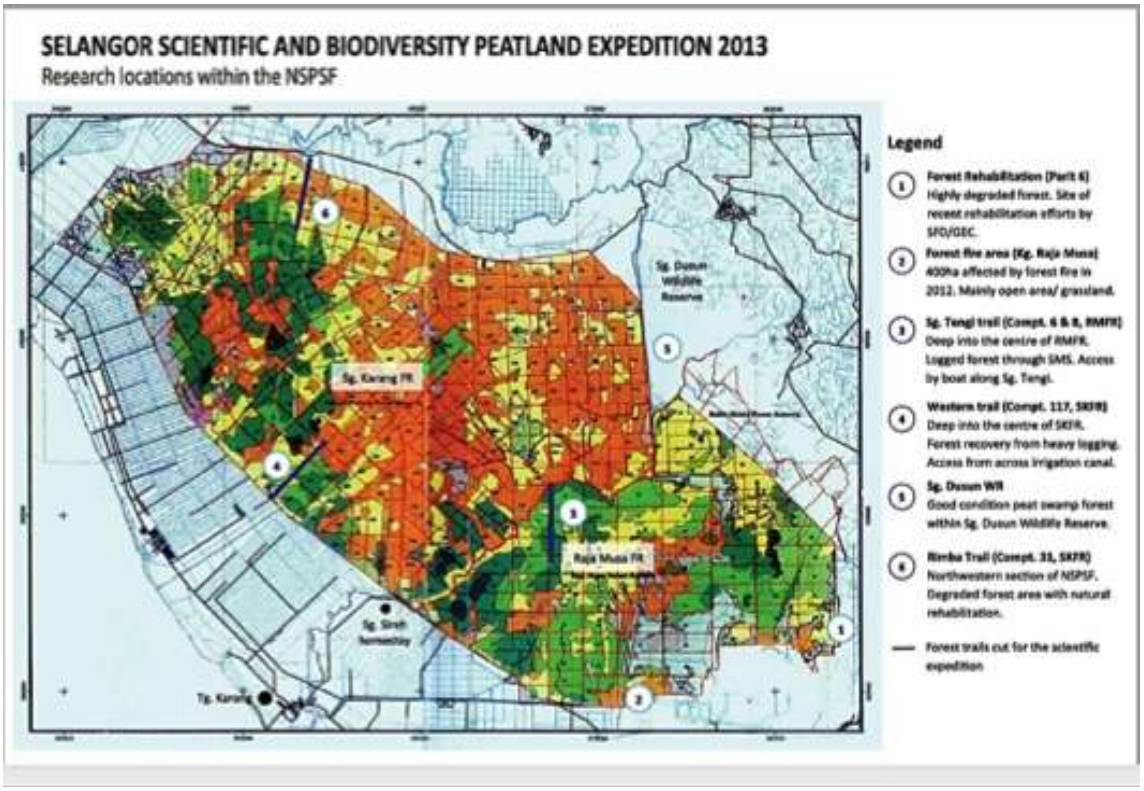
The peat swamp forest (PSF) is a unique ecosystem and the largest wetland forest type with an estimation of total area 302,000 hectares coverage in Peninsular Malaysia. Of this area, they are distributed in the states of Selangor, Johor, Terengganu and Pahang. Approximately 73,392 hectares are found in the North Selangor Peat Swamp Forest (NSPSF) that consists of Raja Musa Forest Reserve (23,486 hectares) and Sungai Karang Forest Reserve (50,106 hectares). Beside act as flood mitigation, carbon sink and giant filters of pollutants and sediments, NSPSF also plays a critical role in conserve and sustain populations of plants and animals that are especially restricted to PSF area. Thus, this study was brought into attention because there is a massive destruction due to indiscriminate human activities is still taking place in the areas which cause the number of plant and animal species found in NSPSF area has been declined.

Orchidaceae being as the largest families of flowering plants with over 25,000 known species from five subfamilies of Apotasioideae, Cypripedioideae, Orchidoideae, Epidendroideae and Vanilloideae that are epiphytic, terrestrial of litophytic in habits (Chase et al., 2003; Holttum 1964). The plant is widely distributed around the world which can be found in a range of habitats and ecosystems from the highest mountains to the lowlands including the wetland areas such as the peat swamp forest. A checklist by Turner (1995) reported that there were 104 species of orchids in Selangor and another checklist by Rusea and Khali (2008) stated that 152 species were recorded in the Peninsular Malaysia's swamp forest. Orchid is not solely appreciated for the uniqueness of the flower but also being utilized for other purposes. *Corymborkisveratrifolia* (hancingali) was reported to be used as treatment for bladder ailments; *Eulophia* species as supplementary food; *Vanilla* species as flavor; and *Phalaenopsis*bellina as fragrance (Rusea and Khali, 2008). The checklist on the diversity of orchid species in NSPSF is crucial since they are very susceptible to environmental changes and they can act as an indication in monitoring our environmental changes due to the climate change or human activities.

MATERIALS AND METHOD

The study on orchid diversity in North Selangor Peat Swamp forest had been conducted since 2005 and this expedition was the continuation of the efforts. Field observation and botanical collection were carried out throughout the five-day scientific expedition from 1 – 5 July 2013 along 4 selected trails: Sg. Tengi Trail (Trail 3), Western Trail (Trail 4), Sg. Dusun (Trail 5) and Rimba Trail (Trail 6) (Figure 1).

Figure 1 : Map of research location within NSPSF Expedition 2013



All macro morphology characters, such as vegetative and floral structures, were observed and recorded in the field for identification. Where necessary, the sterile plants were collected as living collections and transplanted in the greenhouse in Universiti Putra Malaysia for identification once they flowered. Non-sterile and other sterile plants were collected as herbarium collection and flowering materials were preserved as spirit collections. The herbarium collections were processed following the standard herbarium specimen preparation techniques by Bridson and Forman (1989). Specimens were identified using the characters and identification keys described in Holtum (1957), Seidenfaden and Wood (1992), and Comber (1990, 2001). Scientific names adopted here are those accepted by the latest Kew World Checklist of Selected Plant Families accessed via the web.

RESULT AND DISCUSSION

The diversity of ochid in North Selangor Peat Swamp Forest (NSPSF) was represented by a total of 32 species which consisted of 19 epiphytic (59%) and 13 terrestrial (41%) plants (**Table 1**). The species were classified into two subfamilies; Apostasioideae which solely represented by the genus *Apostasia* and Epidendroideae with 21 genera that included *Arachnis, Arundina, Bromheadia, Bulbophyllum, Calanthe, Claderia, Corymborkis, Cymbidium, Dendrobium, Dipodium, Eulophia, Grammatophyllum, Nephelaphyllum, Plocoglottis, Pomatocalpa, Spathoglottis, Tainia, Thecostele, Thelasis*, *Thrixspermum* and *Tropidia*. From the total of 152 species of orchid that were reported from PSF area in Peninsular Malaysia (Rusea and Khali, 2008) we only managed to documented 21% of orchid species in the NSPSF area which was equivalent to 31% of species from a total of 104 species found in Selangor (Turner, 1995). Among of the documented species, two species were the new records to Selangor, namely ***Bulbophyllum corolliferum*** and ***Pomatocalpa spicatum***.

Table 1 : List of Orchids in North Selangor Peat Swamp Forest, life habit and their distribution in Peninsular Malaysia

No	Taxa	Habit	Distribution in Peninsular Malaysia (Turner, 1995)
1.	*Apostasia nuda* R. Br.	Terrestrial	Widespread
2.	*Arachnis flos-aeris* (L.) Rchb.*f.*	Epiphytic	Perak, Pahang, Selangor, Negeri Sembilan
3.	*Arundina graminifolia* (D.Don) Hochr.	Terrestrial	Widespread
4.	*Bromheadia finlaysoniana* (Lindl.) Miq.	Terrestrial	Widespread
5.	*Bulbophyllum corolliferum* J.J.Sm.	Epiphytic	Kelantan,Terengganu,Penang, Perak,Pahang
6.	*Bulbophyllum flabellum-veneris* (J.Koenig) Aver.	Epiphytic	South of Malaya
7.	*Bulbophyllum gracillimum* (Rolfe) Rolfe	Epiphytic	Widespread
8.	*Bulbophyllum patens* King *ex* Hook.*f.*	Epiphytic	Widespread
9.	*Bulbophyllum purpurascens* Teijsm. & Binn.	Epiphytic	Widespread
10.	*Calanthe triplicata* (Willemet) Ames	Terrestrial	Widespread
11.	*Claderia viridiflora* Hook. *f*	Terrestrial	Widespread
12.	*Corymborkis veratrifolia* (Reinw.) Blume	Terrestrial	Widespread
13.	*Cymbidium dayanum* Rchb. *f*	Epiphytic	Perlis, Kedah, Pahang
14.	*Cymbidium finlaysonianum* Lindl.	Epiphytic	Most abundant in the north
15.	*Dendrobium acerosum* Lindl.	Epiphytic	Widespread
16.	*Dendrobium angustifolium* (Blume) Lindl.	Epiphytic	Widespread
17.	*Dendrobium crumenatum* Sw.	Epiphytic	Ubiquitous
18.	*Dendrobium lobatum* (Blume) Miq.	Epiphytic	Widespread
19.	*Dendrobium lobbii* Teijsm. & Binn.	Terrestrial	Common in south
20.	*Dendrobium salaccense* (Blume) Lindl.	Epiphytic	Widespread
21.	*Dipodium pictum* (Lindl.) Rchb.*f.*	Terrestrial	Widespread
22.	*Eulophia graminea* Lindl.	Terrestrial	Widespread, common
23.	*Grammatophyllum speciosum* Blume	Epiphytic	Widespread
24.	*Nephelaphyllum pulchrum* Blume	Terrestrial	Widespread
25.	*Plocoglottis javanica* Blume	Terrestrial	Widespread
26.	*Pomatocalpa spicatum* Breda	Epiphytic	Perak, Pahang, Negeri Sembilan
27.	*Spathoglottis plicata* Blume	Terrestrial	Widespread
28.	*Tainia speciosa* Blume	Terrestrial	Widespread
29.	*Thecostele alata* (Roxb.) C.S.P.Parish & Rchb.*f.*	Epiphytic	Widespread, uncommon
30.	*Thelasis carinata* Blume	Epiphytic	Widespread, common
31.	*Thrixspermum centipeda* Lour.	Epiphytic	Widespread
32.	*Tropidia curculigoides* Lindl.	Terrestrial	Widespread

From the data obtained, it was suggested that the region has a great potential to serve as a suitable habitat for various types of orchids. However, seven species those are common to peat swamp forest but not able to be recorded during the study, which were *Acriopsis liliiflora*, *Aerides odorata*, *Coelogyne rochussenii*, *Papillonanthe hookeriana*, *Phaius tankervillae*, *Renantera elongata* and *Vanilla griffithii*. From the field observations, two main factors were seen to contribute to the absence of the species; a) forest greatly degraded due to forest clearing and peat swamp draining and b) forest's environment too dry as compared to common condition for peat swamp forest.

Therefore, it was suggested that frequent monitoring and strict legislation must be implemented as the public has an easy access to some of the important trails of the forest. This hopefully could further enhance possible regeneration without periodical disturbances.

CONCLUSION

In regards to the many threats to the remaining PSF in Peninsular Malaysia, the conservation and sustainable use of this swamp forest remains very important to the country especially for its timber resource. Sustainable forest management of the area would be one way to ensure total protection of the biodiversity. Thus, we hope this study can act as a fundamental and crucial approach to protect and conserve not only orchid species but also flora and fauna in the area of swamp forest.

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Firstly, we would like to extend our gratitude to the Malaysian Nature Society under the ASEAN Peatland Forests Programme (APFP), the Forestry Department Peninsular Malaysia and the Selangor State Forestry Department, for inviting us to join **The North Selangor Peat Swamp Forest Scientific Biodiversity Expedition 2013** as well as providing logistics and accommodation during this expedition. We would also like to acknowledge the Government of Malaysia for the research grants made available to the main author through E-Science (5450661) and KRIBB-UPM Project (6384300) that ensure our trip to the research site successful.

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Plate 1 : Orchid species in North Selangor Peat Swamp Forests. 1: *Apostasia nuda,* 2: *Arachnis flos-aeris,* 3: *Arundina graminifolia,* 4: *Bromheadia finlaysoniana,* 5: *Bulbophyllum gracillimum,* 6: *Bulbophyllum flabellum-veneris,* 7: *Bulbophyllum patens,* 8: *Bulbophyllum purpurascens,* 9: *Claderia viridiflora,* 10: *Corymborkis veratrifolia,* 11: *Bulbophyllum coolliferum,* 12: *Cymbidium dayanum*

Plate 1 : Orchid species in North Selangor Peat Swamp Forests. (Cont.) 13: *Calanthe triplicata* 14: *Dendrobium crumenatum* 15: *Dendrobium lobatum* 16: *Dendrobium acerosum* 17: *Dendrobium angustifolium* 18: *Dipodium pictum* 19: *Cymbidium finlaysonianum* 20: *Spathoglottis plicata* 21: *Eulophia graminea* 22: *Grammatophyllum speciosum* 23: *Nephelaphyllum pulchrum* 24: *Dendrobium salaccense*

Plate 1 : Orchid species in North Selangor Peat Swamp Forests. (Cont.). 25: *Dendrobium lobbii* 26: *Plocoglottis javanica* 27: *Pomatocalpa spicatum* 28: *Tainia speciosa* 29: *Thecostele alata* 30: *Thelasis carinata* 31: *Tropidia curculigoides* 32: *Thrixspermum centipeda* and open swamp area in Kuala Selangor.

An Inventory of Useful Plants in North Selangor Peat Swamp Forest

NOR'IZZATI SHAIPUDIN[1], WEE-NEE WONG[1], MOHD AKMAL MOHD RAFFI[1], SITI FATIMAH MD ISA[1], KOK-HON YOH[1], NUR ADILAH AUYOB[1], MICHAEL CHARLES RAJARAM[1], VHENOSHA ANNATHURAI[1], SUHAIMA MOHAMAD SUKI[1], SANGMI EUM[2] AND RUSEA GO[1]*

Abstract : North Selangor Peat Swamp Forest is home for a large variety of flora and fauna species, which are useful in our life for their medicinal, ornamental and other uses. During the expedition, a total of 87 species of plants from 71 genera and 52 families were enumerated from North Selangor Peat Swamp Forest known to have ethnobotanical properties. These plants are having different life forms such as trees, herbs, climbers and shrubs. Sixty three species are used in traditional medication for treatment or prevention of diseases, ailments and infections, 35 species as ornamental plants, 16 species as food or beverages, and 13 species are for making tools or other equipments. Medicinal properties topped the list with the most common problems treated by the plants collected in this expedition are stomach and intestinal ailments (27 species), fever (22 species), wounds and injuries (14 species), post and prenatal treatment (11 species), skin complaints (11 species) and rheumatism (11 species), blood circulation (10 species).The outcome of this expedition is expected to aid in the rediscovery of the traditional medicinal and other plant's uses. North Selangor Peat Swamp Forest is indeed rich with ethnobotanical plants and further explorations are suggested to reveal the true extent of their diversity.

Keywords. North Selangor Peat Swamp Forest, Ethnobotany, Medicinal plants.

[1] Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor
[2] Korea Research Institute of Bioscience and Biotechnology, 125 Gwahangno, Yuseong-gu, Daejeon 305-806, Korea
*Corresponding author: go_rusea@yahoo.com or rusea@upm.edu.my

INTRODUCTION

Malaysia is having around 2,588,900 hectares of peatlands with global importance for its role in maintaining endangered and endemic species as well as huge carbon sink. Variety of useful plants from more than five life forms can be found within this unique ecosystem including trees, lianas, ferns, shrubs, sedges as well as herbs and mosses which are useful in many ways. Ethnobotany study usually refers to study of practice, culture and traditional knowledge of people on the usage of plants which are inherited and evolved over time especially plants as medicines, foods and beverages, materials and fibres and many more. However, these valuable species would be swept away if no strict enforcement is being taken by the responsible authorities.

The study area; North Selangor Peat Swamp Forest (hereafter written as NSPSF) is the largest remaining contiguous areas of peat swamp forest on the west coast of Peninsular Malaysia. It comprises about 75,000 ha of mixed peat swamp forest which lies in the north western part of the state of Selangor which consists of Raja Musa Forest Reserve (23486 hectares) and Sungai Karang Forest Reserve (50106 hectares). Since 2008, a rehabilitation programme by Selangor Forestry Department in collaboration with Global Environment Centre was initiated for Raja Musa Forest Reserve which also is one of the pilot sites in the ASEAN Peatland Forests Project (APFP) project. The main activities carried out included the establishing of canal blocks at the existing canals, implementing fire prevention measures and also tree planting in the degraded areas (Lo and Parish, 2013).

Peat swamp forest locally plays significant important role in supplying water for domestic and agricultural uses, plus supporting local wood industry. However, many activities including illegal encroachment, land clearing for agriculture purposes, forest fire and excessive drainage had turned this type of forest into one of the most threatened and least studied biotopes in Peninsular Malaysia. Only one recognized study on a peat swamp region in Peninsular Malaysia has been conducted in year 2005 at Sungai Bebar, Pekan, Pahang which successfully gathered researchers from various institutions in one scientific biodiversity expedition report (Khamis *et al*., 2005).

Therefore, the main purpose of this study is to enhance information of flora diversity in the peat swamp area throughout the trails during the expedition. At the same time, we also evaluate and rediscover their traditional and economic values especially for medicinal uses as well as ornamental purposes, foods and spices and also other tools. Since this expedition was the first in NSPSF area, hence, the results collected should be treated as preliminary data and served as the basic data resources for further references.

METHODOLOGY

Field observations were done randomly along the selected trails throughout the five-days scientific expedition in early July 2013. However, due to time constrains, we only manage to cover four trails, Trail 3, 4, 5 and 6 among the six trails provided.

Most of the specimens were photographed in their natural habitat and their important characteristics were also documented. The fresh specimens were collected for the purpose of species identification and preserved into dried herbarium specimens and spirit collection following the standard herbarium method (Bridson and Foreman, 1992).

