

MIDDLE MAHAKAM CONSERVATION PROGRAM

TECHNICAL REPORT:

2005 Biodiversity Surveys in the Middle Mahakam Lakes and Wetlands Area in East Kalimantan, Indonesia



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&

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PREFACE AND ACKNOWLEDGEMENTS

This technical report presents results of the biodiversity monitoring surveys conducted in the Middle Mahakam Area lakes in East Kalimantan, Indonesia, including main river, tributaries, lakes and wetlands. This research is part of the larger “Middle Mahakam Conservation Program”, which is an ongoing research and conservation program executed by Yayasan Konservasi RASI since 1999 in cooperation with the East Kalimantan Nature Conservation Agency (BKSDA Kaltim) and local Governments (West and Central Kutai Districts). Data were collected at high water levels in March/April 2005 and low water levels in September 2005. The data within this report are still under revision and should not be cited without prior permission of the first author.

Surveys were conducted by Budiono, Lusiana Patandung, Firman Abadi, Nur Leli Yusliati, and Rafidha Agustina. Analyses were performed by Budiono, Rafidha Agustina and Daniëlle Kreb. We would like to thank everyone and our boatmen, Masman and Pak Acoh very much for their hard work. We also would like to thank Christian Gönner and Vincent Nijman for their help in bird species identification.

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Biodiversity Surveys in the Middle Mahakam Lakes and Wetlands Area in East Kalimantan, Indonesia, 2005

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SUMMARY

During April/ May and September 2005 two surveys with a total searched distance of 1430 km were conducted in the Middle Mahakam Area (MMA) in East Kalimantan, Indonesia at high and low water level conditions in order to assess and compare species diversity during different seasons and to locate biodiversity hotspots with a specific focus on avifauna. A total number of 62 bird species from both surveys were positively identified of which 85% were digitally portrayed. Most species were found in the lakes area (firstly in Jempang Lake), but when split to „micro“ habitat type, riparian forest appeared to account for largest diversity of species followed by lake forest and open swamps. On the other hand, densities and total abundance were significantly higher in (open swamp) lake habitat at both high and low water levels compared to other habitats. Large numbers of cattle-, intermediate-, great-, and little egrets, Javan pond-herons, wandering whistling ducks, white-winged, black-naped and whiskered terns were found in the open swamps. During low water levels, significant large numbers of birds also occurred in mudflats solely composed of wandering whistling ducks, black-naped and whiskered terns. Black-nest swiftlets also occurred in large numbers in lake forest edges. All other species occurred in relatively low numbers. Several species of egrets, herons and terns were observed in breeding plumage during both surveys. One-fourth (n=16) of the bird species encountered are listed on the IUCN Red list, although seven of these do not have a national protected status. Red List species other than birds that were encountered in the MMA biodiversity survey include the critically endangered Irrawaddy dolphin and false gavia, the endangered proboscis monkey, the near threatened long-tailed macaque, the vulnerable smooth-coated otter, and endemic Bornean monitor lizard. Threats to the bird community involve an unsustainable catch of wandering whistling-ducks and capture of herons, storks and hornbills as well as habitat loss through conversion of peat- and freshwater swamp forest.

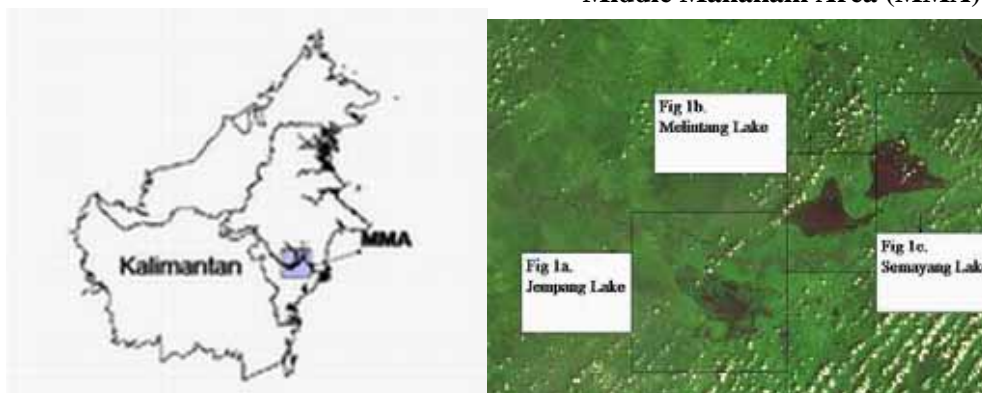
INTRODUCTION

Background

The Middle Mahakam Area (MMA), which is located in the area between 180 km and 375 km upstream of the mouth of the Mahakam River (between 116° and 117° East and 0° to 0°30' South), is one of Kalimantan's largest wetland areas. It includes three major lakes (Jempang, Melintang and Semayang) and several minor lakes, peat and freshwater swamps, and major tributaries. The area is located in East Kalimantan in the Sundaland ecoregion and is part of the Mahakam River

watershed, which is one of the major river systems of Kalimantan and runs from 118° east to 113° west and between 1° north and south.