The identification of species was accomplished by referring to various resources including Henderson (1959), Hsuan (1990), Barnes and Chan (1990), Piggott (1996), Hsuan, *et al*., (1998), Larsen (1999), Werner (2002), Boo (2006) and Endela *et al.,* (2006). For medicinal and other uses of plants we

referred to Lemmens and Bunyapraphatsara (2003), van Valkenburg and Bunyapraphatsara (2002), de Padua *et al.,* (1999), Werner (2002), Chai (2006) and also Kamaruddin and Latiff (2002). The species names listed in this paper were checked with the current checklist from World Checklist of Selected Plant Families (WCSP): Royal Botanic Gardens, Kew accessed online at http://apps.kew.org/wcsp/home.do and The Plant List: accessed online at www.theplantlist.org in Januany, 2014.

RESULTS AND DISCUSSION

A total of 86 species of plants representing 71 genera from 51 families were enumerated from the NSPSF are known to have ethnobotanical values. These plants are having different habits and six life forms were identified during this expedition including tree, shrub, climber (including woody and herbaceous), fern, herb and sedge (Table 1).

The plant group with the highest diversity of families, genera and species was herb which accounted for 26.7% of plant found in NSPSF with 23 species from 16 families. This was followed by tree, 19.8% represented by 17 species in total, climbers with 17.4% representing 12 families including those woody and herbaceous climbers, ferns and shrubs with 16.3% and 12.8%, respectively. The lowest life form group was sedge with only 6 species (7%) from one single family, Cyperaceae.

Meanwhile, the most diverse family was Rubiaceae from dicots with 7 species from 4 families. It was followed by Cyperaceae (6 species), Araceae and Fabaceae with 5 species, each and Piperaceae with 3 species from one genus namely *Piper* which always distinguished by its energizing and spicy aroma. Fourteen families were represented by two species for each family whereas the remaining 32 families are only represented by a single species, each (Table 2).

Among the trails provided, we only managed to cover five trails including one unofficial trail around Kuala Selangor Nature Park whereas the other trails were selected according to their physical appearance which seems to hold high number of plant species and abundance. Number of species, families and plant life forms according to the trails studied were showed in Table 3.

The highest number of plant species and families with more than half of total species found (55.8%) is accounted from Trail 4 or Western Trail. This is the trail where excessive drainage occurred based on the dried ground condition along the trail except at the canals edge. Regeneration of secondary forest after heavily logged over centuries also clearly seen along this trail with the presence of a few pioneer trees species especially *Macaranga* group (Mahang) such as *M.triloba* and *M.gigentea* as well as the presence of other fast growing species of herbs, ferns, shrubs and climbers.

Sixty-eight species (79.1%) of the above plants are used in traditional medication for treatment or prevention of diseases, ailments and infections. Medicinal properties topped the list with the most common problems treated by the plants collected in this expedition are fever including flu and malaria (31 species, 45.6%), stomach and intestinal ailments (28 species, 41.2%), wounds and injuries (15 species, 22.1%), skin complaints (13 species, 19.1%), rheumatism and maternity treatment (12 species, each with percentage of 17.6%) and ability to improve blood circulation (9 species, 13.2%). Parts of these plants are either consumed raw or cooked and may also applied externally for medicinal purposes depends on the type of illnesses.

Besides that, 36 species of plants are used as ornamental plants in cultivated garden or any landscaping areas. Usually, ferns and herbs with fascinating flowers are commonly used as decorations such as *Asplenium nidus* (Paku langsuir), *Adiantum latifolium* (Maiden's hair fern) and also *Seleginella wildernowii* (Paku merak). Besides that, sedges or Cyperaceae are also used as

decorations especially in the wetlands areas while maintain the soil stability and reduce soil erosion within the planted areas.

Meanwhile, another 17 species were consumed as food or beverages. Some parts of the plants are normally eaten raw as salad with many benefits to body health, and sometimes also are cooked as vegetable soup or drink as tonic juice. For example are two common species of ferns, *Diplazium esculentum* (Paku sungai) and *Stenochlaena palustris* (Paku miding) which are believed able to reduce fever and used in postnatal treatment. Additional flavours or spices in cooking as well as sweet desserts with cooling properties also can be produce by a few plant species found. Besides that, a few species has been recognized as the forage species means that it can be consumed by the animals as their food resource. Some of the fruits produced can be eaten or consumed by birds such as *Clidemia hirta* and *Melastoma malabathricum* (both are known as Senduduk) from family Melastomataceae.

A number of 13 plants are traditionally used to make variety of useful tools such as ropes, bags, fishing nets and other handicraft things. Other than that, a few plants species especially trees found can be used to make furniture and containers in variable sizes as well as fire resistant roof. Leaves of *Tacca integrifolia* (Janggut adam) are sometimes used for wrapping purpose and *Uncaria acida* (Gambir) are used as tanning material and also as dyes in batik industry. The complete data on uses of each species identified including medicinal, ornamental and other uses are showed in Table 4 and images of selected species are showed in Appendix 1.

CONCLUSION

Generally, the species richness of plants in NSPSF is high considering the limited sites botanized. However, since part of the surrounding area of NSPSF has been developed into a wildlife reserve (Sungai Dusun Wildlife Reserve) and any destruction within peatland is irreversible, therefore strict enforcement and conservation actions should also be drafted for the adjoining NSPSF to maintain and protect the continuous biodiversity flow from peat swamp to hill forests (Dusun Tua). In addition, as there is no previous ethnobotanical study has been done in this valuable area, further extensive study should be carried out to determine the true species richness of the useful flora in NSPSF.

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Table 1 : Plant life forms found in NSPSF according to family, genus and species

No	Life form	Families	Genera	Species
1	Herb	16	22	23
2	Tree	11	13	17
3	Climber	12	13	15
4	Fern	11	11	14
5	Shrub	8	10	11
6	Sedge	1	6	6

Table 2 : Useful plants found in NSPSF in descending value of plant abundance according to number of genus and species.

No	Family	No of genera	No of species	No	Family	No of genera	No of species
1	Rubiaceae	4	7	27	Cyatheaceae	1	1
2	Cyperaceae	6	6	28	Davalliaceae	1	1
3	Araceae	4	5	29	Dilleniaceae	1	1
4	Fabaceae	4	5	30	Dioscoreaceae	1	1
5	Piperaceae	1	3	31	Flagellariaceae	1	1
6	Compositae	2	2	32	Gentianaceae	1	1
7	Euphorbiaceae	2	2	33	Gesneriaceae	1	1
8	Malvaceae	2	2	34	Hypoxidaceae	1	1
9	Melastomataceae	2	2	35	Lamiaceae	1	1
10	Vitaceae	2	2	36	Lentibulariaceae.	1	1
11	Zingiberaceae	2	2	37	Myrtaceae	1	1
12	Acanthaceae	1	2	38	Passifloraceae	1	1
13	Aristolochiaceae	1	2	39	Phyllanthaceae	1	1
14	Aspleniaceae	1	2	40	Polygalaceae	1	1
15	Cannabaceae	1	2	41	Polygonaceae	1	1
16	Nephentaceae	1	2	42	Pontederiaceae	1	1
17	Polypodiaceae	1	2	43	Pteridaceae	1	1
18	Schizaeaceae	1	2	44	Rhizophoraceae	1	1
19	Urticaceae	1	2	45	Rutaceae	1	1
20	Adiantaceae	1	1	46	Selaginellaceae	1	1
21	Amaranthaceae	1	1	47	Smilacaceae	1	1
22	Asparagaceae	1	1	48	Solanaceae	1	1
23	Blechnaceae	1	1	49	Thelypteridaceae	1	1
24	Boraginaceae	1	1	50	Verbenaceae	1	1
25	Commelinaceae	1	1	51	Woodsiaceae	1	1
26	Cucurbitaceae	1	1		Total	71	86

Table 3 : Plant species encountered from selected trails according to plant life form

Trail	No of species	No of family	Life form (No of species)					
			Tree	Shrub	Climber	Fern	Sedge	Herb
Trail 4 (Western Trail)	48	32	5	8	8	10	5	12
Trail 6 (Rimba Trail)	12	11	4	0	4	0	0	4
Trail 3 (Sungai Tengi)	11	10	1	0	3	3	1	3
Trail 5 (Sungai Dusun Wildlife Reserve)	10	9	3	2	0	1	0	4
Around Kuala Selangor Nature Park	5	4	4	1	0	0	0	0

Table 4 : List of useful plants found in North Selangor Peat Swamp Forest (NSPSF)

No	Species	Family	Life form	Ornamental	Foods	Other uses	Medicinal uses
1	*Acrostichum aureum* L. (Local name: Paku piai)	Pteridaceae	Fern	Yes	Salad	Fire resistant roof, to make cord	
2	*Actinoscirpus grossus* (L.f.) Goetgh. & D.A.Simpson	Cyperaceae	Sedge	Yes			
3	*Adiantum latifolium* Lam. (Local name: Maiden's hair fern)	Adiantaceae	Fern	Yes			
4	*Aeschynanthus pulcher* (Blume) G.Don (Local name: Lipstick plant)	Gesneriaceae	Climber	Yes			Treat intestinal worms
5	*Alocasia longiloba* Miq.	Araceae	Herb	Yes			Hypertension
6	*Alternanthera sessilis* (L.) R.Br. ex DC. (Local name: Bayam pasir; Keremak)	Amaranthaceae	Herb	Yes			Diuretic, as tonic and cooling properties , hair oils, eye complaints
7	*Amischotolype griffithii* (C.B.Clarke) I.M.Turner (Local name: Setawar)	Commelinaceae	Herb				Flu, relieving body aches, neutralize snake bite
8	*Antidesma coriaceum* Tul.	Phyllanthaceae	Tree		Spices		
9	*Asplenium longissimum* Blume	Aspleniaceae	Fern	Yes			
10	*Asplenium nidus* L. (Local name: Bird's nest fern; Paku langsuir)	Aspleniaceae	Fern	Yes			Fever, headache, sore throat, asthma, mitigate blood in stool, ease childbirth
11	*Avicennia marina* (Forssk.) Vierh. (Local name: Grey mangrove)	Acanthaceae	Tree				Treat snake bites, skin complaints, remove placenta after childbirth
12	*Avicennia officinalis* L. (Local name: Api-api ludat)	Acanthaceae	Tree				Remedy for boils and tumors, ulcers, snakebites; aphrodisiac

13	*Bruguiera parviflora* (Roxb.) Wight & Arn. ex Griff	Rhizophoraceae	Tree	Yes		Insecticide	
14	*Cayratia trifolia* (L.) Domin (Local name: Fox grape)	Vitaceae	Climber				Fever, itch, ulcer of nose, dandruff, blood purifier, inflammation
15	*Christella dentata* (Forssk.) Holttum	Thelypteridaceae	Fern	Yes			Antibacterial properties
16	*Cissus hastata* Miq. (Local name: Hastate leaf treebine)	Vitaceae	Climber				Rheumatic arthralgia, psoatic strain, limb numbness, injuries caused by falls
17	*Clidemia hirta* (L.) D. Don (Local name: Senduduk bulu)	Melastomataceae	Shrub	Yes	Fruits		
18	*Crotalaria trichotoma* Bojer	Fabaceae	Herb	Yes	Forages	Fibre for cordage	
19	*Cyathea latebrosa* (Wall. ex Hook.) Copel.	Cyatheaceae	Fern	Yes			
20	*Cyperus javanicus* Houtt.	Cyperaceae	Sedge	Yes			
21	*Diplazium esculentum* (Retz.) Sw. (Local name: Paku sungai)	Woodsiaceae	Fern		Salad, vegetable		Fever, post natal treatment
22	*Eichhornia crassipes* (Mart.) Solms	Pontederiaceae	Herb	Yes	Salad	Furniture, handbags and rope	Medicating the skin of horses
23	*Euphorbia hirta* L. (Local name: Ara tanah)	Euphorbiaceae	Herb				Fever, asthma, bronchial and nasal problems, dysentery, toothache, headache, conjunctivitis and ulcerated cornea
24	*Fagraea racemosa* Jack (Local name: Kopi utan)	Gentianaceae	Tree	Yes			As aromatherapy
25	*Fimbristylis dichotoma* (L.) Vahl	Cyperaceae	Sedge	Yes			
26	*Flagellaria indica* L.	Flagellariaceae	Climber		Consumed by birds	Rope, woven for traps and nets	Hair wash, contraceptive, heal wounds, sore eyes

27	*Globba pendula* Roxb. (Local name: Halia hutan)	Zingiberaceae	Herb			Ease childbirth, treating stomach complaints
28	*Glycosmis lanceolata* (Blume) Teijsm. & Binn. ex Kurz (Local name: Merapi)	Rutaceae	Tree			Tonic during confinement, treat intestinal ailments, diarrhoea, coughs, rheumatism, anaemia, jaundice, fever, liver problems, eczema and skin infections.
29	*Heliotropium indicum* L. (Local name: Rumput ekor kucing)	Boraginaceae	Herb			Cure wounds, skin ulcers and furuncles, conjunctivitis, poultice, reduce urination, to counteract putrefaction, ringworm infection
30	*Hibiscus tiliaceus* L. (Local name: Baru-baru)	Malvaceae	Shrub	Yes	Sea craft construction, firewood, and wood carvings, rope	Fever
31	*Homalomena rostrata* Griff. (Local name: Janggut baung)	Araceae	Herb	Yes		Treat hypertension, high blood pressure
32	*Hyptis capitata* Jacq. (Local name: Knobweed; Rumput butang)	Lamiaceae	Shrub			Fever, bronchial and gastrointestinal problems, toothache, sore eyes
33	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy ex Hutch. & Dalziel (Local name: White water sedge)	Cyperaceae	Sedge	Yes		Fever, diarrhoea, antidote, sore throat, dysentery, skin problems, ulcers
34	*Lecananthus erubescens* Jack	Rubiaceae	Tree	Yes		
35	*Lygodium flexuosum* (L.) Sw. (Local name: Ribu-ribu gajah)	Schizaeaceae	Fern	Yes		Fever, ringworm, sore eyes
36	*Lygodium microphyllum* (Cav.) R. Br. (Local name: Ribu-ribu)	Schizaeaceae	Fern	Yes		Treat skin ailments, swelling and dysentery
37	*Macaranga triloba* (Thunb.)	Euphorbiaceae	Tree			Antioxidant; enhance immune system,

	Müll.Arg. (Local name: Mahang bulan)						antitumor
38	*Melastoma malabathricum* L. (Local name: Senduduh hutan)	Melastomataceae	Shrub	Yes			Diarrhoea, stop bleeding
39	*Mikania micrantha* Kunth (Local name: Selaput tunggul)	Compositae	Climber				Skin itchiness and wounds
40	*Mimosa pigra* L. (Local name: Semalu)	Fabaceae	Herb	Yes	Forages	Cover crop	Cold, toothache, eye infection, treat snakebite, diarrhoea
41	*Mimosa pudica* L. (Local name: Semalu)	Fabaceae	Herb				Sore throat, asthma, diarrhoea, arthritis, swellings, urinary complains, wounds and ulcers, insomnia
42	*Molineria latifolia* (Dryand. ex W.T.Aiton) Herb. ex Kurz (Local name: Lemba)	Hypoxidaceae	Herb		Fruits	Fishing net	Menorrhagia, fever, stomachic
43	*Momordica charantia* L. (Local name: Peria tikus)	Cucurbitaceae	Climber		Fruits		Diarrhoea, stomach ache, rheumatism, gout, spleen, skin (wounds, bruises, burns), malaria, lumbago, liver problems
44	*Morinda citrifolia* L. (Local name: Mengkudu)	Rubiaceae	Tree				Fever, cough, asthma, ulcers, diabetes, arthritis, centipede bites, headache, stomach ache, dysentery, diarrhoea, hypertension, lumbago
45	*Nepenthes ampullaria* Jack (Local name: Periuk kera)	Nephentaceae	Climber	Yes	Herb and Spices	Woven and ropes (stem)	Roots for stomach ache and dysentery; stem for fever
46	*Nepenthes rafflesiana* Jack (Local name: Periuk kera)	Nephentaceae	Climber	Yes	Herb and Spices	Woven and ropes (stem)	Roots for stomach ache and dysentery; stem for fever; moisturize skin, soothe burns, treat eye inflammation, as well as laxatives
47	*Nephrolepis biserrata* (Sw.) Schott (Local name: Paku uban)	Davalliaceae	Fern				Stimulate breast milk, body aches
48	*Neptunia natans* W. Theob.	Fabaceae	Herb	Yes			
49	*Oldenlandia auricularia* (L.) K.Schum.	Rubiaceae	Shrub				Fever, stomach complaints, diarrhoea

	(Local name: Kerekah batu)					
50	*Oldenlandia corymbosa* L. (Local name: Diamond flower)	Rubiaceae	Herb			Treat heartburns, stomach ache, acute appendicitis, hepatitis, flatulence, diarrhoea, dysentery and constipation
51	*Passiflora foetida* L. (Local name: Letup-letup)	Passifloraceae	Climber			Urinary problems, constipation, hernia
52	*Peliosanthes teta* Andrews (Local name: Derhaka mentua)	Asparagaceae	Herb			Post natal treatment
53	*Persicaria pulchra* (Blume) Soják (Local name: Hairy knot-weeds)	Polygonaceae	Herb		Salad, vegetable, forages	Tonic and to purify the blood, syphilis, rheumatism and swellings
54	*Piper caninum* Blume (Local name: Sirih hutan)	Piperaceae	Climber		Salad	Antioxidant and antimicrobial agents for therapeutic industries
55	*Piper miniatum* (Miq.) Blume (Local name: Sirih bubut)	Piperaceae	Climber			Rheumatism
56	*Piper sarmentosum* Roxb. (Local name: Kaduk)	Piperaceae	Herb	Yes	Salad	Promote urination, malaria, coughs, colds, sore hips, sore teeth and bone aches, ringworm
57	*Pluchea indica* (L.) Less. (Local name: Beluntas)	Compositae	Shrub			Anti-aging, repel pathogenic wind, fever, dizzy, dysentery, digestion problem.
58	*Poikilospermum scortechinii* (King) Merr. (Local name: Mera)	Urticaceae	Tree			Treatment for eye disease, itches and fever
59	*Poikilospermum suaveolens* (Blume) Merr. (Local name: Mera/Entaban)	Urticaceae	Tree			treatment for eye disease, itches and fever, gonorrhoea, headache
60	*Polygala paniculata* L. (Local name: Rumput minyak angin)	Polygalaceae	Herb			Wounds, gonorrhoea, lumbago
61	*Pyrrosia lanceolata* (L.) Farw. (Local name: Duit-duit)	Polypodiaceae	Fern			High fever, dengue, headache
62	*Pyrrosia piloselloides*	Polypodiaceae	Fern	Yes		Gingivitis, jaundice, stop bleeding,