Middle Mahakam Area (MMA)



The area of the Middle Mahakam Lakes (Danau Jempang: 116°12' E, 0°25' S) covers about 400,000 ha. The three largest lakes are Danau Jempang (15,000 ha in average), Danau Melintang (11,000 ha) and Danau Semayang (13,000). Due to alternating water levels the size of the lakes' water surface ranges from zero in extremely dry years (1982/83, 1991, 1994, 1997/98) to more than 60,000 ha. Their maximum depth is about 6-7m. Annual fluctuations can reach more than 6m. The Middle Mahakam Area (MMA) receives an average annual rainfall of 2,100-2,400 mm. Maximum temperatures range between 30-34°C, minimum temperatures between 22-24°C. The yearly average relative humidity is about 85%. The vegetation of the lakes (more than 86 aquatic plant species and genera) is dominated by floating weeds (mainly *Salvinia spec.* and *Eichhornia crassipes*, *Mimosa pigra* and *Polygonum barbatum*) (Gönner, 2000).

The lakes and swamps in the MMA are very important fish-spawning grounds and replenish the main river seasonally. Therefore, the MMA is an area of intensive fishing activity with an annual average catch of 25,000 to 35,000 metric tons since 1970 (MacKinnon et al., 1997). To date the area has been the largest single supplier of dried freshwater fish for the island of Java, with between 6,000 and 9,000 tons being exported annually (MacKinnon et al. 1997). On a landscape level, the area plays an important buffer role for the natural regulation of the Mahakam River and also downstream human settlements. The swamp area of the lakes is surrounded by freshwater (periodic) swamp forests, peat swamp forests (mainly in the northern part) and lowland dipterocarp rain forests. There are several smaller freshwater swamp lakes and black-water tributaries that directly drain from the swamps. To the north of Melintang and Semayang Lakes, peat swamp forests were severely affected by forest fires in 1998. Despite the enormous damage caused by recent forest fires, the MMA is still one of Kalimantan's most important wetland areas. A comparison of water birds between the MMA and Negara River in South-Kalimantan (van Balen & Prentice 1997) or Tanjung Puting National Park (Nash & Nash 1988) highlights the MMA's importance as a crucial breeding and migration site for 90 waterbird species, including important breeding populations of various herons and the Lesser Adjutant (*Leptoptilos javanicus*). Breeding was also noted for the Little Tern (*Sterna albifrons*), and the White-headed Stilt (*Himantopus leucocephalus*), which appear to be the first breeding record for Borneo (Gönner, 2000, Gönner 2005 pers. comm.). Several thousand wandering

whistling-ducks, waders and terns, both from the Oriental as well as from the Austral region, visit the MMA on their annual migration. The preservation of these wetlands and lakes is of not only national but also international biodiversity importance in terms of migrating and breeding bird species in these areas. The MMA, besides representing an area of high fish and bird diversity (at least 98 freshwater fish species identified by WIIP in 2000), is also home to a significant number of endangered mammals (including 10 primate species), such as the endemic Proboscis Monkeys (*Nasalis larvatus*) and the wild Banteng (*Bos javanicus*). Two species of crocodiles (*Crocodylus siamensis* and *Tomistoma schlegeli*) are found in the marshes (Cox, 1993). The MMA is also the area which is most frequented by Indonesia's single freshwater dolphin species, the Critically Endangered Irrawaddy dolphin (*Orcaella brevirostris*) of which the population is estimated to consist of only 55 individuals (Kreb, 2005).