	(L.) M.G. Price (Local name: Duit-duit)						rheumatism, dysentery, constipation
63	*Rhaphidophora lobbii Schott*	Araceae	Herb	Yes	Flavouring		
64	*Rhaphidophora montana* (Blume) Schott	Araceae	Climber	Yes	Desserts with cooling properties		Rheumatism, fractures and skin diseases, dysentery, against breast cancer and leukaemia cells
65	*Rhodamnia cinerea* Jack (Local name: Mempoyan)	Myrtaceae	Tree				Anti-diabetic
66	*Rhynchospora corymbosa* (L.) Britton	Cyperaceae	Sedge	Yes			
67	*Schefflera tomentosa* (Blume) Harms	Araceae	Tree				Promote circulation of blood and alleviate pain, treat rheumatoid arthritis, numbness in limbs and abdominal pain.
68	*Scleria sumatrensis* Retz. (Local name: Senayan hutan)	Cyperaceae	Sedge	Yes			Gonorrhoea, kidney stones, good for women health
69	*Selaginella willdenowii* (Desv. ex Poir.) Baker (Local name: Paku merak)	Selaginellaceae	Fern	Yes			Fever
70	*Smilax setosa* Miq. (Local name: Banok)	Smilacaceae	Climber		Juice, tonic		Rheumatism
71	*Solanum rudepannum* Dunal (Local name: Terung pipit)	Solanaceae	Shrub				Fever, urinary problems
72	*Stachytarpheta cayennensis* (Rich.) Vahl (Local name: Snake weed)	Verbenaceae	Shrub				Yellow fever, headache and earache, syphilis, jaundice, wounds, liver and intestinal problems, dysentery
73	*Stenochlaena palustris* (Burm. f.) Bedd. (Local name: Paku miding)	Blechnaceae	Fern		Salad, vegetable		Fever, stomach ache, postnatal treatment
74	*Tacca integrifolia* Ker Gawl. (Local name: Janggut adam)	Dioscoreaceae	Herb	Yes		Leaves for wrapping	Post natal treatment, diabetes, high blood pressure, bone fracture, joint pain, repel wind

					purposes	
75	*Tetracera scandens* (L.) Merr. (Local name: Mempelas)	Dilleniaceae	Climber			Fever, cold, itch, snake bite, pulmonary haemorrhages
76	*Thottea grandiflora* Rottb. (Local name: Telinga kelawar)	Aristolochiaceae	Shrub			Fever, postnatal treatment, diabetics, abscess and wound and for other ailments
77	*Thottea tomentosa* (Blume) Ding Hou (Local name: Hempedu beruang)	Aristolochiaceae	Shrub			Snake bite, cough, diuretic, toothache, postnatal treatment
78	*Trema cannabina* Lour.	Cannabaceae	Tree			Antioxidant and antibacterial
79	*Trema tomentosa* (Roxb.) H. Hara	Cannabaceae	Tree			Treat fever
80	*Uncaria acida* (Hunter) Roxb. (Local name: Gambir)	Rubiaceae	Climber		Tannin, dyestuff in batik	Astringent, leaves for diarrhoea, dysentery, gargle for sore throats, lumbago
81	*Uncaria callophylla* Blume ex Korth. (Local name: Gambir)	Rubiaceae	Tree			Antioxidant and anti-diabetic; promote blood flow, rheumatism, antioxidant, traumatic injury, headache, menstruation, lumbago; jaundice; Gonorrhoea; hematemesis; cough; arthritis; scald wound.
82	*Uncaria cordata* (Lour.) Merr. (Local name: Gambir)	Rubiaceae	Tree			Antioxidant and anti-diabetic
83	*Uraria crinita* (L.) DC. (Local name: Ekor kucing/Serengan)	Fabaceae	Herb			Stop bleeding, reduce fever, relieve coughs
84	*Urena lobata* L. (Local name: Pulut-pulut)	Malvaceae	Shrub			Fever, wounds, snake bites, bowel complains, diarrhoea, dysentery, labor pain, headache, rheumatism, lumbago, toothache
85	*Utricularia bifida* L.	Lentibulariaceae.	Herb	Yes		Unknown
86	*Zingiber puberulum* Ridl. (Local name: Lempoyang anjing, Tepus kecil)	Zingiberaceae	Herb			Fever, intestinal problems, fainted, rheumatism, asthmatic

Appendix 1 : Example of Useful Plants

Momordica charantia
(Peria tikus)

Polygala paniculata
(Rumput minyak angin)

Stenochlaena palustris
(Paku miding)

Solanum rudepannum
(Terung pipit)

Tetracera scandens
(Mempelas)

Melastoma malabathricum
(Senduduk hutan)

Lygodium flexosum
(Ribu-ribu gajah)

Mikania micrantha
(Selaput tunggul)

Schefflera tomentosa
(tapak hantu)

Urena lobata
(Pulut-pulut)

Asplenium longissimum

Piper sarmentosa
(Kaduk)

Pluchea indica
(Beluntas)

Heliotropium indicum
(Rumput ekor kucing)

Acrostichum aureum
(Paku piai)

Morinda umbellata
(Buah mengkudu)

Tacca integrifolia
(Janggut adam)

Amischotolype griffithii
(Setawar)

Selaginella willdenowii
(Paku merak)

Uncaria calophylla
(Gambir)

Peliosanthes teta
(Derhaka mertua)

Thottea grandiflora
(Telinga kelawar)

Thottea tomentosa
(Hempedu beruang)

Stachytarpheta cayennensis
(Snake weed)

Mosses of Northern Selangor Peat Swamp Forest, Selangor, Malaysia

YONG KIEN-THAI[1]* & CHEAH YIH-HORNG[1]

Abstract : A total of 33 species and 1 variety of mosses, in 15 genera and 6 families were collected during the 5 days survey to the Raja Musa peat swamp forest, from 26-30 June 2013. By far, this is the second large-scale bryological survey to the peat swamp area in Peninsular Malaysia. Among the many moss species documented in this survey, most of them belong to Family Calymperaceae, followed by Sematophyllaceae and Hypnaceae. The total moss diversity reported for Raja Musa peat swamp forest is lower than the Sungai Bebar peat swamp forest, Pahang. However, the forest indeed harbours a few rare and interesting species. A new country record, *Calymperes couguiense* Besch., which formerly known only to Northeastern Australia and Pacific islands, was collected during this survey.

[1] Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia
*Corresponding author: yongkt@um.edu.my

INTRODUCTION

Peat swamp forest is recognized as the largest wetland forest type in Malaysia, comprises of about 7.9% of the country's total forested area (Faridah-Hanum et al., 2005). Even though the flora of the peat swamp forest in Peninsular Malaysia, particularly the timber tree species, is well versed (see Ng & Ibrahim, 2001; Faridah-Hanum et al., 2005), but little attention has been given to the tiny plants, particularly bryophyte, in most of the floristic surveys to the peat swamp area. The very first report on bryophyte from the peat swamp forest in Malaysia was perhaps by Johnson (1958), where she published a new moss species, *Sphagnum flaccidifolium* Dixon ex A. Johnson, based on the materials collected by J. Carrick and R.E. Holttum from Telok Forest Reserve and its neighbouring area in the 1930s. This moss species was later reduced to the varietal level by Eddy (1977) and known with a wider distributional range, including Borneo and Sumatra (Tan et al., 2008).

The first extensive survey on mosses in the peat swamp forest in Peninsular Malaysia was conducted by A. Damanhuri and his team in year 2005 at Sungai Bebar, Pekan, Pahang. As the result of the survey, a total of 38 species of mosses in 20 genera and 10 families was reported for that area, and this represented 7.3 % of the total moss species known to Peninsular Malaysia (Damanhuri et al., 2005). In the same report, Damanhuri et al. (2005) remarked that the moss diversity documented for Sungai Bebar peat swamp area was much lower in comparison to the dryland forests in Peninsular Malaysia, particularly the lowland dipterocarp forest.

Present study could be considered as part of a continuous effort to a better understanding of the peat swamp moss flora of Peninsular Malaysia and is the second large-scale survey on mosses of the peat swamp area in the country. Hence, a summary of the total moss diversity in the peat swamp forest of Peninsular Malaysia, in addition to the checklist of the mosses in Northern Selangor peat swamp forest is provided in this report.

METHODOLOGY

Field collection was carried out at Sungai Karang and Raja Musa Forest Reserve from 26-30 June 2013, during the North Selangor Peat Swamp Forest Scientific Expedition. About 500 specimens were collected during the five days excursion, where most of the specimens were obtained from the forested area with trees achieving 10 m tall or taller. Collections were identified using the latest monographs and all voucher specimens were deposited in the Herbarium of University of Malaya (KLU).

RESULTS & DISCUSSIONS

A total of 33 species and 1 variety in 15 genera and 6 families of mosses were collected during the expedition (Table 1). This represents 13% of 46 families, 9.4% of 159 genera and 6.3% of 522 moss species reported for Peninsular Malaysia. Calymperaceae is the largest family documented for present study, comprises of 15 different moss species. The second largest family is Sematophyllaceae, with 7 species, and follows by Hypnaceae which represents by 5 moss species. By considering the collections from Sungai Bebar area and present report, the total mosses reported from peat swamp forest in Peninsular Malaysia now stands at 58 species and 1 subspecies and 1 variety, in 25 genera and 14 families, and the total represents 11.1% of recorded moss flora of Peninsular Malaysia.

The North Selangor peat swamp forest shows broad similarities in species composition with the Sungai Bebar, Pekan area, especially among the members of the two largest families, namely Calymperaceae and Sematophyllaceae (Table 1). Nevertheless, differences in species composition

between the two areas are noted here. Pilotrichaceae and Thuidiaceae are the two moss families that present in the North Selangor peat swamp forest but not found in Sungai Bebar area. Whereas seven moss families, mostly represented by a single species, reported for Sungai Bebar area but absent in Northern Selangor peat swamp area (Table 1) (Damanhuri et al., 2005). In a way, this indicates that forests with similar type of edaphic condition but difference locality would support a different set of moss diversity where the factors that attributed to these differences warrant future investigation.

Among the many moss species reported here, *Calymperes couguiense* Besch. is reported for the first time to the country. The species was formerly known only to the Pacific Islands and Northeastern Australia, in various types of habitat ranging from undisturbed forest to cultivated garden (Ellis, 2002). With this finding, Peninsular Malaysia is now known to be the westernmost locality of the occurrence of this species. This related disjunctive distributional pattern has been noted for other moss species, e.g., *Mittenia plumula* (Mitt.) Lindb., a species common to New Guinea and Australasia that was also collected from Mount Kinabalu, Borneo (Tan, 1990). However, due to the limited bryological activities at the South East Asian peat swamp area, as well as many parts of the Malesian area, the disjunctive distributional pattern of *Calymperes couguiense* could not be properly assess at this moment.

Papillidiopsis bruchii (Dozy & Molk.) W.R. Buck & B.C. Tan, an Malesia endemic species known only from limited collections in the Malesia region, was found in Northern Selangor peat swamp area. This species has been collected from at scanty patches from different localities in Peninsular Malaysia (Yong et al., 2013). It was never been seen abundant and common in Peninsular Malaysia but was frequently encountered in the Northern Selangor peat swamp forest. This relatively large-sized moss is often found creeping on the lower trunk of medium to large size trees, with DBH not less than 15 cm, in the study area.

Table 1 : Summary of the moss diversity in the peat swamp forest in Northern Selangor, Sungai Bebar, Pahang and Peninsular Malaysia. Information extracted from present study, Damanhuri et al. (2005) and Johnson (1958).

	Northern Selangor		Sungai Bebar, Pahang		Peninsular Malaysia	
	Genera	Species	Genera	Species	Genera	Species
Calymperaceae	5	15	6	20	6	25+1 ssp.
Fissidentaceae	-	-	1	1	1	1
Hypnaceae	2	5	2	2	2	5
Leucobryaceae	-	-	1	2	1	2
Meteoriaceae	-	-	1	1	1	1
Myuriaceae	-	-	1	1	1	1
Neckeraceae	-	-	1	1	1	1
Pilotrichaceae	1	1+1 var.	-	-	1	1+1 var.
Pylaisiadelphaceae	1	3	2	2	2	4
Rhizogoniaceae	-	-	1	2	1	2
Sematophyllaceae	5	7	3	5	5	11
Sphagnaceae	-	-	-	-	1	1
Symphyodontaceae	-	-	1	1	1	1
Thuidiaceae	1	2	-	-	1	2
Total	15	33+1 var.	20	38	25	58+1 ssp.+1 var.

Arthrocormus schimperi (Dozy & Molk.) Dozy & Molk., *Isopterygium albescens* (Hook.) A. Jaeger*, Pelekium gratum* (P. Breauv.) A. Touw, *Syrrhopodon albo-vaginatus* Schwagr., *Syrrhopodon ciliatus* (Hook.) Schwägr. and *Vesicularia miquelii* (Sande Lac.) M. Fleisch. are among the common and often abundant mosses in Northern Selangor peat swamp area. These species were collected several times in nearly every visited station during the survey. They were commonly encoutered either, with many sporophytic structure as in *Isopterygium albescens, Pelekium gratum, Vesicularia miquelii*, or produce large amount of vegetative reproductive structures as in *Arthrocormus schimperi* and *Syrrhopodon ciliatus*. Eddy (1990) pointed out that the gemmiferous stage is rarely seen among the collection of *Syrrhopodon ciliatus*, which is not the case for the population in North Selangor. The gemmiferous leaf, or differentiated gemmae producing leaf is often developed and commonly been observed for the species in the study area. It is interesting to note that *Pelekium gratum*, a Thuidiaceae species which only reported once for Peninsular Malaysia (see Touw, 2001), and absent in Sungai Bebar area, is apparently very common and abundant in the study area. The plant has been collected from buttresses, adventitious roots, as well as rotten logs, and usually in a large mat that covering the substrates.

The peat swamp forest ground that occasionally flooded by water is apparently not a suitable habitat for most of the mosses. Most of the samples collected during this survey are from the tree trunks, buttresses, adventitious roots, rotten logs and even on leaves, but rarely on peat soil. The only three moss species that were found growing on dry peat ground during the survey are *Arthrocormus schimperi*, *Isopterygium albescens* and *Syrrhopodon albo-vaginatus*. Nevertheless, the previously mentioned species are more commonly seen on other substrates in the study area, instead of the forest ground.

ACKNOWLEDGEMENT

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Appendix 1 : Systematic list of the mosses recorded in Northern Selangor Peat Swamp Forest

1. Calymperaceae
1.1. *Arthrocormus schimperi* (Dozy & Molk.) Dozy & Molk.
1.2. *Calymperes boulayi* Besch.
1.3. *Calymperes crassinerve* (Mitt.) A. Jaeger
1.4. *Calymperes couguiense* Besch.
1.5. *Calymperes palisotii* Schwägr.
1.6. *Calymperes tenerum* Müll. Hal.
1.7. *Leucophanes octoblepharioides* Brid.
1.8. *Mitthyridium fasciculatum* subsp. *cardotii* (M. Fleisch.) B.C. Tan & L.T. Ellis
1.9. *Mitthyridium flavum* (Müll. Hal.) H. Rob.
1.10. *Mitthyridium jungquilianum* (Mitt.) H. Rob.
1.11. *Mitthyridium undulatum* (Dozy & Molk.) H. Rob.
1.12. *Syrrhopodon albo-vaginatus* Schwägr.
1.13. *Syrrhopodon aristifolius* Mitt.
1.14. *Syrrhopodon ciliatus* (Hook.) Schwägr.
1.15. *Syrrhopodon spiculosus* Hook. & Grev.

2. Hypnaceae
2.1. *Isopterygium albescens* (Hook.) A. Jaeger [syn. *I. minutirameum* (Müll. Hal.) A. Jaeger]
2.2. *Isopterygium bancanum* (Sande Lac.) A. Jaeger
2.3. *Vesicularia dubyana* (Müll. Hal.) Broth.
2.4. *Vesicularia miquelii* (Sande Lac.) M. Fleisch.
2.5. *Vesicularia reticulata* (Dozy & Molk.) Broth.

3. Pilotrichaceae
3.1a. *Callicostella papillata* (Mont.) Mitt. var. *papillata*
3.1b. *Callicostella papillata* var. *prabaktiana* (Müll. Hal.) Streimann

4. Pylaisiadelphaceae
4.1. *Taxithelium instratum* (Brid.) Broth.
4.2. *Taxithelium isocladum* (Bosch & Sande Lac.) Renauld & Cardot
4.3. *Taxithelium nepalense* (Schwägr.) Broth.

5. Sematophyllaceae
5.1. *Acanthorrhynchium papillatum* (Harv. in Hook.) M. Fleisch.
5.2. *Meiothecium microcarpum* (Harv.) Mitt.
5.3. *Papillidiopsis bruchii* (Dozy & Molk.) W.R. Buck & B.C. Tan
5.4. *Radulina borbonica* (Bél.) W.R. Buck
5.5. *Trichosteleum boschii* (Dozy & Molk.) A. Jaeger
5.6. *Trichosteleum singapurense* M. Fleisch.
5.7. *Trichosteleum stigmosum* Mitt.

6. Thuidiaceae
6.1. *Pelekium gratum* (P. Beauv.) A. Touw
6.2. *Pelekium velatum* Mitt.

Diversity of Macrofungi in North Selangor Peat Swamp Forest

AMIRA PELI[1]

Abstract : A study on the diversity of macrofungi from North Selangor Peat Swamp Forest, Selangor was carried out on June 2013. The macrofungi were collected on trunks and branches from three trails; Rimba Trail (Site 6), Forest Rehabilitation (Site 1) and Western Trail (Site 4). In this expedition, 10 species were identified and documented. Majority of the macrofungi collected on peatland forest are bracket fungi namely Daedaleopsis confragosa, Microporous xanthopus, Phellinus sp., Pycoporous sanguineus, Coriolopsis polyzona, Earliella scabrosa, Lentinus squamorus, Lenzites betulina. Two edible fungi were collected in this study; Schizophyllum commune and Auricularia auricula-judae.

[1] Department of Biology, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

Diversity of macrofungi in North Selangor Peat Swamp Forest

Amira Peli
Department of Biology,Universiti Putra Malaysia
43400 UPM Serdang, Selangor.

INTRODUCTION

- Macrofungi referred to a group of fungi which can produce large fruiting bodies that visible
- commonly produce above ground on soil (terrestrial habitat) or on trees, logs and leaves (lignicolour habitat).
- play a crucial roles in ecosystem but also influence the human and human activities (Mueller *et al.*, 2004).