Historical Background of Project

This current project builds on earlier biodiversity assessment surveys conducted by YK-RASI. In 2001, YK-RASI conducted a preliminary survey on the status of various bird species with particular reference to the Lesser Adjutant, but also on two crocodile species, Siamese Crocodile and False Gaviol in collaboration with Global Nature Funds (GNF) (Budiono, 2001). Between 1999 and 2002, as well as in 2005 intensive monitoring surveys were conducted to detect abundance and identify core dolphin areas by Kreb (2005) and YK-RASI. In 2005 YK-RASI also conducted an assessment of important fish spawning areas sponsored by GNF. The surveys are part of the Middle Mahakam Conservation Program that started in 2000 and initially focused mainly on monitoring of the critically endangered freshwater dolphin population and its threats, as well as raising environmental awareness of fishermen and schoolchildren with reference to the dolphins and sustainable use of fish- and natural resources in general. Protection of the lakes and wetlands may considerably contribute to the protection of fish resources of important dolphin areas that connect with these lakes. The current and planned activities of YK-RASI focus on the protection of the lakes and wetlands areas as well as important river areas through integrated/participatory spatial planning management. The program is being executed by the local NGO Yayasan Konservasi RASI (YK-RASI) in collaboration with Wetlands International Indonesia Program (WIIP).

Objectives

The general goal of the Middle Mahakam Conservation Program is to contribute to the preservation of global and regional biodiversity by establishing a well-supported (scientifically, politically and socially) and legally-enforceable spatial plan for critical wetland, lake and river habitat with regards to extractive, restricted and prohibitive use of natural resources, and protected areas for birds, fish spawning and freshwater dolphins.

The specific objective of the current project is to assess and compare species diversity during different seasons and to locate biodiversity hotspots with a specific focus on avifauna.

METHODS

In April/ May and September 2005 we conducted two surveys in the Middle Mahakam Lakes area at high and low water level conditions, which lasted 7 and 8 days, respectively. The high-water level (HWL) survey covered the main river between Muara Kaman (c. 180 km from the mouth) and Melak (c. 350 km from the mouth), tributaries Kedang Rantau, Kedang Kepala, Belayan, Kedang Pahu, Sebintulung, Berangan, Enggelam, Rebaq Rinding, Minta, Baroh, Bolowan, Bongan, Jelau, Nayan and the lakes Semayang, Melintang, Jempang, Siran, Wis, Tubuhan, Tempatung, Perian and Abit (Figs. 1a,b,c). Total distance searched by two survey teams during the HWL survey was 906 km. The second low-water level (LWL) survey covered the main river area between Muara Kaman and Muara Pahu (c. 300 km from the mouth), including the same tributaries and lakes exclusive of tributary Baroh and inclusive of the tributaries Keliran and Aloh, and Tubuhan Lake. Total distance searched during the LWL survey 524 km.

The first HWL survey used 2 survey teams of 2 observers each, that surveyed different areas. The LWL survey only used one survey team of 2 observers. The vegetation/ forest strips and mudflats along rivers, lakes, and wetlands were scanned from small motorized boats (12 -20 hp) traveling at an average speed of 16 km h⁻¹ following a pre-designed route between 7.30-17.30 hours. During the HWL survey, lakes' forest edges were submersed and search effort was conducted by boat both within the forest and at the edges of the forest. During the LWL survey, the forest edges of the lakes were too far to observe from the boat due to aquatic vegetation blocking any boat passage (c. 500 m from the shore). Therefore, a total distance of 10 km in different representative areas of the lakes was surveyed by walking quietly towards and along the edges usually in opposite wind direction. The observers searched the vegetation and trees both with the naked eye and by binoculars during walking and halts. During search effort, every 15 minutes, area (river, tributary, lake), time, GPS position, cloud coverage (1-9), wind conditions (beaufort), sun reflection (%) was recorded. Every change of survey location was also recorded.

When a sighting of an animal or group of animals was made, we recorded its position, time, species names, estimated total numbers (using best, low and high estimate ranges), numbers of juveniles and adults (only during the second survey), their behaviour (feeding, flight, roosting, rest, etc), breeding or non-breeding plumage, name of location, global habitat type (lake, tributary, main river) and detailed habitat type (open water, mudflat, open swamp area (immersed sedge, grassland and aquatic vegetation), freshwater and peat-swamp forests). At every sighting, digital photographs were taken of each species using a digital Canon Eos 20D camera and 300mm/f4.0 lens for later identification. A direct, preliminary field identification was also made using a fieldguide for birds (MacKinnon *et al.* 2000) and mammals (Payne *et al.* 1985), including a description of plumage and other body characteristics. All bird field identifications were cross-checked by bird specialists (all by C. Goenner and some raptor species by V. Nijman) and only positive species identifications were included. 65% of all positive species identifications were digitally portrayed.

RESULTS

Species and sighting locations

During the high water level (HWL) and low water level (LWL) surveys conducted in April/May and September 2005, a combined total of 62 bird species were positively identified from 26 families; four reptile species (false gavia, Borneo lizard, gold-coil snake, swamp snake); and six mammal species of which three primate (long-tailed macaque, proboscis monkey, silvered langur;

one delphinid (Irrawaddy dolphin); one mustelid (smooth otter); and one squirrel species (Prevost's squirrel) (Appendix 1). The main bird community of the Mahakam River and larger tributaries (Belayan, Kedang Rantau, Kedang Kepala, Kedang Pahu) consisted of 34 species and included eight heron/bittern/egret species, seven eagle/falcon species, three pigeon/dove species, two rail species kingfisher, duck, darter, swiftlet, hornbill, lesser adjutant, coucal, drongo, jungle-flycatcher, fireback, woodpecker, munia, snipe and tern.

Thirty-three bird species were identified in lake habitat including freshwater swamp forest (33 species) and most of them in two large lakes, i.e. Jempang Lake (26 species) and Melintang Lake (23 species) (Figs. 1a,b,c). Other lakes with significant bird presence are Tempating Lake (15 species), Semayang Lake (12 species), Siran Lake (11 species), Tubuhan Lake (11 species), Wis Lake (8 species). The lakes' bird communities included eight heron/bittern/egret species, three duck species, five eagle/falcon species, four crakes and rail species, three tern species, kingfisher, darter, swiftlet, lesser adjutant, dove, swallow, woodpecker, sparrow, starling, jacana and one group of the rare white-shouldered ibis in flight.

For the narrow tributary bird community 26 species were identified including 2 kingfisher species, 3 hornbill species, 5 eagle/ kite/ falcon species, darter, swiftlet, pond-heron, lesser adjutant, pigeon, dove, coucal, koel, malkoha, broadbill, swallow, woodpecker, waterhen, ruff, sandpiper, starling species.

Birds that were most often sighted ($n > 6$ times per survey) along the rivers and tributaries are oriental pied hornbills, brahminy kites, lesser adjutants (in flight), oriental darters, stork-billed kingfishers, and spotted doves. In the lakes most commonly sighted are Javan pond-herons, wandering whistling ducks, great egrets, cattle egrets, little egrets, oriental darters, lesser adjutants, purple herons, whiskered terns, and brahminy kites.

The primate species mentioned above occurred in all habitats at river, tributary and lake edges, and were all most commonly sighted in riparian forest of large rivers, whereas the reptile species were only sighted in narrow tributaries or lakes. Otters were sighted only in narrow tributaries and the freshwater Irrawaddy dolphin was sighted at the mouth of tributaries and in one lake at high water levels.

Species account per water condition

During the HWL survey 53 bird species, six mammal and four reptile species were identified, whereas during the LWL survey 40 bird species, four mammal and one reptile species were identified (Appendix 2). During high-water levels access was greatly facilitated for observing birds in freshwater forest strips surrounding the lakes, whereas at low water levels several forest strips could not be accessed and only representative areas were surveyed by walking. Therefore, the total number of species is actually suspected to be higher during the dry season due to easier food access in the shallow lakes, grasslands and extensive mudflats. During both surveys, 31 similar bird species were encountered (50%) of a total of 62 species. Species that were encountered only during the HWL survey in relatively large numbers and absent during the LWL survey are the little egret, savannah nightjar and white-winged tern, the latter which is a northern migrant on its passage to Australia during northern winter. Species that were encountered during the LWL survey in relative large numbers and were low in numbers during the HWL survey are the great egret, intermediate egret, the Javan pond heron, the wandering whistling duck and the oriental darter, which are all suspected roosting between July and October (Gönnér, 2000), whereas the black-nest swiftlet is roosting in mudholes of dry-fallen river/ lake shores. Other species that feed on fish in the shallow lakes or narrow tributaries during the dry season are migratory whiskered terns, black-naped terns, but also the resident stork-billed kingfishers and common moorhen which is believed to be resident

(Gönner, 2000), but was not observed during the HWL survey. During the HWL survey, we encountered the dark morph of the changeable hawk-eagle, whereas a lighter morph was encountered during the LWL survey.

Aquatic mammal (the Irrawaddy dolphin) and reptile species were only encountered at high water levels because they concentrate in particular areas at low water levels that may not have been surveyed during the dry season. For example, the Irrawaddy dolphin was frequently observed during the same dry season period at several mainstream sections in a survey particularly designed to monitor the dolphin population (Kreb, 2005).

Relative species abundance and population densities

At high water levels we encountered more species for reasons earlier mentioned but made fewer sightings of birds than at low water levels (Table 1). Additionally, larger groupsizes of mainly terns, ducks, herons, egrets, and swiftlets result in larger total numbers of individual birds during the LWL survey (Appendix 2). During both water levels, the lakes account for the highest birds densities.