- Before this forest was gazetted in 1990, North Selangor Peat Swamp Forest has undergone heavy logging activities.
- The Intergrated Management Plan for NSPSF from 2001 until 2010 has recommended significant area of the forest were reserved for research, conservation and rehabilitation area(Parish, 2002).

MATERIALS AND METHODS

- Sample collected from:
  - Rimba Trail (Site 6)
  - Forest Rehabilitation (Site 1)
  - Western Trail (Site 4)

Collection

Identification

- morphological data was recorded
- photograph and botanical sketches of samples

- the samples are dried by using oven
- deposited in Mycology Laboratory, Faculty of Science, Universiti Putra Malaysia, Serdang Selangor.

Preserved

Macrofungi collected in North Selangor Peat Swamp Forest

Date	Site	Location	Species
26 June 2013	Site 6	Rimba Trail	*Daedaleopsis confragosa*
			Auricularia auricula-judae (Cendawan Telinga Kera)
			Phellinus sp.
			Microporous xanthopus
27 June 2013	Site 1	Forest Rehabilitation	*Schizophyllum commune* (Cendawan Kukur)
	Site 4	Western Trail	*Microporous xanthopus*
			Coriolopsis polyzona
			Lentinus squamosus
			Pycoporous sanguineus
			Lenzites betulina
			Earliella scabrosa

Macrofungi collected in Rimba Trail

A: *Daedaleopsis confragosa*

B: *Microporous xanthopus*

C: *Phellinus* sp.

J: *Auricularia auricula-judae.*

Macrofungi in Western Trail & Forest Rehabilitation Site

A: *Coriolopsis polyzona;* B: *Pycoporous sanguineus;* C: *Earliella scabrosa;* D: *Lentinus squamorus;* E:*Lenzites betulina* and F: *Schizophyllum commune*

Polypore fungi as indicator for conservation?

- In Europe, polypore fungi has been used as indicator species for healthy natural forest.
- This is due to the polypore fungi are prefer to growth on well decayed and large logs and its occurrence became rarer with the increase of logging activities (Bader *et al.*, 1995; Norstedt *et al.*, 2001).
- Can the polypore fungi to be used as indicator for forest conservation?

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Fungi Associated with North Selangor Peat Swamp Forest

MOHD FAIRUZUDDIN FAIZAN MOHD YUSOFF[1]*, MOHD KHAIRUL AZWAN AHMAD[1], MOHD MAHAYUDDIN HUSIN[1], ZOOL HILMI IBRAHIM[1], NURUL HAMMIZAH HAMIDON[1] & NEELAM SHAHAB[1]

Abstract : Fungi play a more dominant role than bacteria in the decomposition process in peat swamp forest ecosystem. The basis for understanding their functional role can lead to exploitation of economic fungi. In this study, 29 samples constituting soil sediment, fallen leaves, rotten fruit and twigs were collected from North Selangor Peat Swamp Forest, Selangor, Malaysia. A total of 38 fungal colonies were isolated from the samples. Due to strain duplication and heavy contamination, 14 isolates were selected for purification and molecular identification. Molecular identification was conducted via polymerase chain reaction (PCR) method which employed internal transcribe spacer region (ITS) of the fungal genomic DNA for identification purpose. Nucleotide sequencing of the amplified ITS region successfully identified all isolates. Two of the isolates were *Dothideomycetes* sp. Other isolates were *Aspergillus aculeatus*, *Aspergillus auricomus*, *Chaetomiaceae* sp., *Cochliobolus lunatus*, *Gibberella* sp., *Gongronella* sp., *Microsphaeropsis arundinis*, *Mortierella* sp., *Penincillium* sp., *Sordariomycetes* sp., *Talaromyces leycettanus* and *Trichoderma viride.*

[1] Industrial Biotechnology Research Centre, SIRIM Berhad, 1 Persiaran Dato' Menteri, Section 2, P.O Box 7035, Shah Alam, Selangor
*Corresponding author: fairuzmy@sirim.my

INTRODUCTION

Peat swamp forests are located primarily in Southeast Asia regions with high rainfall and poor drainage (Ambak and Melling, 2000). In Malaysia, it is the largest wetland type, comprising about 75% of the country's total wetlands. The growing waterlogged layer of partially decayed plant materials up to 20 metres thick that made up the peat is the main characteristics of peat swamp forests. The decaying process of the dead vegetation is slowed down by the acidic and anoxic conditions of the high water table of peat swamp. Besides being acidic (pH 4.5), water from peat swamp is poor in nutrients. Due to these harsh conditions, there are many floral species unique to peat swamp forest which can adapt to its environment. The peat ecosystem consists of archaea, bacteria, fungi, protists, animals and plants (Nuyim, 2000).

To date, microbial diversity and ecology of peat swamp forests are little known. It has been argued that main decomposers in peat ecosystems are fungi which assume more dominant role than bacteria (Williams and Crawford, 1983). Various fungi have been isolated from peat land soils worldwide including anamorphic ascomycete, teleomorphic ascomycete, Zygomycota and Basidiomycota (Thormann, 2006). They play an important role in carbon cycle and exchange organic and inorganic compounds with plants (Kamal and Varma, 2008).

North Selangor Peat Swamp Forest located in Selangor, Malaysia is approximately 750 sq. km in area and is an important peat swamp ecosystem in Malaysia. It is surrounded by one of the largest rice cultivation areas in the country. The forest consists of swamp forest on at least 0.5 m – 5.0 m thickness of peat. Due to high quality timber source, the area is affected by logging activity at certain locations and is now subjected to intensive conservation efforts. At 25th-27th June 2013, the authors participated in North Selangor Peat Swamp Forest Scientific Biodiversity Expedition 2013 which was held in Kuala Selangor, Selangor, Malaysia. The research team's main activities focused on peat swamp microalgae and fungi samplings. However the present study only reports the identification of several fungal species associated with North Selangor Peat Swamp Forest using molecular approach. It therefore provides a basis for understanding the functional role of fungi in the ecosystem, and hence, the exploitation of economically important fungi.

MATERIALS AND METHODS

Collection of samples

A total of 29 samples were collected from North Selangor Peat Swamp Forest, near Kampung Sungai Sireh, Selangor. Ten samples were soil sediment, leaves (5), rotten fruit (1) and twigs (13). These samples were then air-dried in paper bags for 5 days prior to transfer into sampling plastic bag and kept at -20 °C.

Strain isolation and maintenance

Fallen leaves, rotten fruit and twigs were cut into small pieces and one gram of each soil sediment sample was subjected to fungal isolation process. Each sample was mixed with saline water, vortexed for 3 minutes and filtered. The suspension was serially diluted up to 10^{-3} dilution level. An aliquot (100 µl) of each dilution level was pipetted and spread in duplicate onto various media which included Leaf Extract Agar (LEA), Tomato Agar (TA), Marine agar (MA) and Potato Dextrose Agar (PDA added with chlorotetracycline). All plates were incubated at 30 °C for 1-2 weeks. After 2 weeks of incubation at 30 °C, fungal strains were selected based on morphology distinction such as colour of aerial mycelium, surface texture (raised colonies, velvety, furry), agar pigmentation, etc. Selected fungal colonies were isolated and sub-cultured onto fresh PDA slant. Pure colonies were stored in 10%

glycerol at -20 °C for long-term storage and on slant at room temperature for further examination. For molecular identification, the selected strains were grown in shake flasks containing Potato Dextrose Broth in an incubator shaker at 30°C, 140 rpm for 1 week.

Fungal molecular identification

Fungal cells were filtered from the broth and mechanically disrupted in the presence of liquid nitrogen. Genomic DNA extraction was performed based on the method described by Liu *et al*. (2000) with modification. The extracted DNA was electrophoresed on a 1% agarose gel stained with ethidium bromide for analysis. Molecular identification was conducted via polymerase chain reaction (PCR) method by amplifying the Internal Transcribe Spacer (ITS) region of the genomic DNA. The primers used for amplification were ITS1F and LR3R. The PCR reaction mixture (25 µl) consisted of 12.5 µl 2x PCR buffer, 1.0 µl ITS-1F, 1.0 µl LR3R, 0.5 µl Taq polymerase, 9.0 µl dH_20 and 1 µl DNA template. Reactions were performed with cycling conditions of a pre-denaturation at 95°C for 3 min, followed by 25 cycles of denaturation at 95°C for 30 sec, annealing at 50°C for 30 sec, elongation at 72°C for 1 min and final extension at 72°C for 7 min. The PCR product was later analysed on 1% agarose gel stained with ethidium bromide. Prior to sequencing, PCR products were purified using QIAQuick PCR Product Purification Kit (QIAGEN, Germany).

Sequencing and bioinformatics analysis

Purified PCR products were sent out to First BASE Laboratories Sdn Bhd, Serdang for sequencing. Nucleotide sequences of the PCR products were later matched using homology search programme, blastN from NCBI (National Centre for Bioinformatics) database which can be accessed online at http://www.ncbi.nlm.nih.gov/.

RESULTS AND DISCUSSIONS

A total of 38 fungal colonies were isolated. However due to duplication of strains and heavy contamination, only 14 isolates were selected and successfully purified. Molecular approach has successfully identified all the selected 14 isolates. Two of them were identified at class level as *Dothideomycetes* sp which is common in peat swamp forest and dominant in submerged substrates. Other identified isolates were *Aspergillus aculeatus* and *Aspergillus auricomus* which are part of common soil microbial communities that express hydrolytic and oxidative enzymes for the breakdown of plant lignocellulose. *Gibberella* sp. which produces gibberilin for cell elongation, seedling growth and flower formation was also identified among the selected isolates. Other identified isolates were *Mortierella* sp. that plays as saprophytes during decomposition process, cellulolytic *Chaetomiaceae* sp., *Cochliobolus lunatus, Microsphaeropsis arundinis*, *Gongronella* sp., *Penincillium* sp. which is normally found in soils rather than any other sources, *Sordariomycetes* sp., thermotolerant *Talaromyces leycettanus* and *Trichoderma viride* that produces biofungicide for biological control against pathogenic fungi in agriculture.

The isolated fungi may be used in many applications. However, there might be novel strains present among unidentified isolates. Moreover, further research needs to be conducted especially in the area of fungal biodiversity of Malaysia peat swamp forest for broader spectrum of fungal strains.

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Labah-Labah Di Hutan Hutan Paya Gambut Selangor Utara

MUHAMAT AZMAN YAHYA[1]

Abstrak : Satu kajian ringkas labah-labah di Hutan Paya Gambut Selangor Utara telah dijalankan pada 15 – 25 Mei 2013 merangkumi 2 Hutan Simpanan Kekal iaitu Hutan Simpan Raja Musa dan Hutan Simpan Sungai Karang. Kajian telah dijalankan di Denai 2, 3, 4 dan 5. Sampel diperolehi melalui pemerhatian secara visual di siang hari dan difotograf secara in-situ untuk pengecaman spesies. Sampel ditinjau di bahagian lantai hutan dan di bahagian ranting serta daun pokok sehingga berketinggian 2 meter dari lantai hutan. Hasil daripada kajian ini, sejumlah 17 spesies labah-labah daripada 7 famili direkodkan. Spesies terbanyak yang direkodkan terdiri daripada Famili Araneidae sebanyak 6 spesies, diikuti Famili Salticidae sebanyak 4 spesies, Famili Tetragnathidae sebanyak 3 spesies dan masing-masing dari Famili Heteropodidae, Lycosidae, Oxyopidae dan Theridiidae sebanyak 1 spesies. Jumlah spesies yang diperolehi di Hutan Paya Gambut Selangor Utara adalah kurang berbanding kajian yang pernah dijalankan di Pulau Pangkor yang merekodkan sebanyak 8 famili dan 25 spesies manakala di Hutan Simpan Gunung Belumut, sebanyak 9 famili dan dan 26 spesies direkodkan. Sebagai kesimpulan, lebih banyak kajian perlu dilakukan untuk mengkaji kepelbagaian spesies labah-labah yang wujud di Hutan Paya Gambut Selangor Utara.

[1] Jabatan Perhutanan Semenanjung Malaysia Jalan Sultan Salahuddin, 50660 Kuala Lumpur

PENGENALAN

Hutan Paya Gambut Selangor Utara (HPGSU) mempunyai kawasan seluas kira-kira 76,000 hektar yang merangkumi Hutan Simpan Raja Musa dan Hutan Simpan Sungai Karang (GEC, 2002). HPGSU terletak di beberapa daerah sivil iaitu Daerah Hulu Selangor, Kuala Selangor dan Sabak Bernam.

HPGSU merupakan salah satu kawasan hutan paya gambut yang terbesar terdapat di Semenanjung Malaysia dan telah dikenalpasti sebagai satu kawasan penanda aras kepada pemuliharaan dan pendidikan di hutan paya gambut (GEC, 2002). Namun, kawasan hutan ini yang berhampiran dengan komuniti setempat sering diceroboh untuk aktiviti mencari sumber hutan seperti rotan, kayu balak, memburu dan juga ditebusguna untuk kegiatan pertanian dan perikanan. Aktiviti pencerobohan ini sedikit sebanyak telah merosakkan habitat semulajadi bagi flora dan fauna yang wujud di HPGSU ini. Aktiviti pembakaran hutan yang tidak terkawal untuk aktiviti pertanian juga dikenalpasti sebagai salah satu punca utama kepada kemusnahan habitat semulajadi di HPGSU.

Secara umumnya, kajian mengenai inventori labah-labah di Semenanjung Malaysia sangat kurang. Direkodkan di Semenanjung Malaysia, terdapat 425 spesies dari 42 famili dan 238 genera (Norma-Rashid & Li, 2009). Di seluruh dunia pula telah direkodkan lebih daripada 40,000 spesies di bawah 112 famili dan 4,000 genera (Platnick, 2014).

Untuk memastikan kepelbagaian kumpulan labah-labah di HPGSU, satu kajian ringkas dijalankan dan diharap boleh dijadikan satu senarai semak kumpulan labah-labah di habitat hutan paya gambut. Seterusnya satu perbandingan dibuat dengan kajian yang seumpamanya yang telah dilakukan di Hutan Simpan Gunung Belumut, Johor dan hutan Pulau Pangkor, Perak.

BAHAN DAN KAEDAH

Pencarian spesies labah-labah dilakukan di denai 1, 2, 3, 4, dan 5 yang merangkumi Hutan Simpan Raja Musa, Hutan Simpan Sungai Karang dan Rezab Hidupan Liar Sungai Buluh. Kaedah pemerhatian secara visual dilakukan pada lantai hutan sehingga berketinggian 2 meter dari atas tanah dan tertumpu di celah-celah daun, ranting-ranting kayu dan sarang-sarang yang dibina. Kamera digunakan untuk merakam gambar statik labah-labah di lapangan untuk pengecaman spesies. Pengecaman spesies dibuat berdasarkan rujukan kepada Murphy & Murphy (2000) dan Koh (1989).

KEPUTUSAN DAN PERBINCANGAN

Sejumlah 17 spesies labah-labah daripada 7 famili direkodkan sepanjang ekspedisi ini berlangsung. Famili terbanyak yang dijumpai adalah dari Famili Araneidae iaitu sebanyak 5 spesies, manakala selebihnya dari Famili Salticidae sebanyak 4 spesies, Famili Tetragnathidae sebanyak 3 spesies dan masing-masing dari Famili Lycosidae, Oxyopidae dan Theridiidae sebanyak 1 spesies.

Jumlah famili yang dijumpai di HPGSU hampir sama dengan jumlah famili yang dijumpai dalam kajian-kajian yang sama dari hutan darat di Pulau Pangkor, Perak pada Mei 2009 dan Hutan Simpan Gunung Belumut, Johor pada Ogos 2009. Di Pulau Pangkor, 8 famili dan 25 spesies direkodkan (Muhamat Azman et al, 2012). Manakala di Hutan Simpan Gunung Belumut, sebanyak 9 famili dan dan 26 spesies direkodkan (Jambari et al, 2012). Bilangan spesies yang direkodkan di HPGSU adalah kurang berbanding di Pulau Pangkor dan Hutan Simpan Gunung Belumut **(Jadual 1)**. Hutan Pulau Pangkor merupakan hutan darat di pulau yang terpisah jauh dari tanah besar manakala Hutan Simpan Gunung Belumut, Johor merupakan hutan darat di tanah besar yang terletak di Daerah Kluang, Johor.

Jadual 1 : Komposisi spesies labah-labah yang dijumpai di HPGSU, Pulau Pangkor dan Gunung Belumut

Famili/ Spesies	HPGSU	Pulau Pangkor	Gunung Belumut
Araneidae			
Acusilas sp.	-	+	-
Anepsion depressium	-	+	-
Araneus mitificus	-	-	+
Argiope versicolor	+	-	-
Argiope sp.	-	+	-
Eriovixia sp.	+	+	-
Gasterachanta kuhli	+	-	-
Gea spinipes	+	-	-
Nephila maculata	-	+	+
Zygiella calyptrata	+	-	-
Zygiella sp.	-	+	-
Salticidae			
Agorius constrictus	-	-	+
Cytaea oreophila	-	-	+
Epeus flavobilineatus	-	+	-
Epeus sp.	-	+	-
Epocilla calcarata	+		-
Harmochirus sp.	-	+	-
Orsima ichneumon	-	-	+
Orsima sp.	-	-	+
Pancorius magnus	+	-	-
P. thorelli	+	-	+
Pinthella sp.	-	+	-
Plexippus paykuhli	-	+	-
Plexippus sp.	-	+	-
Portia labiata	-	-	+
Siler sp.	-	-	+
Telamonia elegans	-	+	-
Telamonia sp. 1	-	+	-
Telamonia sp. 2	-	+	-
Thiania bhamoensis	+	-	+
Tetragnathidae			
Leucauge decorata	-	+	-
L. fastigata	-	+	-
L. celebesiana	-	-	+
Leucauge sp.	+	-	-
Leucauge sp.1	-	+	-
Leucauge sp.2	-	+	-
Tylorida striata	+	-	+
Perilla teres	+	-	-
Heteropodidae			
Heteropoda venatoria	+	-	-

Lycosidae			
Hippasa holmerae	+	-	+
Lycosa sp. 1	-	-	+
Lycosa sp. 2	-	-	+
Pardosa pseudoannulata	-	+	+
Pardosa sp.	-	-	+
Venonia coruscans	-	+	+
Oxyopidae			
Oxyopes birmanicus	+	+	+
O. javanus	-	-	-
Theridiidae			
Chrysso spiniventris	-	-	+
Chrysso sp.	-	+	-
Phoroncidia lygeana	+	-	+
Pisauridae			
Eurychoera quadrimaculata	-	+	-
Hygropoda prognata	-	-	+
Cryptothelidae			
Cryptothele sundaica	-	+	-
Sparassidae			
Pandercetes sp.	-	-	+
Thomisidae			
Dieta sp.	-	-	+
Phrynarachne sp.	-	-	+

Persamaan kehadiran famili labah-labah di ketiga-tiga hutan dapat dilihat apabila hampir kesemua famili yang dijumpai di HPGSU turut dijumpai di hutan Pulau Pangkor dan Hutan Simpan Gunung Belumut kecuali Famili Heteropodidae. Namun begitu, terdapat 1 famili yang direkodkan di hutan Pulau Pangkor dan Hutan Simpan Gunung Belumut tidak terdapat di HPGSU iaitu Famili Pisauridae manakala Famili Cryptothelidae hanya terdapat Pulau Pangkor. Selain itu, Famili Sparassidae dan Thomisidae hanya direkodkan di Hutan Simpan Gunung Belumut.