Three primate species (long-tailed macaque, proboscis monkey, silvered langur) were most often sighted during the HWL survey and this survey also yielded largest numbers primarily in tributary and secondly in large river habitat (riparian forest). Reversely, during the LWL survey large river habitat yielded largest numbers and secondly narrow tributaries.

Table 1. Sighting rates (mean numbers/ km transect surveyed) per habitat and water level condition.

HABITAT	BIRDS		PRIMATA	
	HWL mean N/km transect	LWL mean N/km transect	HWL mean N/km transect	LWL mean N/km transect
Rivers	0,8	2,6	0,3	0,32
Lakes	6,1	16,7	0,1	0,01
Tributaries	1,3	2	3,7	0,16
n species	53	40	3	3
n sightings	139	177	51	24
N best estimate	2572	6798	260	121

At high water levels, most species were sighted in riparian forest habitat, then open swamp and lake forest edges, whereas, nearly similarly, at low water levels most species were observed in riparian forest, then lake forest edges, open swamp and mudflats (Table 2, Appendix 3a,3b). For both surveys combined the highest species diversity was also found in riparian forest (46 species), followed by lake forest (23 species), open swamp (19 species) and open water (10) species).

On the other hand, most birds concentrated in open swamp habitat during HWL and a comparatively small number frequented other habitats. During LWL birds were more spread over several habitat types although largest numbers were found in open swamps and mudflats. Riparian forest and lake-forest abundance at low water was low.

For primates riparian forest represented their primary habitat at both water level conditions.

Table 2. Total numbers and relative abundance per habitat and water level conditions

BIRDS	OS		LF		OW		RF		M
	HWL	LWL	HWL	LWL	HWL	LWL	HWL	LWL	LW
Total numbers	2286 (2001-2596)	2322 (1641-3017)	67 (62-71)	607 (538-654)	14	637 (471-802)	228 (219-236)	249	1186 (1100-1275)
Relative abundance (%)	88%	46%	3%	12%	1%	13%	8%	5%	24%
Total species	19	10	12	18	7	6	36	26	3
Species 2 surveys		19		23		10		46	3
PRIMATA									
Total numbers	-	-	71 (69-73)	7	-	-	185 (181-205)	111	-
Relative abundance (%)	-	-	28%	6%	-	-	72%	94%	-
Total species	-	-	2	1	-	-	3	3	-
Species 2 surveys				2			3		

N.B. : HWL = High water levels; LWL = Low water levels; OS = Open swamp (immersed sedge and grasslands; aquatic vegetation); LF = Lakes (freshwater/peat swamp) forest ; OW = open water including single trees (logs); RF = Riparian forest (rivers and tributaries); M = Mudflat

Breeding bird species

Most breeding bird species are mating in May/June and roosting in August. Our first survey was conducted in end April/ early May and only few species and individuals already showed breeding plumages, i.e. Javan pond heron (10-20%), intermediate egret and cattle egret (20-25%), great egret (30-40%), whiskered tern and white-winged tern (30-40%). The second survey was conducted around early September when many species and individuals already regained their non-breeding plumage, but some were still (partial) in breeding plumage, i.e. Javan pond heron (30%), intermediate egret (30%), cattle egret (40%), great egret (20%), whiskered tern and white-winged tern (20%). From twenty-six species we also observed juveniles of the following species (see also Appendix 3a & 3b): 4 eagle/ kite species, 4 egret species, 3 heron species, 3 hornbill species, 3 tern species, 2 rail species, spotted dove, little green pigeon, lesser adjutant, nightjar, oriental darter, pintail snipe, wandering whistling ducks

DISCUSSION

Current species conservation status

Species global and local status are presented in Appendix 4. According to the IUCN Red List 2004, six bird species and one primate species (long-tailed macaque) are listed Near Threatened, nine bird species and one otter species (smooth-coated otter) are listed Vulnerable, the proboscis monkey is listed as Endangered, whereas one bird species (the white-shouldered ibis), one dolphin species (Irrawaddy dolphin) and one crocodile species (false gavia) are listed as Critically Endangered. Species observed that have a national protected status include five egret bird species, one stork (lesser adjutant), one ibis species (white-shouldered ibis), ten eagle, kite and falcon species, three

tern species, three hornbill species, the oriental darter, one primate species (proboscis monkey), one monitor lizard, the false gaviol and the Irrawaddy dolphin.