Sebagai kesimpulan, senarai semak ini tidak menunjukkan satu inventori yang lengkap untuk menggambarkan kepelbagaian spesies labah-labah yang wujud di HPGSU ini. Kaedah pengutipan data perlu dipelbagaikan lagi untuk mendapatkan sampel seperti penggunaan perangkap *pitfall* untuk memerangkap labah-labah di lantai hutan dan yang aktif bergerak di waktu malam. Kajian yang seumpamanya perlu diteruskan untuk mendapatkan senarai semak spesies labah-labah yang lebih pelbagai dan perlu melibatkan lebih ramai pengkaji labah-labah dari Institusi Pengajian Tinggi serta agensi lain.

Oxyopes birmanicus

Pancorius magnus

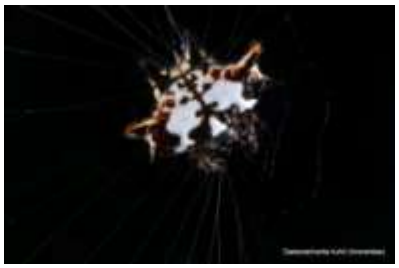
Tylorida striata

Gea spinipes

Pancorius thorelli

Eriovixia sp.

Hippasa holmerae



Gasterachanta kuhli

Heteropoda venatoria

Argiope versicolor

Epocilla calcarata

Phoroncidia lygeana

Gambarajah 1 : Sebahagian spesies labah-labah yang dijumpai di Hutan Paya Gambut Selangor Utara

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The Odonata of North Selangor Peat Swamp Forest, Selangor

C.Y. CHOONG[1]

Abstract : Dragonflies and damselflies (Order: Odonata) were recorded during a scientific expedition on 24 June-1 July 2012 at North Selangor Peat Swamp Forest (NSPSF), Selangor. In total 47 species from nine families were recorded during the expedition. Of these, 28 species were in family Libellulidae, nine were in family Coenagrionidae, two each were in families Platycnemididae and Protoneuridae and Chlorocyphidae, and one each was in families Gomphidae, Lestidae, Argiolestidae and Corduliidae. A good number of species recorded in NSPFS were peat swamp specialists. The number of Odonata species recorded during the scientific expedition was high, representing 19% of the species found in Peninsular Malaysia indicating NSPFS is particularly rich in Odonata fauna.

Keywords. Biodiversity, Damselflies, Dragonflies, Odonata, Peat Swamp

[1] Centre for Insect Systematics, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor.
*Corresponding author: cychoong@ukm.my

INTRODUCTION

In Peninsular Malaysia, the Selangor state is quite well studied for its Odonata. The main published records of Odonata of Selangor are available for Gombak Valley (Kalkman 2004), Sungai Chongkak Recreational Forest (Raja Zalinda et al. 2006), Bangi Forest Reserve (Choong et al. 2008), Paya Indah Wetlands (Fadilawati et al. 2008) and Kota Damansara Forest Reserve (Choong et al. 2012). However, none of the above studied areas are of peat swamp habitat.

North Selangor Peat Swamp Forest (NSPSF) located at the north western Selangor state consists of two forest reserves – Raja Musa Forest Reserve and Sungai Karang Forest Reserve. With a coverage of 76,000 ha, NSPSF appears to be the largest remaining contiguous peat swamp forest on the west coast of Peninsular Malaysia.

Until now no inventory of Odonata of NSPSF had been published, and I am not aware of any Odonata records from NSPSF. This paper describes the results of recording and collecting dragonflies and damselflies carried out at NSPSF on 24 June-1 July 2013 as part of the series of NSPSF scientific expedition organised by Malaysian Nature Society and Selangor Forestry Department.

METHODS

Adult Odonata were collected by using hand held nets and preserved with acetone treatment and drying in silica gel. Specimens were identified to species under a microscope, by reference to the relevant literatures, and direct comparison with materials from other places. The family level taxonomy used here follows that in Orr (2005). The latest taxonomic treatment of families Megapodagrionidaea and Argiolestidae (Kalkman & Theischinger 2013) is adopted. The material collected is held in the Centre for Insect Systematics at Universiti Kebangsaan Malaysia (UKM).

LOCATIONS

Sampling was done on 24 June-1 July 2013 at all the trails/locations prepared during the NSPSF scientific expedition. Locations A-D are in Raja Musa Forest Reserve and locations E-G are in Sungai Karang Forest Reserve. Location H is in Sungai Dusun Wildlife Reserve adjacent to the former two forest reserves. No specimen was taken out from location H as a directive from PERHILITAN. Therefore, the record was only done by observation in location H.

A. Trail 1, highly degraded forest; site of recent rehabilitation efforts by Selangor Forestry Department, Raja Musa Forest Reserve.
B. Trail 2, 400 ha affected by forest fire in 2012, mainly open area and grassland, Raja Musa Forest Reserve.
C. Trail 3, deep into the centre of Raja Musa Forest Reserve, logged forest through SMS.
D. Along Sungai Tengi on the side of Raja Musa Forest Reserve, mainly bushes and drainages with peat water.
E. Along Sungai Tengi on the side of Sungai Karang Forest Reserve, mainly bushes and drainages with peat water.
F. Trail 4, deep into Sungai Karang Forest Reserve, forest recovery from heavy logging.
G. Trail 6, north western section of North Selangor Peat Swamp Forest, degraded forest with natural rehabilitation.
H. Sungai Dusun Wildlife Reserve, trail along the rhinoceros rehabilitation area.

RESULTS

In total 47 species from nine families were recorded during the NSPSF scientific expedition (Table 1). Of these, 28 species were in family Libellulidae, nine were in family Coenagrionidae, two each were in families Platycnemididae and Protoneuridae and Chlorocyphidae, and one each was in families Gomphidae, Lestidae, Argiolestidae and Corduliidae. Sungai Karang Forest Reserve had the most number of species (37), followed by Raja Musa Forest Reserve (33) and Sungai Dusun Wildlife Reserve (14).

DISCUSSION

It must be noted that the sampling during the NSPSF scientific expedition mainly covered Raja Musa Forest Reserve and Sungai Karang Forest Reserve. The aquatic habitats found in both the forest reserves are of forest peat swamp and open peat swamp. On the other hand, the field work in Sungai Dusun Wildlife Reserve was carried only in a single day around the rhinoceros rehabilitation centre, where the habitat of the rehabilitation centre is of lowland dipterocarp forest (not peat swamp). It is understood that some parts of the Sungai Dusun Wildlife Reserve are covered by peat swamp, but the trail prepared during the NSPSF scientific expedition was not in the peat swamp area. Therefore, the data for Sungai Dusun Wildlife Reserve presented here was far from comprehensive, and it did not represent the Odonata fauna of Sungai Dusun Wildlife Reserve.

A total of 47 species covering nine families were recorded from the three reserves, representing 19% of the total number of species known from Peninsular Malaysia. Species found abundantly in NSPSF were *Chalybeothemis fluviatilis*, *Libellago hyalina*, *Podolestes buwaldai*, *Orthetrum sabina*, *Ictinogomphus decoratus*, *Nannophya pygmaea*, *Tyriobapta laidlawi*, *Rhyothemis aterrima*, *Epophthalmia vittigera*, *Teinobasis ruficollis* and *Elattoneura aurantiaca*. The true alluvial swamp and peat swamp species recorded at NSPSF are *Libellago hyalina*, *Podolestes buwaldai*, *Agriocnemis minima*, *Archibasis viola*, *Archibasis melanocyana*, *Teinobasis ruficollis*, *Elattoneura aurantiaca*, *Brachygonia oculata*, *Chalybeothemis fluviatilis*, *Rhyothemis atterima* and *Tyriobapta laidlawi*. The abundance of peat swamp specialists in the checklist (Table 1) might have indicated that the peat swamp habitat in NSPSF is still in good health even though NSPSF is a secondary forest. Nevertheless, other notable peat swamp specialists such as *Amphicnemis* species and *Orchithemis pruinans* were absent from NSPSF. Another peat swamp forest in Peninsular Malaysia comparable to NSPSF in Odonata fauna is Nenasi Forest Reserve in Pahang. However, it is noted that a few notable peat swamp specialists from Nenasi Forest Reserve (Dow et al. 2012) were absent from NSPSF.

A few interesting species recorded in NSPSF were *Tyriobapta laidlawi*, *Podolestes buwaldai* and *Teinobasis ruficollis*. Surprisingly, the uncommon *T. laidlawi*, true peat swamp specialist, was found abundantly in NSPSF. After Nenasi Forest Reserve (Dow et al. 2012) and Ayer Hitam Forest Reserve (Choong & Cheah 2013), NSPSF is the third site known for *T. laidlawi* in Peninsular Malaysia. *Podolestes buwaldai* is a rare and local species confined to southern Peninsular Malaysia and Sumatra (Orr 2005), and it occurred abundantly in NSPSF. *Teinobasis ruficollis* is also another rare and local species found in Peninsular Malaysia and Sumatra. As the former two interesting species, *T. ruficollis* also occurred in good number in NSPSF.

The species composition between Raja Musa Forest Reserve and Sungai Karang Forest Reserve was not much different as both the forest reserves shared most of the species recorded. However, the species composition of Sungai Dusun Wildlife Reserve was different to the former two forest reserves due to the different of aquatic habitat in Sungai Dusun Wildlife Reserve being surveyed during the NSPSF scientific expedition.

CONCLUSION

With 47 species recorded during the short survey reported here, it can be said that NSPSF is rich in Odonata fauna. It is clear that NSPSF is a refuge for many peat swamp specialists, including the scarce local species (*Podolestes buwaldai*, *Tyriobapta laidlawi* and *Teinobasis ruficollis*) found in Peninsular Malaysia. The protection and conservation of NSPSF is vital to safe guard these scarce Odonata species.

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Table 1 : Odonata species known from NSPSF. Locations A-D are in Raja Musa Forest Reserve, locations E-G are in Sungai Karang Forest Reserve, and location H is in Sungai Dusun Wildlife Reserve. √ indicates specimens collected, and * indicates species observed.

	Sampling locations							
	A	B	C	D	E	F	G	H
Family Chlorocyphidae								
Libellago hyalina (Selys, 1859)				√	*	√	√	
Libellago lineata (Burmeister, 1839)				√		√		
Family Argiolestidae								
Podolestes buwaldai Lieftinck, 1940			√				√	*
Family Lestidae								
Orolestes wallacei (Kirby, 1889)							√	
Family Coenagrionidae								
Agriocnemis minima Selys, 1877	√							
Agriocnemis pygmaea (Rambur, 1842)				√				
Archibasis melanocyana (Selys, 1877)							√	
Archibasis viola Lieftinck, 1949								*
Ceriagrion cerinorubellum (Brauer, 1865)	√	√	√			√	√	
Ischnura senegalensis (Rambur, 1842)	√	√		√	*			
Pseudagrion microcephalum (Rambur, 1842)		√					√	
Pseudagrion williamsoni Fraser, 1922		*		√	√	√		
Teinobasis ruficollis (Selys, 1877)			√				√	
Family Platycnemididae								
Coeliccia octogesima (Selys, 1863)								*
Copera vittata (Selys, 1863)			√			√	√	*
Family Protoneuridae								
Elattoneura aurantiaca (Selys, 1886)						√	√	
Prodasineura collaris (Selys, 1860)								*
Family Corduliidae								
Epophthalmia vittigera (Rambur, 1842)		√		*	*		*	

Family Gomphidae								
Ictinogomphus decoratus melaenops (Selys, 1858)		√		*	*		*	
Family Libellulidae								
Acisoma panorpoides Rambur, 1842	√	√				√		
Aethriamanta gracilis (Brauer, 1878)				√	√			
Brachydiplax chalybea Brauer, 1868	√	√		√	*	√		
Brachygonia oculata (Brauer, 1878)			*			√	√	*
Brachythemis contaminata (Fabricius, 1793)						√		
Chalybeothemis fluviatilis Lieftinck, 1933				√	√	√		
Cratilla lineata (Brauer, 1867)								*
Cratilla metallica (Brauer, 1878)							*	*
Diplacodes nebulosa (Fabricius, 1793)		√						
Diplacodes trivialis (Rambur, 1842)		*					√	
Hydrobasileus croceus (Brauer, 1867)	*			*		*		
Lyriothemis biappendiculata (Selys, 1878)								*
Nannophya pygmaea Rambur, 1842	√	*			√	√		
Nesoxenia lineata (Selys, 1879)							√	
Neurothemis fluctuans (Fabricius, 1793)	√	√	√	*	*	√	√	*
Orthetrum chrysis (Selys, 1891)				√	*		√	*
Orthetrum sabina (Drury, 1770)	√	√		√	*	*	√	*
Orthetrum testaceum (Burmeister, 1839)					√			*
Pantala flavascens (Fabricius, 1798)	√			√				
Rhodothemis rufa (Rambur, 1842)	√	√		*		*		
Rhyothemis aterrima Selys, 1891	√			√	*	√		
Rhyothemis obsolescens Kirby 1889				√		√	√	
Rhyothemis phyllis (Sulzer, 1776)	√			√		*	*	
Tholymis tillarga (Fabricius, 1798)						√		
Tramea transmarina euryale Selys, 1878		√		*		*		
Tyriobapta laidlawi Ris, 1919			√			√	√	
Tyriobapta torrida Kirby, 1889								*
Urothemis signata insignata (Selys, 1872)				√	√	√		
Total number of species	13	15	6	21	15	23	21	14

Phylogenetic Relationships among Bagridae in North Selangor Peat Swamp Forest

ROSHANI OTHMAN[1]*, SHARR AZNI HARMIN[1], NOR NORHISYAM MAT SOUT[1], IRENCE JOHN[1], NUR AKMAL SULIMAN[1] AND MOHD SYAHRIL MOHD ZAN[2]

Abstract : Like any other catfish, bagrid catfish do not have scales, they have a large adipose dorsal fin, four pairs of barbells and serrated pectoral spines. However, to identify the strain, genotypes or individuals requires further confirmation due to limitation of morphological identification. A solution to this problem is the application of molecular markers for identification of bagrid catfish species. Investigation on the four species of bagrid catfish in North Selangor Peat Swamp Forest Reserve (NSPSF) (Coordinate: 3˚32' 297"N 101˚18' 33.9"E) during NSPSF Scientific Biodiversity Expedition 2013 was done to determine their relationships. Amplification of genomic DNA using cytochrome *b* (cyt-*b*) primer was employed to determine the bagrid catfish species. The samples include 10 individuals obtained from the Sungai Karang Forest Reserve. Six samples were identified as false black lancer (*Bagrichthys macropterus*), two samples of silver lancer (*Mystus bocourti*), one sample of river catfish (*Hemibagrus nemurus*) and one sample of bumblebee catfish (*Leiocassis poecilopterus*) with fragment size of 585 bp. The molecular phylogenetic tree was constructed by neighbour-joining (NJ) method followed by maximum parsimony (MP) method. Both analysis were done using MEGA 5.10 program. The lowest genetic distance is obtained between *Mystus bocourti* and *Bagrichthys macropterus* at 0.2%, while the highest genetic distance is between *Leiocassis poecilopterus* and *Mystus bocourti* at 18.1%. Topology of the constructed tree (NJ and MP) in MEGA 5.10 justifies that all the sampled species are closely related. Based on this study, cyt-*b* is suitable for identification of bagrid catfish species in Malaysia. These findings can establish nucleotide sequence for bagrid catfish species for future use especially for application of selective breeding program.

Keywords. Phylogenetic, peat swamp forest, bagrid catfish, cytochrome b

[1] Faculty of Science and Biotechnology, Universiti Selangor, Bestari Jaya Campus, Jalan Timur Tambahan, 45600 Batang Berjuntai, Selangor Darul Ehsan, Malaysia
[2] Faculty of Applied Science, Universiti Teknologi MARA, Kuala Pilah Campus, Negeri Sembilan Darul Khusus, Malaysia
*Corresponding author: roshani@unisel.edu.my

INTRODUCTION

Sungai Karang Forest Reserve is part of North Selangor Forest Reserve (NSPSF). The NSPSF with an area about 76, 000 ha and covers the Raja Musa Forest Reserve (23, 486 ha) and the Sungai Karang Forest Reserve (50, 106 ha). According to Ng et al., (1992), more than 100 species of fish have been recorded in NSPSF. Many species of fish live in blackwater have unique character and are important source of aquarium fishes (Parish, 2002).

The bagrid catfish is a large family of freshwater catfish that have a large adipose dorsal fin, small eyes and four pairs of barbels around mouth (Allaby, 1999). There are several genera under the family Bagridae. These include *Bagrus, Bagrichthys, Bagroides, Hemibagrus, Heterobagrus, Mystus, Leiocassis, Macrones* and *Peltabagrus* (Inger &Chin, 1962; Mohsin & Ambak, 1983; Kottelat et al., 1993). The bagrid catfishes live in both fresh and brackish water throughout Asia and Africa. According to Teugels (2003), family Bagridae have at least 144 species and 18 genera.

However, very little work has been done to establish the identities and phylogenetic relationship of family Bagridae found in Malaysia's peat swamp forest. In this study, mitochondrial DNA (mtDNA) was used to study the molecular relationship among bagrid catfish found in Sungai Karang Forest Reserve. Hence, the aim of this study is to use the molecular DNA marker for species identification.

MATERIALS AND METHODS

Fish Samples

The samples of bagrid catfish were collected from Sungai Karang Forest Reserve during NSPSF Scientific Biodiversity Expedition 2013. A small piece of finclips was taken from each individual and placed in 1.5 mL microcentrifuge tube containing CTAB buffer. The samples were then brought to the laboratory and kept under -20°C prior to DNA extraction.

DNA Preparation and Amplification Procedures

Extraction of DNA was carried out using the modified CTAB extraction method as described by Stockinger (1996). The method that yields better (quality and quantity) genomic DNA was employed for subsequent mtDNA analysis. PCR amplification of the mitochondrial DNA encoded cytochrome b gene was employed. Two pairs of primers for cytochrome b gene (585 bp) L15267, 5'- AAT GAC TTG AAG AAC CAC CGT-3' and H15891, 5'- GTT TGA TCC CGT TTC GTG TA- 3' (Kadar et al., 2008) were amplified through polymerase chain reaction (PCR) from each individual DNA sample in a Bio-Rad MJ Mini™ Personal Thermal Cycler. PCR mixtures were prepared in 50 μL with a final concentration of 0.4 μM for each primer, one μL of template DNA and 25 μL MyTaq Mix. The amplification process was conducted at 95°C for 1 min, followed by 35 cycles (95°C for 15 s, 52°C for 15 s, 72°C for 10 s and 72°C for 7 min). The PCR products were separated by gel electrophoresis (2.0% agarose gel) and stained with Safe-Red™.

PCR Purification and Sequencing

PCR products were purified using innuPREP PCRpure Kit. Successful PCR products were sent for sequencing to Repfon Glamor Sdn Bhd. The strands of the PCR fragments were sequenced enabling the identification of PCR product ambiquities.

Data Analysis

The DNA sequence data of all samples were analyzed for ambiguities in the sequence using MEGA5. The whole sequences were aligned by Clustal X Multiple Sequence Alignment (Tamura et al., 2011). A phylogenetic tree was determined based on maximum- parsimony method, to observe the character values from each species. A neighbour-joining analysis based on the distance measurement of the p-distance analysis was examined using MEGA5 software to evaluate genetic distance between species (Tamura et al., 2011). Relative support at nodes was evaluated using bootstrap analysis with 1000 replicates.

RESULTS AND DISCUSSION

Morphological differences has long been an important key in identifying species. The morphological characterization of the four bagrid catfish found in Sungai Karang Forest Reserve can be used to identify fish with similar morphology. However, closely related species which, shares common morphology traits will face many constrain when species classification procedure is performed. According to An et al. (2012), identification and characterization of catfishes are usually based on morphological, meristic and anatomical characters. However, considerable ambiguity exists due to morphological similarity and they have led some controversial hypotheses on species identification. For examples, the *Leiocassis sp.* has a confused taxonomy and there been misidentified as *Pseudomystus sp.* Certain East Asian bagrids formerly placed in this genus have been moved to *Pseudomystus* (Ng & Lim, 2006), in another report by Linder (2000) both *Leiocassis sp.* and *Pseudomystus sp.* are locally known as bumblebee catfish.

In this study, six samples were identified as false black lancer (*Bagrichthys macropterus*), two samples of silver lancer (*Mystus bocourti*), one sample of river catfish (*Hemibagrus nemurus*) and one sample of bumblebee catfish (*Leiocassis poecilopterus*). Molecular approach was used to identify the bagrid catfish in Sungai Karang Forest Reserve.

Genomic DNA of bagrid catfish was successfully extracted using the modified CTAB extraction method. Gel electrophoresis analysis was performed in order to check the quantity and quality of the samples. The primer has successfully amplified 585bp *cyt b* gene (Figure 1). The evolutionary history can be inferred via Maximum Parsimony (MP) method. The result from MP shows, 271bp out of 857bp were found to be conserved, 185 were informative and 401 were uninformative. The overall result showed that the parsimony tree is comprised of subcluster A (*Bagrichthys macropterus*), subcluster B (*Leiocassis poecilopterus*), subcluster C (*Hemibagrus nemurus*) and subluster D (*Mystus bocourti*). Four generas from the Bagridae family were examined and were divided into two clades. The first clade consists of *Bagrichthys, Hemibagrus* and *Leiocassis* species (subcluster A, B and C) whereas the second clade consists of *Mystus* species (subcluster D).

The NJ tree revealed similar result with MP tree. The subcluster A (False Black Lancer) shows the highest bootstrap value of 100% (figure not shown) and MP tree (99%) (Figure 2). Subcluster B, consisting of Bumblebee Catfish, shares the common ancestor with subcluster A with a bootstrap value of 98%. Subcluster C (Asian Catfish) shares the common ancestor with both subcluster A and subcluster B displayed a bootstrap value of 89% . Subcluster D, also shows the highest bootstrap value of 100%, confirming that Silver Lancer is a part of Bagridae family. The lowest genetic distance is obtained between *Mystus bocourti* and *Bagrichthys macropterus* at 0.2%, while the highest genetic distance is between *Leiocassis poecilopterus* and *Mystus bocourti* (18.1%). Subcluster E is *Wallago attu* (Accession No.: JX260994.1) acted as the outgroup for Bagridae. The findings was supported by a previous study done by Muchlisin and Siti Azizah (2009), stating that *Hemibagrus* spp. and *Mystus* spp. are of different genera as observed in the Fishbase species nomenclature. Thus, the

finding affirms that *H. nemurus* belongs to the genus *Hemibagrus* and not, *Mystus spp*. However, Ku et al. (2007) reported that with 87% bootstrap value, the *Mystus* sp. and *Hemibagrus nemurus* were grouped together. In this study, both trees show that *Bagrichthys macropterus* and *Leiocassis poecilopterus* are grouped together with the bootstrap value of 87% (MP) and 98% (NJ). Hardman (2005) stated that *Leiocassis* was claimed as the most closely-related species to *Bagrichthys* although it was not supported by strong bootstrap evidence.

The molecular phylogenetic analysis using the mtDNA has been extensively conducted in fish due to the high-resolution information on the evolutionary relationships between taxonomically close family and species-specific. Cyt-*b* genes are well conserved and have been sequenced in various invertebrate and vertebrate taxa (An et al., 2012).

Figure 1 : PCR amplification of cytochrome b gene ~ 585bp measured against 100bp DNA ladder (left) and 1kb DNA ladder (right)

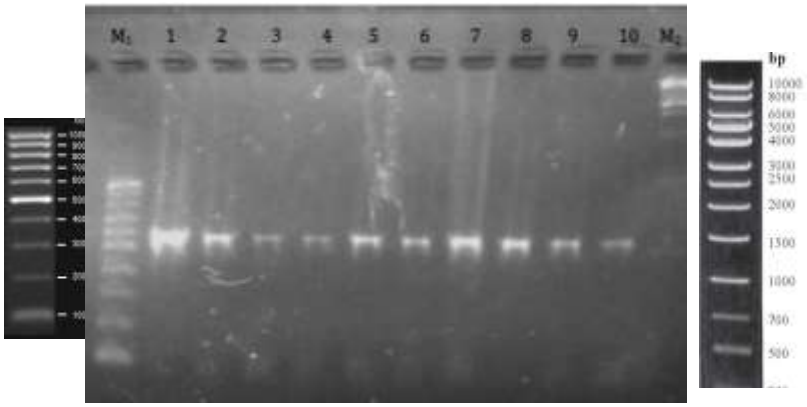
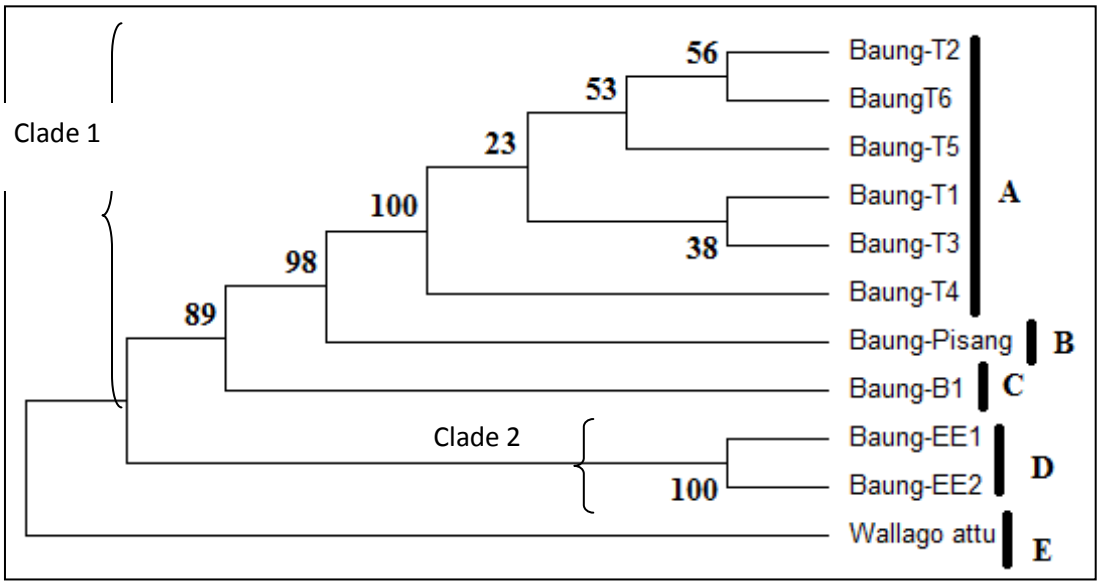


Figure 2 : NJ tree reconstructed with cyt-*b* sequences from 10 samples of Bagrid Catfish with *Wallago attu* (Accession No.: JX260994.1) used as the outgroup.The percentage trees in bootstrap test of NJ were 1000 replicates.



CONCLUSION

As a conclusion, the genetic distance of bagrid catfish in Sungai Karang Forest Reserve is low (0.2-18.1%) because they are from the same family (Bagridae). The NJ and MP phylogenetic tree generate four subclusters with each subcluster consisted of different species; subcluster A (*Bagrichthys macropterus*), subcluster B (*Leiocassis poecilopterus*), subcluster C (*Hemibagrus nemurus*) and subluster D (*Mystus bocourti*). The local Malaysian Catfish has a high evolutionary relationship as compared to other species as revealed by the Genbank where definitive identity matches in range of 87% - 94% for consensus sequence of the four species of Family Bagridae. From the research, cyt-*b* was found to be a suitable marker in obtaining DNA sequence for determination of gene evolution amongst species within Bagridae family.

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Community Structure of Understorey Bird in Raja Musa

AINIL HAWA BINTI SAZALI[1]

Abstract : A study on avian diversity was conducted at Raja Musa Forest Reserve, North Selangor from February 2012 until january 2013. The number of birds that were captured throughtout the data collection period is 1047 birds which consists of 73 of species. The most common would be the Yellow-Vented Bulbul (*Pycononotus goiavier)* with the highest number of birds. The list is followed by Zebra Dove (*Geopelia striata*), Olive Winged Bulbul *(Pycnonotus plumosus)* and White throated kingfisher *(Halcyon smyrnensis*). Peat swamp forest is a unique and diverse ecosystem with an abundance and variety of often highly adapted fauna and flora. However, it is also a fragile ecosystem. When the forest is cleared, the exposed peat will dry out and quickly and catches fire easily. Detection seems to be hard since it spreads underground slowly. Peat fire can cause more serious problem in term of destruction of ecosystem and fire control.

[1] Faculty of Science and Biotechnology, University Selangor, Jalan Timur Tambahan, 45600 Bestari Jaya, Selangor, Malaysia
*Corresponding author: ainnyl@yahoo.com

INTRODUCTION

Birds inhabits ecosystem that exist on all seven continents, from the Arctic to Antarctic. According to the Birdlife International (2008), there are around 10,000 different species of birds that currently inhabit the earth. Today, an estimated 300 billion birds belonging to inhabit virtually every terrestrial habitat on the planet. Elementary biogeographic factors influence the distribution of avian diversity around the world, with tropical countries sustaining the highest species richness. The influence in significant geographic differences in avian species diversity is the variety (and area) of different habitats present.

Birds are most fascinating creatures on Earth. They are warm blooded animals as mammals and more akin near reptile which began evolving about 135 years ago. Approximately 300 billion of birds in about 10 000 of species are inhabit in our earth. Peat swamps are an important component of the world wetlands. The combination of the dynamic link between land and water, a transition zone where the flow of water, the cycling of nutrients and the energy of the sun produced a unique ecosystem of hydrology, soils, and vegetation. Peat normally formed when the plant material is inhibited from decaying fully by the acidic conditions. This normally happened in marshy area.

Malaysia is one of the 12 megadiversity countries in the world. And has a diverse range of habitat types to offer includingthe lowland dipterocarp forest, the hill dipterocarp forest, the upper hill dipterocarp forest, the oak-laurel forest, the montane forest, the mangrove forest and the peat swamp forest (Wyatt-Smith, 1995). Different forest types and habitats, suitable and attractive to particular bird assemblages, have their own species distribution and composition. These different types of forest offer a variety of habitat niche for species of birds. Jenkins (2004) reported that there are around 747 species of avifauna found in Malaysia and many are endemic to the country. As of 2013, Malaysia is currently home to 766 species of birds. This indicates the high avian species diversity in Malaysia. On the Peninsular alone, there are 644 species of birds recorded and many are endemic to the mountains of Peninsular. The forests of East Malaysia (Sabah and Sarawak) also shows high level of endemism among avian species, with 38 species found nowhere else.

Bird studies conducted in the peat swamp forest of Malaysia have confirmed the presence of various globally significant bird species(Prentice and Aikanathan 1989).The bird species categorised as globally significant species in the IUCN Red List include an Endangered species: Storm's Stork *Ciconiastormi*; and four Vulnerable species: Wallace's Hawk-Eagle *Spizaetusnanus*, Crestless Fireback*Lophuraerythrophthalma*, Large Green Pigeon *Treroncapellei*, and Hook-billed Bulbul *Setorniscriniger* while 41 other species are listed as Lower Risk but Near Threatened (UNDP,2013). Some of the avian species that has been documented in peat swamp forest includes Grey-breasted Babbler, BorneanBristlehead, Hook-billed Bulbul, Grey-chested Flycatcher, Wrinkled Hornbill, Long-tailed Parakeet, White-bellied Woodpecker, White-chested Babbler, Red-crowned Barbet, Dusky Eagle Owl, Blue-rumped Parrot (Prentice and Aikanathan 1989).

Objectives:

1. To asses the diversity and abundance of bird within different habitats
2. To identify the trophic structure of understorey bird community
3. To determine the habitat use of selected bird in Raja Musa peat swamp Forest Reserve

MATERIALS AND METHOD

Study sites

The North Selangor Peat Swamp Forest is located on a flat coastal plain in the northern part of the State of Selangor. It consists of the Raja Musa and the Sungai Karang Forest Reserves and covers the total area of 73,529 hectares. However, this study was conducted only in Raja Musa Peat-swamp Forest Reserve, Bestari Jaya because RMFR is the primary forest and consists of native tree species . RMFR is a significant block of remaining peat forest in Peninsular Malaysia and important ecosystem for freshwater sources also carbon storage. This area consists of forest reserves, agricultural landscape planted with oil palm also area destroyed by forest fire were subsequently encroached especially by people inhibiting the nearby villages and settlements for agricultural purposes. RMFR support tree species with small to medium sized crowns typically 30 meters tall emergent trees are scattered throughout the area. *Kompassia malaccensis* (kempas), *Santriria spp*. (kedondong), *Eugenia spp*.(kelat) and *Durio carinatus* (Durian) are the dominant tree species. *Gonystylos bancanus* (Ramin) which is common species in peat swamp forest is now rarely found in this forest.

Mist Netting

In order to study the effect of habitat structure on the bird community, the site were divided into four area: i) clear felled forest ii) forest cultivated land boundary, outer forest sharing boundaries with oil plantation, iii) riparian habitat, along Sungai Tengi iv) inside the peat swamp forest .
To obtain the species listing on the under storey bird species, the mist netting method was conducted in three months for each sites. A total of 20 mist nests (12mx2.6m, 30mm mesh) were placed at the study site and shifted at random once every three to four days. The height of the mist nests were about 0.5 m above the ground and each mist net supported by two aluminium poles. This restricted our samples to birds that fly within this narrow height range.

The mists net opened at 0630am and close at 0730pm during the study period and was checked for every two to three hours. Captured bird was identified, measured and fitted with aluminium rings (serial numbers were provided by the Department of Wildlife and National Park, Malaysia) and released at the site of the capture. The birds were identified using the field guides by Jeeyarajasingam and Pearson (1999) and Davidson and Yeap (2010).

If the bird were recaptured two or more times, the bird will be fitted with a radio transmitter which enables the bird to be tracked as it moves around in RMFR.

Field Observations

In addition to mist netting, daily visual observation and opportunistic sighting also been carried out during mist netting period. Transects has surveyed on foot or from a vehicle or boat travelling by noting the bird species see or hear. Binocular was used during visual observation. The data collected during observations was included as follows; a description of the location within the vegetation where each species is observed and the behaviour of the birds.

Measuring Stand-level Attributes

Radio Telemetry

To determine bird movement range, captured birds were fitted with radio transmitter. The transmitter (model Holohil Systems, Canada) transmitted at the 151.000- 152.000MHz frequency

range, weighed one gram and have estimated life span 1 month. They were glued to the back of the birds below the scapula with surgical glue (Braun Surgical, Germany). Radio tagged bird species were tracked using a hand held antenna attached to a portable receiver (TRX-4,Telonics Inc.,Arizona)

RESULT AND DISCUSSION

Diversity and abundance of birds

In the Raja Musa Peat Swamp Forest, within which netting and survey walks were conducted, a total of 1047 individual from 73 species and 38 families have been recorded living within forest habitat including resident and migrants. The family with the greatest diverse of species was Pycnonotidae (7 species) followed closely by Columbidae (6 species), Apopidae (4 species), Picidae (4 species), Cuculidae, Cisticolidae, Sturnidae and Strigidae represented three species respectively. The others families were represented with a mere two to one species each.

Meanwhile, the species that most abundance was Yellow Vented Bulbul with 298 individuals captured, followed by Zebra Dove (147 individuals), Olive Winged Bulbul (90 individuals) and White throated kingfisher (71 individuals). Yellow vented bulbul is a common resident in Malaysia. It can be found in almost all habitats from mangrove to secondary forests and from rural to urban areas. Nesting is common and can be encountered in gardens, parks as well as long corridors of high building where the birds nest in the potted plants (Wee 2009).