Several species that are listed as Vulnerable on the IUCN Red List and are locally rare lack a national protected status such as the Java sparrow, rufous-collared kingfisher, black- and- red broadbill, eye-browed jungle-flycatcher, striated heron, crested fireback, the more common black-nest swiftlet and the smooth-coated otter and near threatened long-tailed macaque.

Threats

Impacts of human activities on the lakes' ecology

1. The area has experienced high sedimentation rates due to the opening of forested swamp areas for agriculture, coal-mining and oil-palm plantations, together with extensive logging and forest fires in areas connected with the lakes. The increase in sedimentation has caused the disappearance of nine of the 11 locally managed fish sanctuaries in the MMA, flooding of downstream and near-upstream settlements and most likely a decrease in fish abundance. Sixty-six percent of total respondents (230 fishermen) in the socio-economic assessment survey felt that illegal logging and coal-mining activities contributed to depletion of fish resources;
2. High rates of phosphor from fertilizer and soap-products were found in the lakes, which caused an increase in aquatic weeds and subsequent decrease in the depth of the lakes;
3. Fishing using poison, and pesticides used in farming and oil palm plantations resulted in pollution. Also, relatively high ammonium levels were found from domestic and agricultural waste products.
4. Acidic waste water/run-off from coal mining also caused pollution.

Impacts on wildlife in the lake areas

The following practices have impacted on wildlife in the area:

1. Direct catch of protected and endangered species (e.g. herons, storks, hornbills, crocodiles, turtles) and unsustainable catch of wandering whistling-ducks with occasional use of poison, primarily during the dry season;
2. Habitat and species diversity loss through forest conversion, forest fires and (illegal) logging;
3. Over-fishing and unsustainable fishing techniques such as electro-fishing and use of poison;
4. Boat traffic (noise and fuel pollution) disturbing freshwater dolphins;
5. Direct mortality of freshwater dolphins through gillnet entanglement. The present mortality rate is five dolphins per year on average and a population viability analysis (PVA) analysis revealed that the population can only survive if two to three individuals can be saved yearly (Kreb, 2004). Nearly eighty percent of respondents (230 fishermen) claimed that the presence of dolphins brought advantages to them, largely because the dolphins indicate the right location and season for fishing.

Habitat protection

Semayang Lake was proposed as a National Park in the early 1980s by the Directorate General for Forest and Nature Conservation of the Forestry Ministry of Indonesia. MacKinnon et al. (1997) list the area as a proposed site for a strict nature reserve. However, to date no official protection status has provided to any open water body within the Mahakam River ecosystem. With regards to protected fish reserves, a survey conducted by the Indonesian Institute of Sciences (LIPI) in 2003 (pers. comm., Dr. Dede Irving Hartoto) showed that nine out of a total of 11 fish sanctuaries were identified as destroyed due to sedimentation caused by upstream logging. Two fishery conservation areas, the first one near Kota Bangun (Loa Kang), which is 930 ha in size, and the second one near Muara Muntai, which is 450 ha in size (Batu Bumbun), are still relatively intact. Both reserves were

set up during the Kutai Muslim Sultanate some 500 years ago and have been managed under Kutai Regency since 1978 (*Perda Kabupaten Kutai No. 18, 1978*). Northeast of Semayang Lake lies the Muara Kaman reserve (62,500 ha *cagar alam*), which is supposed to protect a vast swamp area. This reserve has been heavily degraded by forest fires, agricultural encroachment, and illegal logging.

Future Research

The preliminary results indicate that the Middle Mahakam rivers, lakes and wetlands area host a large variety of bird species of which a large proportion only occur in low numbers and some are threatened in their survival. The total number of species found is certainly an underestimation of the real number of species. This is because only two surveys were conducted in 2 months, whereas the species account may vary per month and year. Also, many species (e.g. plovers, sandpipers and stints) that normally visit the dry mudflats were not observed, since this year drought was not intensive (mean temp. = 32°) and mudflats were not as extensive, whereas during normal dry seasons drought is more prolonged (mean temp. = 34-35°) and extensive mudflats exist. In order to get a better idea of the species dynamics and migratory or resident patterns, more systematic surveys are needed over a longer time period (2-3 years) and during more months per year (at least 2-3 times).