Home ranges

Table 1.1 : Total number of individuals caught at Raja Musa Peat Swamp Forest Reserve

Family	Common Name	Species	Total
Pycnonotidae	Yellow Vented Bulbul	*Pycnonotus goiavier*	298
	Olive Winged Bulbul	*Pycnonotus plumosus*	90
	Red Eye Bulbul	*Pycnonotus brunneus*	28
	Cream Vented Bulbul	*Pycnonotus simplex*	3
	Spectacled Bulbul	*Pycnonotus Erythropthalmos*	2
	Hairy Backed Bulbul	*Tricholestes criniger*	1
	Yellow Bellied Bulbul	*Alophoixus phaecephalus*	2
Columbidae	Emerald Dove	*Chalcophaps indica*	25
	Spotted Dove	*Streptopelia chinensis*	36
	Peaceful Dove	*Geopelia striata*	147
	Pink Naked Green Pigeon	*Treron vernan*	12
	Thick Billed Green Pigeon	*Rteron curvirostra*	1
	Little Green Pigeon	*Treron Olax*	10
Apodidae	House Swift	*Apus affinis*	26
	Glossy Swiftlet	*Collocalia esculenta*	11
	Asian Palm Swift	*Cypsiurus balasiensis*	16
	Himalayan Swiftlet	*Aerodramus brevirostris*	12
Cuculidae	Lesser Coucal	*Centropus bengalensis*	9
	Chestnut Winged Cuckoo	*Clamator coromandus*	6
	Plaintive Cuckoo	*Cacomantis merulinus*	1
Caprimulgidae	Large Tailed Nightjar	*Caprimulgus macrurus*	42
	Savana Night Jar	*Caprimulgus affinis*	2
Halcyoninae	White Throated Kingfisher	*Halcyon smyrnensis*	71

Alcedinidae	Blue Eared Kingfisher	*Alcedo meninting*	2
Turnicidae	Barred Buttonquil	*Turnix suscitator*	2
Cisticolidae	Rufescent Prinia	*Prinia rufescens*	2
	Yellow Bellied Prinia	*Prinia flaviventris*	2
	Ashy Tailorbirds	*Orthotomus ruficeps*	1
Meropidae	Bluethroated Bee Eater	*Merops viridis*	7
	Blue Tailed Bee Eater	*Merops philippinus*	24
Rhipiduridae	Malaysia Pied Fantail	*Rhipidura javanica*	8
Ploceidae	Baya Weaver	*Ploceus phillipinus*	13
Sturnidae	Asian Glossy Starling	*Aplonis panayensis*	3
	Common Myna	*Acridotheres tristis*	6
	Javan Myna	*Acridotheres javanicus.*	5
Tytonidae	Oriental Bay Owl	*Phodilus badius*	2
Turdidae	Oriental Magpie Robin	*Copsychus saularis*	14
	White Rumped Shama	*Copsychus malabricus*	1
Picidae	Rufous Woodpecker	*Micropternus brachyurus*	7
	Common Flameback	*Dinopium javanense*	5
	Buff Necked Woodpecker	*Meiglyptes tukki*	1
	Rufous Piculet	*Sasia abnormis*	1
Strigidae	Collared Scops Owl	*Otus lempiji*	16
	Barred Eagle Owl	*Bubo sumatranus*	1
	Brown Wood Owl	*strix leptogrammica*	3
Falconidae	Rajawali Dahi Putih	*Microhierax latifrons*	2
Hirundinidae	Pacific Swallow	*Hirundo tahitica*	1
	Barn Swallow	*Hirundo rustica*	1
Aegithinidae	Common Iora	*Aegithina tiphia*	2
	Green Iora	*Aegithina viridissima*	1
Ardeidae	Purple Heron	*Ardea purpurea*	1
Pandionidae	Osprey	*Pandion haliaetus*	1
Halcyoninae	Stork Billed Kingfisher	*Pelargopsis capensis*	1
Dicaeidae	Orange Bellied Flowerpecker	*Dicaeum trigonostigma*	1
	Yellow Breasted Flowerpecker	*Prionochilus maculatus*	3
Pittidae	Blue Winged Pitta	*Pitta moluccensis*	1
	Mangrove Pitta	*Pitta megarhyncha*	1
Muscicapidae	Siberian Robin	*Luscinia cyane*	1
	Yellow Rumped Flycatcher	*Ficedula zanthopygia*	3
Trogonidae	Scarlet Rumped Trogon	*Harpactes duvaucelii*	1
Timaliidae	Pin Striped Tit-Babbler	*Macronus gularis*	2
Locustelidae	Lanceolated Warbler	*Locustella lanceolata*	1
Rallidae	White Breasted Waterhen	*Amaurornis phoenicurus*	1
Cettiidae	Sunda Bush Warbler	*Cettia vulcania*	1
Accipitridae	Japanase Sparrow Hawk	*Accipiter gularis*	1
Laniidae	Brown Shrike	*Lanius cristatus*	27
Coraciidae	Oriental Dollar Bird	*Eurytomus orientalis*	1
Motacillidae	Paddyfield Pipit	*Anthus rufulus*	3
	Richards Pipit	*Anthus richardi*	6
Rallidae	Band Bellied Carke	*Porzona paykullii*	1
Oriolidae	Black Naped Oriole	*Oriolus chinensis*	2
Phasianidae	Red Jungle Fowl	*Gallus gallus*	2
Scolopacidae	Swinhoes Snipe	*Gallinago megala*	1
		Overall Birds	1047

Satu Senarai Pendek Tumbuhan Berbunga Dari Hutan Paya Gambut Selangor Utara Dan Sekitarnya

MOHAMAD AMINI NORDIN, MOHD NOR JAMALUL LAIL, ABDUL ZAHIR AZIZ, MOHD ZUBIR IDRIS, HAZMAN ZAKI & AHMED ZAINUDIN IBRAHIM

Abstrak : Sejumlah 57 sampel tumbuhan yang tergolong dalam 44 spesies daripada 29 famili telah dikumpul dari Hutan Paya Gambut Selangor Utara dan sekitarnya. Tumbuhan yang dikumpul merangkumi tumbuhan herba, pemanjat, renek dan pokok besar. Spesimen herbarium bagi setiap spesies yang dikumpul turut disediakan dan disimpan di Herbarium Taman Botani Putrajaya (HTBP) bagi tujuan rujukan.

Abstract : A total of 57 live plants samples comprising of 44 species from 29 family has been collected from North Selangor Peat Swamp Forest and surrounding areas. Plant samples collected comprising of herbs, climbers, shrubs and big trees. Herbarium specimens were prepared for all the species collected and deposited at Taman Botani Putrajaya Herbarium (HTBP) for reference.

PENDAHULUAN

Ekspedisi Saintifik dan Biodiversiti Hutan Paya Gambut Selangor Utara telah dijalankan di dua hutan simpan yang agak besar iaitu Hutan Simpan Raja Musa dan Sungai Karang. Hutan Simpan Paya Gambut Selangor Utara adalah antara hutan simpan paya gambut yang masih kekal di Semenanjung Malaysia, pelbagai usaha pemuliharaan telah dijalankan oleh Kerajaan Negeri Selangor dan Jabatan Perhutanan serta dibantu oleh badan-badan bukan kerajaan bagi memastikan kelestarian kepelbagaian biologi hutan tidak terjejas disamping ia dapat memberikan faedah pada hidupan khususnya kepada manusia sendiri.

BAHAN DAN KAEDAH

Pengumpulan tumbuhan tersebut telah dilaksanakan selama 7 hari di 4 laluan seperti dalam Jadual 1. Semua tumbuhan yang berbunga dan berbuah telah dikumpul sepanjang laluan tersebut seperti senarai di Jadual 2. Semua tumbuhan yang dikumpul diawet dengan spirit sebelum dibawa ke makmal untuk proses seterusnya.

Sekembalinya dari lapangan, semua tumbuhan ini akan dikeringkan pada suhu 55°C sehingga kering. Seterusnya, tumbuhan ini dilekatkan di atas kertas khas dan dilabel mengikut buku catatan kerja lapangan. Akhir sekali, spesimen ini direkod dan disimpan di Herbarium Taman Botani Putrajaya (HTBP). Semua tumbuhan ini telah dibuat pengecaman menggunakan kekunci dari buku *Tree Flora Of Malaya*; Whitmore (1972, 1973) dan Ng (1978, 1989) juga *Malaysian Wild Flowers;* Henderson (1954). Manakala status kelimpahan serta senarai pendek tumbuhan adalah berpandukan *The Gardens' Buletin Singapore;* Turner (1995).

Jadual 1 : Lokasi pengumpulan tumbuhan

HTBP 4259 - 4271; H.S. Raja Musa, Parit 6, Trek 1, 27 & 28 Mei 2013
HTBP 4272 - 4281: H.S. Raja Musa, Laluan Sg. Tengi, Trek 3, 29 Mei 2013
HTBP 4282 - 4295: H.S. Sg. Karang, Laluan Barat, Trek 4, 30 Mei 2013
HTBP 4296 - 4315: H.S. Sg. Karang, Laluan Rimba, Trek 6, 2-4 Julai 2013

Jadual 2 : Senarai ringkas tumbuhan yang dikumpul

ANNONACEAE
Fissistigma latifolium (Dunal) Merr.; HTBP 4296
Tumbuhan jenis memanjat, buah berwarna hijau.

Fissistigma sp.; HTBP 4312
Tumbuhan jenis memanjat, bunga berwarna jingga cerah.

Uvaria rufa Blume; HTBP 4313
Tumbuhan jenis memanjat berkayu, bunga berwarna kuning, kadang-kadang boleh ditemui.

APOCYNACEAE
Alstonia spatulata Blume; HTBP 4266
(Pulai Paya)

Pokok 5 meter tinggi, mempunyai getah berwarna putih, buah (*pod*) berwarna hijau, mudah ditemui kebiasaannya di kawasan hutan tanah rendah berpaya.

ASCLEPIADACEAE
Hoya sp.; HTBP 4295
Tumbuhan jenis memanjat, bunga berwarna merah.

CECROPIACEAE
Poikilospermum microstachys (Barg.-Petr.) Merr.; HTBP 4294
Tumbuhan jenis hemi-epifit, bunga berwarna putih, mudah ditemui kebiasaannya di kawasan hutan berpaya dan tepian sungai.

Poikilospermum scortechinii (King) Merr.; HTBP 4310
Tumbuhan jenis hemi-epifit, jambak bunga berwarna ungu, mudah ditemui kebiasaannya di kawasan berpaya dan kawasan yang berdekatan sumber air.

Poikilospermum suaveolens (Blume) Merr.; HTBP 4287 dan HTBP 4315
Tumbuhan jenis hemi-epifit, jambak bunga berwarna krim, mudah ditemui terutama kawasan laluan air di hutan.

COMMELINACEAE
Amischotolype griffithii (C.B. Clarke) I.M. Turner; HTBP 4301
Tumbuhan jenis herba, bunga berwarna ungu, mudah ditemui di merata tempat (*widespread*).

CUCURBITACEAE
Zehneria japonica (Thunb.) H.Y. Liu; HTBP 4311
Tumbuhan jenis memanjat, buah dari berwarna hijau bertukar ke kuning, bunga berwarna kuning, kadang-kadang boleh ditemui.

ELAEOCARPACEAE
Elaeocarpus nitidus Jack; HTBP 4280
Pokok 5 meter tinggi, buah berwarna hijau kebiruan.

Elaeocarpus petiolatus (Jack) Wall.; HTBP 4307
Pokok 5 meter tinggi, jambak bunga berwarna hijau, mudah ditemui di merata tempat (*widespread*).

EUPHORBIACEAE
Antidesma cuspidatum Müll.Arg.; HTBP 4291 dan HTBP 4304
Pokok 5 meter tinggi, buah berwarna hijau bertukar ke warna merah, agak mudah ditemui (*common throughout*).

GESNERIACEAE
Aeschynanthus parvifolius R.Br.; HTBP 4299
(Gincu Monyet / Lipstick Plant)
Tumbuhan jenis epifit yang menjalar, bunga berwarna merah, mudah ditemui di merata tempat (*widespread*).

GUTTIFERAE
Garcinia parvifolia (Miq.) Miq.; HTBP 4306
Pokok 9 meter tinggi, buah berwarna hijau, mudah ditemui.

LAURACEAE
Litsea costata (Blume) Boerl.; HTBP 4314
Pokok 6 meter tinggi, buah berwarna hijau, kadang-kadang boleh ditemui.

LEGUMINOSAE
Archidendron clypearia (Jack) I.C. Nielsen; HTBP 4265
Pokok 5 meter tinggi, buah (*pod*) berwarna hijau bertukar ke warna coklat, jambak bunga berwarna hijau cerah.

Uraria crinita (L.) Desv. ex DC.; HTBP 4288
(Ekor Kucing / Ekor Anjing)
Tumbuhan jenis renek, bunga berwarna ungu, mudah ditemui (*widespread*) banyak di kawasan terbuka dan tempat-tempat pembuangan.

MELASTOMATACEAE
Clidemia hirta (L.) D. Don; HTBP 4261
Tumbuhan jenis renek, buah berwarna hijau bertukar ke warna biru gelap, bunga berwarna putih, mudah ditemui (*widespread*) terutama di tempat-tempat yang teduh, dikatakan berasal dari tropika Amerika.

Diplectria divaricata (Willd.) Kuntze; HTBP 4262
Tumbuhan jenis memanjat berkayu, bunga berwarna merah jambu (*pink*), mudah ditemui (*common*), kebanyakannya ditemui di hutan tanah rendah.

MORACEAE
Ficus annulata Blume; HTBP 4271, 4275, 4284, 4292 & 4300
(Ara)
Tumbuhan jenis berpaut (*strangler*), buah *(figs)* berwarna hijau, getah berwarna putih, mudah ditemui di merata tempat (*widespread*), banyak terdapat di kawasan utara tanah air.

Ficus obscura Blume var. *borneensis* (Miq.) Corner; HTBP 4281 & 4272
(Ara)
Tumbuhan jenis berpaut (strangler), buah *(figs)* berwarna hijau putih bertukar ke warna merah jingga, getah berwarna putih, agak mudah ditemui (*common throughout*).

MYRSINACEAE
Maesa ramentacea Wall. *ex* Roxb.; HTBP 4273 & 4308
Pokok 3 meter tinggi, buah berwarna hijau, bunga berwarna kuning, mudah ditemui.

MYRTACEAE
Psidium guajava L.; HTBP 4285
(Jambu batu)
Pokok 2 meter tinggi, buah berwarna hijau.

Syzygium setosum (King) I.M. Turner; HTBP 4290
(Kelat)
Pokok 4 meter tinggi, buah berwarna hijau, banyak di kawasan paya gambut, endemik.

NEPENTHACEAE
Nepenthes ampullaria Jack; HTBP 4268 & 4303

Tumbuhan jenis memanjat, mangkuk daun (*cups*) berwarna hijau, kebanyakannya dijumpai di pinggir hutan.

Nepenthes gracilis Korth. ; HTBP 4267 & 4269
Tumbuhan jenis memanjat, mangkuk daun (*cups*) berwarna hijau, kebanyakannya dijumpai di pinggir hutan tanah rendah.

ORCHIDACEAE
Calanthe sp.; HTBP 4279
Tumbuhan jenis herba, buah berwarna hijau, bunga berwarna putih.

PALMAE
Cyrtostachys renda Blume; HTBP 4278
(Pinang Merah)
Tumbuhan jenis palma, jambak buah berwarna hijau (belum matang), upih berwarna merah, banyak di kawasan paya gambut, mudah ditemui (*scattered*).

PANDANACEAE
Freycinetia angustifolia Blume; HTBP 4305
Tumbuhan jenis memanjat berkayu, buah berwarna hijau, banyak dijumpai di kawasan hutan berbukit rendah dan kawasan berpaya.

PASSIFLORACEAE
Adenia macrophylla (Blume) Koord. var. *macrophylla*; HTBP 4270
Tumbuhan jenis memanjat, bunga berwarna kuning, mudah ditemui di merata tempat (*widespread*).
POLYGONACEAE
Persicaria barbata (L.) H. Hara; HTBP 4282
Tumbuhan jenis herba, bunga berwarna putih, mudah ditemui di merata tempat (*widespread*).

RUBIACEAE
Lecananthus erubescens Jack; HTBP 4277 & 4289
Tumbuhan jenis renek epifit, bunga berwarna putih, jambak bunga berwarna ungu, mudah ditemui di merata tempat (*widespread*), banyak di kawasan berair.

Psychotria angulata Korth.; HTBP 4302
Pokok 2 meter tinggi, buah berwarna hijau, mudah ditemui.

Timonius flavescens (Jack) Baker; HTBP 4293 & 4309
Pokok 4 hingga 10 meter tinggi, buah berwarna hijau, banyak di kawasan gambut, mudah ditemui.

Uncaria acida (W. Hunt.) Roxb.; HTBP 4263
Tumbuhan jenis memanjat, bunga berwarna hijau muda, banyak di kawasan hutan tanah rendah berpaya di selatan tanah air.

Uncaria attenuata Korth.; HTBP 4264
Tumbuhan jenis memanjat, bunga berwarna hijau, mudah ditemui (*scattered*).

RUTACEAE
Melicope lunu-ankenda (Gaertn.) T.G. Hartley; HTBP 4259, 4274 & 4286
Pokok 2 hingga 5 meter tinggi, buah berwarna hijau, mudah ditemui.

SOLANACEAE
Solanum torvum Sw.; HTBP 4283
(Terung Pipit)
Tumbuhan jenis renek, buah berwarna hijau, bunga berwarna putih, mudah ditemui di merata tempat (*widespread*).

URTICACEAE
Nothocnide mollissima (Blume) Chew; HTBP 4276
Tumbuhan jenis renek memanjat, bunga berwarna putih, kadang-kadang ditemui.

VERBENACEAE
Stachytarpheta indica (L.) Vahl; HTBP 4260
Tumbuhan jenis herba, bunga berwarna ungu cerah, jambak bunga berwarna hijau, banyak di kawasan berpasir berhampiran laut, mudah ditemui di merata tempat (*widespread*), dikatakan berasal dari Amerika Tropika.

VITACEAE
Cayratia wrayi (King) Gagnep.; HTBP 4297
Tumbuhan jenis memanjat, buah berwarna kuning bertukar ke warna jingga, banyak ditemui di pinggir-pinggir hutan.

ZINGIBERACEAE
Zingiber gracile Jack; HTBP 4298
Tumbuhan jenis herba, bunga berwarna putih, jambak bunga berwarna merah, kadang-kadang boleh ditemui, endemik.