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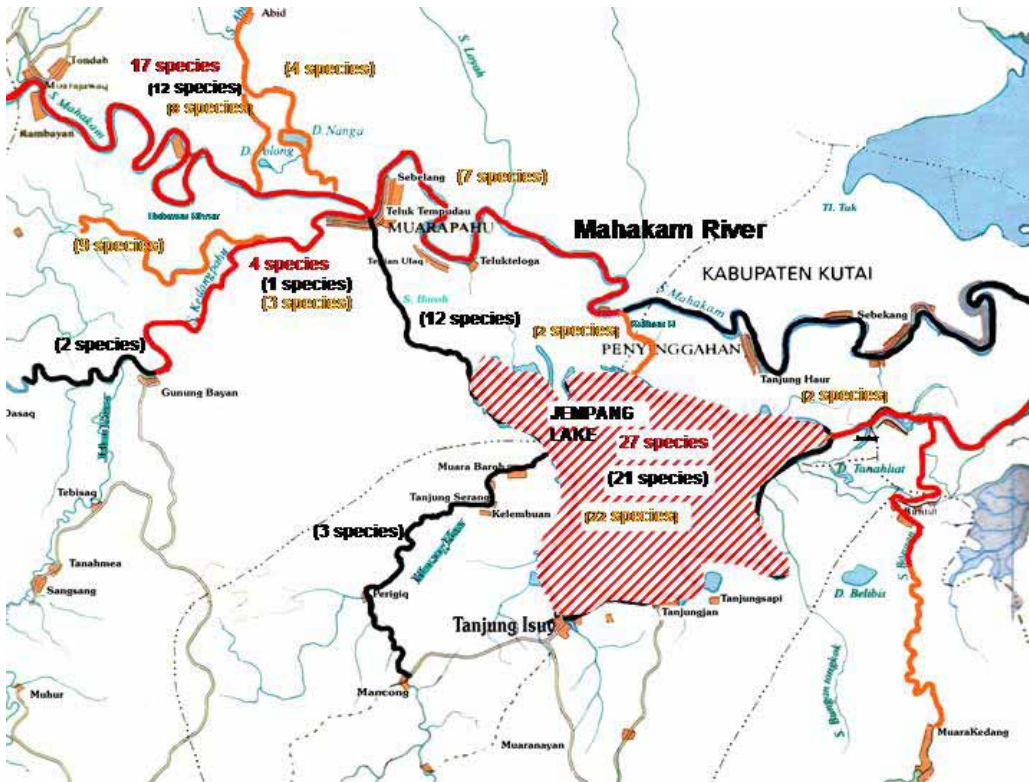


Fig. 1. Survey Area 1, including the lakes of Jempang and Perian, Mahakam River and tributaries Kedang Pahu, Muara Jelau, Baroh, Mancong, Keliran, Abid and Aloh



Fig. 2. Survey Area 1, including the lakes of Melintang and Tempatung, Mahakam River and tributaries Enggelam and Rebaq Rinding