KEPUTUSAN DAN KESIMPULAN

Dari 57 spesies sampel yang dikutip, bolehlah disimpulkan bahawa hutan ini masih kaya dari segi biodiversitinya. Berdasarkan jumlah kutipan tertinggi, spesies dari famili Moraceae dan Rubiaceae mendahului kutipan diikuti oleh famili Cecropiaceae dan Annonaceae. Dari sudut ekologi, kesemua spesies dikumpul merupakan tumbuhan yang beradaptasikan kawasan hutan tanah rendah dan kawasan paya gambut. Dari pemerhatian yang dilakukan, kebanyakan spesies tumbuhan adalah mudah untuk ditemui seperti *Amischotolype griffithii, Elaeocarpus petiolatus, Uraria crinita, Aeschynanthus parvifolius, Clidemia hirta, Diplectria divaricata* dan sebagainya serta spesies yang endermik seperti *Syzygium setosum* dan *Zingiber gracile* telah berjaya dikumpulkan.

PENGHARGAAN

Kami ingin mengucapkan ribuan terima kasih kepada Jabatan Perhutanan Semenanjung Malaysia dan Malaysian Nature Society (MNS) kerana telah menjemput kami menyertai Ekspedisi Saintifik Kepelbagaian Biologi Hutan Gunung Tebu, Jabatan Perhutanan Negeri Selangor kerana telah menyediakan kemudahan semasa ekspedisi berlangsung dan Jabatan Landskap dan Taman, Perbadanan Putrajaya yang membenarkan kami mengikuti ekspedisi ini.

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HTBP 4305; *Freycinetia angustifolia* Blume

HTBP 4297; *Cayratia wrayi* (King) Gapnep.

HTBP 4310; *Poikilospermum scortechinii* (King) Merr.

HTBP 4287 & 4315; *Poikilospermum suaveolens* (Blume) Merr.

HTBP 4299; *Aeschynanthus parvifolius* R.Br.

HTBP 4302; *Psychotria angulata* Korth.

Fireflies (family Lampyridae) in the North Selangor Peat Swamp Forest

WONG CHOONG HAY[1]

Abstract : Fireflies (family Lampyridae) prefer the warm and humid conditions and can be found in natural wetlands and forest, man-made lakes, canals and plantations or gardens, and in dry area usually after seasonal rain. In Malaysia, fireflies were not recorded before from the harsh habitat of peat swamp forest. This rapid survey was conducted in 5 nights between May 15 to July 4, 2013 at the forest fringe grassland with sparse trees and canals (site 1, 2), logged over peat swamp forest with canals (site 4) and regenerating peat swamp forest (site 6) for comparing the firefly diversity. Site 1 has one species of congregating firefly, *Colophotia* spp., *Pyrocoelia* spp.1, and an unidentified larva, which looks like a *Stenocladus*. No fireflies were spotted at Site 2 open area, which may be due to the rain. Site 3 was along the main canal forest fringe, with sightings of fireflies along the fringe by other researchers. Site 4 has fast and high flying glowing fireflies and some fireflies were spotted along the forest fringe along the main canal. The original forest in Site 5 was not visited. The near-regenerating canopied peat forest of Site 6 is bordered by oil palm, a canal and grassland. A similar *Pyrocoelia* spp.1 was observed. All the aforementioned fireflies are quite common in open area, plantation, forest fringes and secondary forests. Inside the peat swamp forest of Site 6 may be the peat swamp firefly species. One unidentified firefly flying up and below the canopy perched in the forest canopy and emitted two rapid flashes regularly. The mid level flier may be *Pyrocoelia* spp.2*,* and *Pyrocoelia* spp.3 with an odd red projection between the antennae. Also present may be two different type of larva from the Lampyrinae subfamily. A ground level flier with bright flashes, is from a 3-4mm firefly, possibly a *Luciola* spp. and several larva from different instars, from the Luciolinae subfamily were present. The survey has possibly found the peat swamp fireflies. However due to the short survey, it may be too early to conclude that the firefly diversity is higher in a regenerating peat swamp forest compared to the other disturbed area.

[1] Conservation Division, Malaysian Nature Society, Kuala Lumpur
*Contact information: Wong, C.H., Conservation Division, Malaysian Nature Society, JKR 641, Jalan Kelantan, Bukit Persekutuan, 50480 Kuala Lumpur, Malaysia. Email: conservation2@mns.org.my

INTRODUCTION

Fireflies are bioluminescence beetles which belong to the Lampyridae family. Fireflies prefer humid and warm areas especially the wetlands and forests area including plantations and even in urban gardens if the habitat requirements are met. Their lifecycle is holometabolus. The larva is a predator and preys on invertebrates like the snails, earthworms, ants, amongst others. The adult firefly's main function is to reproduce. Generally, the firefly falls into two main group according to the mating behavior (Wong, CH 2013). Fireflies communicate by light signals. Most species of fireflies, where the adult male firefly will roam alone producing light signals to seek for a female firefly. There are a small group of fireflies, where the males will congregate together on display trees to attract the females. The light signals can either be produced synchronously or non-synchronously by the adult males. The famous Selangor firefly or *Pteroptyx tener* produced synchronous light signals. These congregating fireflies are found in abundance in Malaysia as well in the ASEAN, East India, Hong Kong and New Guinea islands (Ballantyne, L., Lambkin, C.L., 2013). Much focus is usually on these congregating fireflies which inhabit the riverine mangrove rivers in Malaysia. The Malaysian firefly diversity is relatively unknown, and at the same time many of these habitats are fast diminishing from land use changes. The other challenge to the fireflies are the ecological light pollution which disrupts ecosystems to varying degrees (Longcore, T., and C. Rich, 2004), (Lloyd, J.E., 2006). Fireflies are found in many different type of wetlands area e.g. riparian forest, mangroves, freshwater swamp, lakes, and even in man-made areas like padi fields, canals and dams. However, no reports were mentioned from the harsh conditions of a peat swamp. This survey will be to assess the firefly diversity and habitat requirement in peat swamp forest habitat and to compare the diversity between a disturbed and undisturbed peat swamp forest habitat. This will be the first documentation of peat swamp fireflies.

METHODOLOGY

The rapid assessment was conducted in 4 nights between May to July 2013. The survey was done in Site 1, 2, 4 and 6 between 6.30pm to 10pm. Site 3 was based on sightings on a boat and by other expedition members. Site 5 was not visited. We walked into the trail as far as possible just before sunset and waited. The night survey began when the first firefly emerged and noted down the time. A sweep net was used to catch the fireflies and macro - photographed on site. The firefly locations were marked by a GPS. Notes (data sheets) were taken about the environmental conditions, fireflies, habitat, land use, other wildlife amongst others. A simple count was made. Attempts of firefly identification will be made.

The May dates were moonrise nights (moon above the horizon), which means a moon-influenced night. The June/ July dates were no moonrise nights during the survey.

Site description: Only site 1, 2, 4, and 6 were visited
Site 1 was an open scrub land, with few trees along the paths, drainage canals and a reforestation program. About two kilometer to the west is the regenerating forest edge. The border is old palm plantation with a few houses.
Site 2 recently burnt area, similar to Site 1, but wetter.
Site 3 was along Sg Tengi fringed by a grassy bank, forest reserve and the perimeter road.
Site 4 was a logged over open canopy forest with palms, pandanus, hardwood and softwood.
Site 6 is located at the fringe of a regenerated logged over forest with a denser canopy than site 4. There is a bird tower and is bordered by a field, canal and plantation.

Map 1 : Survey sites

RESULTS

Table 1 : Summary of fireflies observed in the different sites

Site	Habitat	Sub family	genus	note
1	Scrubland with sparse trees	Lampyrinae	*Pyrocoelia* 1	2 adult male
		Luciolinae	*Colophotia*	12-15 adults
		Ototretinae ?	*Stenocladus* ?	1 larvae
2	Wet, scrubland	None, after rain and late into the night		
3	Grassy bank and forest fringe	Lampyrinae ?	?	Sightings of fireflies along the bank from boat, glowing
4	Open canopy forest	Lampyrinae ?	?	6 big individuals flying fast not captured and glowing
5	Undisturbed peat forest	unvisited		
6	Regenerating canopy peat forest and small field	Lampyrinae	*Pyrocoelia* 2	6 adult male (field)
			Pyrocoelia 3	10 adult male with different colouration on elytra
			Pyrocoelia 4	
			Pyrocoelia 5	2 instars larva
		Luciolinae ?	?	12 individuals high up on trees, two regular flashes
		Luciolinae	?	2 larvae
		Luciolinae	?	A tiny female

Site 1 (Parit 5, 6, and 7).

May 15, 2013
It was humid and rained just after the survey. There was night glow and lightning. One species of congregating firefly, *Colophotia* spp. were observed on display trees (Balik Angin *Mallotus*, Mahang *Macaranga*) and flying around along the eastern path bordered by canal and trees (192, 193). The first emergent was at 7.38pm across the canal on th*e Mallotus* tree (193). Its light is yellowish-white, around 1cm in length. Twelve individuals were spotted on the smaller leaf trees. The flying fireflies were blinking fast. The western bank is more than the eastern bank along the eastern path. One firefly was observed to have a brighter light. The female is more active and blink most of the time. The male firefly activity is lower and seldom flashed. The firefly larva not found. Two males and one female netted for further observation, but unfortunately the fireflies escaped from the box when it

hit the potholes. *Colophotia* male fireflies have two light segments on the 6th and 7th ventrite. The 7th ventrite has long bipartite light organ.

Along the Eastern path, a single *Pyrocoelia* spp. with its glowing light was observed and an unidentified firefly larva, more than 1 cm long, with banded patterns and with glowing light, possibly a *Stenocladus* (194), was among the *lallang*, leaf litter on the dry eastern bund trail. We tried to catch it but it was not found among the leaf litter.

June 24, 2013
A cool humid hazy night with a full moon. Based on Parit 6 and 7, the congregating fireflies was not observed further west from these two points (196, 200), which may correspond to the increasing tree density along the paths going east. The Parit 6 and 7 where the fireflies are found were about the same distance from the eastern path. Fourteen fireflies were spotted on the trees or flying around. No larva was spotted. Two *Pyrocoelia* fireflies were spotted, each is about 1.1 to 1.2 cm long. These are found along the eastern path and the plantation.

<u>Site 2</u>
15 May 2013
It was a cool, windy and humid night with night glow. No fireflies were spotted at Site 2.

<u>Site 3</u>
15 May 2013
Not visited. Along the Sungai Tengi, other researchers have reported sightings of glowing fireflies (possibly from the Lamyrinae sub-family) along the riverbank (pers. comm. Boyd, Maikal, Morgana)

Map 2 : Showing the firefly survey done at Site 1: Parit 5, 6 & 7

Figure 1 : Site 1 (Parit 7)

Figure 2 : an adult male *Colophotia* firefly (ventral and dorsal)

Figure 3 : Site 2

Figure 4 : *Pyrocoelia* sp.

Site 4

June 30, 2014

The night was warm and dry with night glow. Roughly 4-6 fireflies were spotted flying fast and high from the interior to the wetter areas, possibly *Pyrocoelia* with the glowing lamp. No larva spotted. Did not go in further. 2-3 glowing fireflies spotted along the river bank from the boat.

Map 3 : Site 4 (204- 203) survey

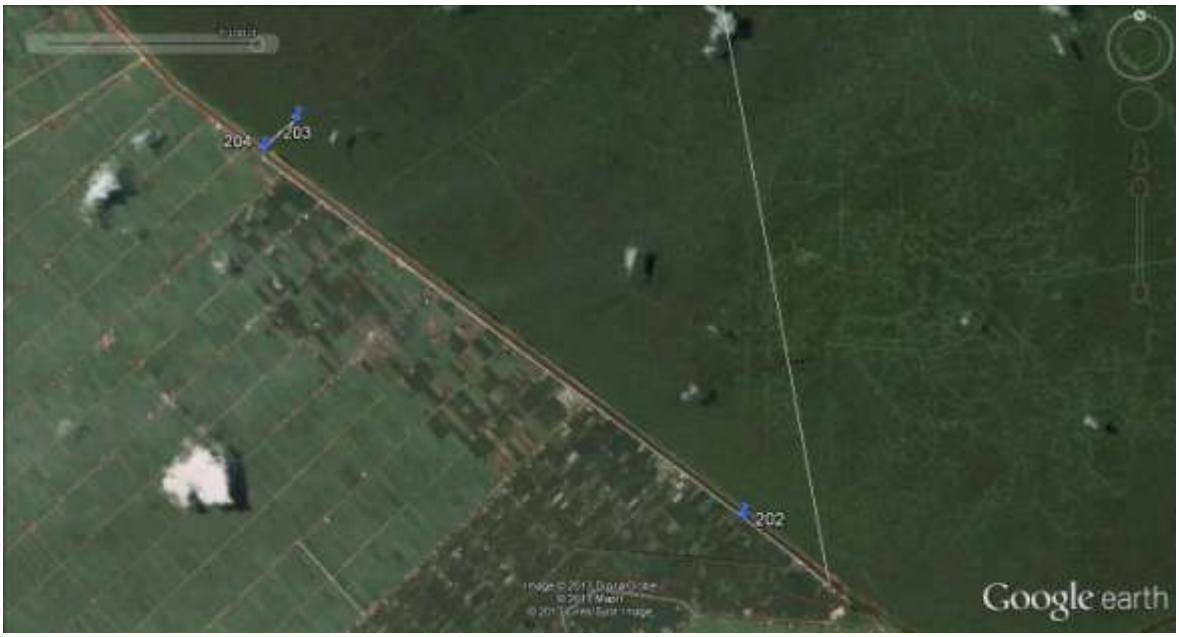

Figure 5 : Site 4 logged over forest rest

Figure 6 : The river bank bordering the fo

Site 5
The original peat swamp forest was not visited.

Site 6
June 25, 2014
It was drizzling, observation was done around the field at the trail entrance and did not go into the trail. Roughly 5 to 7 glowing fireflies were spotted among the trees, field and canal. One adult male *Pyrocoelia* about 1cm long was caught, possibly similar to Site 1. Larva not spotted.

Figure 7 : Adult male *Pyrocoelia* at Site 6 entrance

4 July 2014
The night was humid and cool and the forest floor was dry with leaf litter and tree roots. At the canopy level, the firefly emerged at 7.40pm and goes up the canopy. The lights are orangey-yellow light and flickering as it goes up. Two rapid flashes were emitted by the firefly from the canopy at regular interval. About 10-12 fireflies occurred in various trees. It is difficult to catch due to the vegetation. Two firefly larva (sub-family Luciolinae) of different instars were found at the base of trees among leaf litter. It oval shaped with segmented plates. The instars is between 8-14mm and it glowed faintly.

At mid level, there were about 10 '*Pyrocoelia*' between 1.5-2cm were spotted slowly flying about. They glowed greenish white. Two were caught. One male firefly had a small red projection between the eyes. Both of the firefly's elytra looked a bit different in colouration and form. Two Lampyrinae

firefly larvae of different instars were found between 3.5 – 5 cm long among the leaf litter glowing brightly.

There is only one tiny 3-4mm long female Luciolinae firefly flying at a lower level. The lights are very bright.

Map 4 : Site 6 survey

Figure 8 : Regenerated forest

Figure 9 : Tiny Luciolinae firefly

Figure 10 : Luciolinae firefly larva

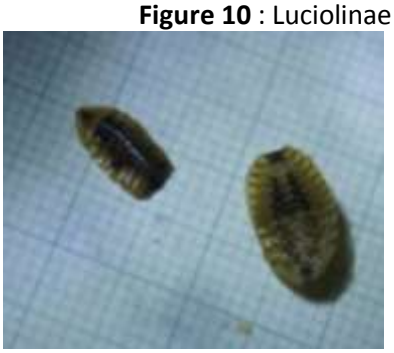

Figure 12 : *Pyrocoelia 1* (without the red structure between the antennae)

Figure 13 : *Pyrocoelia* 2

Figure 14 : Type 2 Lampyrinae larva

Figure 15 : Type 3 Lampyrinae larva

DISCUSSIONS

Due to the limitations of time, weather and moonlight, the survey was able to be done in Site 1, 2, 4 and 6. During the survey, factors that may affect the results may be night glow, moonrise, humidity, wind, time, temperature and other disturbances.

From table 1, the *Pyrocoelia* fireflies are present in Site 1, 3 and 4 (both unconfirmed), and 6. These big glowing fireflies are common to open area, forest fringe, plantation, and secondary forests. Another common firefly is the congregating firefly, *Colophotia* although found in Site 1 are usually found in disturbed area like scrub area with individual trees.

At site 1, a surprising encounter, which was unfortunately unable to capture, may be a glimpse of a *Stenocladus* larva with its dual coloured segmented body and a single glowing light. The author has observed this in regenerated forest and natural forest and not in an open area.

There was no fireflies spotted at Site 2 which is an open wet area, this may be due to the windy condition and late into the night.

The near-regenerating canopied peat forest of Site 6 also harbor mid level flier which may be two type of *Pyrocoelia* fireflies, due to the red projection between the antennae which may be just a natural growth or disease and some differences in elytra colour which needs to look into in the future. No female fireflies were found. However, further in the peat swamp forest may be the 'peat swamp' firefly species. Due to the difficulty of the terrain and vegetation, emergent of these fireflies was unable to be captured. There is a certain time for the emergent which the firefly will fly straight up to the trees thus hard to capture. The distinct emission of two regular rapid flashes of unknown sex will be the identification for future study. However, a ground level flier with bright flikering flashes, is from a 3-4mm female firefly, possibly a *Luciola* spp. together with several larva from different instars (Luciolinae subfamily) were present. The possibility of the identity between the canopy fireflies, the tiny female firefly and the larva is unconclusive.

The presence of firefly larva meant the area is healthy with food source and suitable habitat condition. However, no survey was done for the food source which will be the small invertebrates on the forest floor.

Inside the peat swamp forest of Site 6 may possibly be the peat swamp firefly species. One unidentified high flying firefly, perched high up in the forest canopy and emitted two rapid flashes regularly. The mid level flier may be *Pyrocoelia sp2,* and *Pyrocoelia sp3* with an odd red projection between the antennae. Also present may be two different type of larva from the Lampyrinae subfamily. A bright low level flier is a very small 3-4mm firefly, *Luciola* spp. A few larva from different instars (Luciolinae subfamily) were present.

CONCLUSION

The rapid assessment found that there are fireflies which are adaptable to the harsh environment of the peat swamp forests. However, it may be too early to conclude that the firefly diversity showed a higher number in regenerating peat swamp forest compared to the other disturbed area.

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