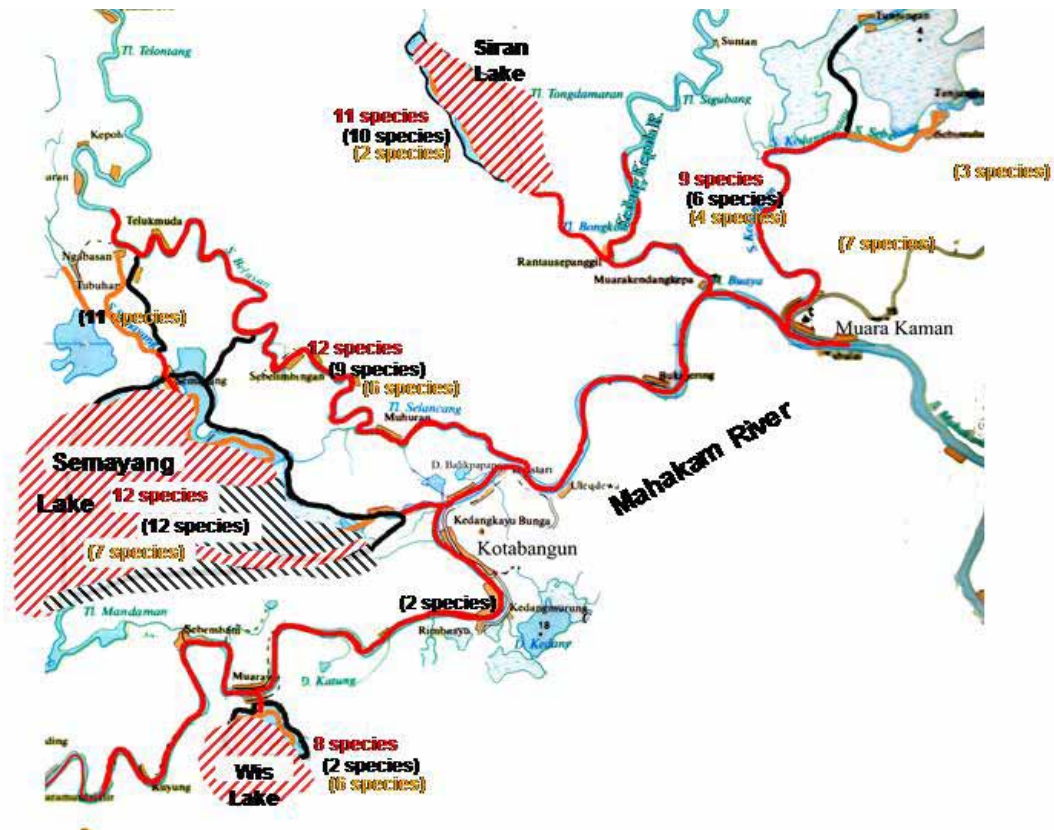


Fig 3. Survey Area including the lakes of Semayang, Wis, Tubuhan and Siran, the Mahakam River and tributaries Belayan, Kedang Kepala, Kedang Rantau, Sebintulung

Figures Legend:

- = Rivers surveyed during Survey I alone (April/ May 2005)
- = Rivers surveyed during Survey II alone (September 2005)
- = Area surveyed during both surveys I and II
- ▨** = Lakes surveyed during Survey I alone
- ▨** = Lakes surveyed during both surveys I and II
- (Text)** = Number of bird species encountered during Survey I
- (Text)** = Number of bird species encountered during Survey II
- Text** = Total number of different species encountered during both surveys

APPENDICES

Appendix 1. Species identified and their sighting locations.

No	Local	International	Family	Location
BIRDS				
1	Cangak Merah	Purple Heron	Ardeidae	Jempang Lake, Melintang Lake, Semayang Lake, Tempatung Lake, Jantur, Perian Lake and Siran Lake.,
2	Kuntul Kerbau	Cattle Egret	Ardeidae	Jempang Lake, Tempatung Lake, Melintang Lake, Semayang lake, Kedang Kepala River and Siran Lake.
3	Kuntul Perak	Intermediate Egret	Ardeidae	Jempang Lake, Melintang Lake, Semayang Lake, Tempatung Lake, Siran Lake and Kedang Kepala River.
4	Kuntul Besar	Great Egret	Ardeidae	Melintang Lake, Jempang Lake, Tempatung Lake, Semayang Lake, Kedang Kepala River, Tubuhan Lake, Mahakam, Siran Lake and Belayan River.
5	Kuntul Kecil	Little Egret	Ardeidae	Mahakam, Jempang Lake, Semayang Lake, Belayan River, Kedang Kepala River, Siran lake and Wis Lake.
6	Blekok Sawah	Javan Pond-Heron	Ardeidae	Jempang Lake, Tempatung Lake, Melintang Lake, Belayan River, Wis Lake, Semayang Lake, Tubuhan Lake, Sebintulung River and Siran Lake
7	Bambangan Hitam	Black Bittern	Ardidae	Mahakam, Jempang Lake
8	Kokokan Laut	Striated Heron	Ardidae	Mahakam
9	Kowak Malam Kelabu	Black-Crowned Night Heron	Ardidae	Mahakam, Melintang Lake
10	Belibis Kembang	Wandering Whistling-Duck	Anatidae	Mahakam, Jempang Lake, Melintang Lake, Semayang Lake, Tubuhan Lake, Tempatung Lake, Siran Lake
11	Itik Rumbai	Tufted Duck	Anatidae	Jempang Lake
12	Itik Gunung	Grey Duck	Anatidae	Jempang Lake
13	Ibis Karau	White-Shouldered Ibis	Threskiornithidae	Jempang Lake
14	Jalak Suren	Asian Pied Starling	Sturnidae	Melintang Lake and Abid River
15	Elang Bondol	Brahminy Kite	Accipitridae	Mahakam, Jempang Lake, Rebak Rinding River, Semayang Lake, Belayan River, Sebintulung River, Kedang Pahu River, Jelau River, Bolowan River, Baroh River, Melintang Lake, Wis Lake, Enggelam River, Kedang Kepala River and Siran Lake.
16	Elang Ikan Kecil	Lesser Fish-Eagle	Accipitridae	Melintang Lake
17	Elang Wallace	Wallace's Hawk-Eagle	Accipitridae	Kedang Rantau River, Mahakam, Kedang Kepala River
18	Elang Laut Perut Putih	White-Bellied Fish-Eagle	Accipitridae	Mahakam, Jempang Lake, Baroh River, Tempatung Lake, Jantur, Aloh River,
19	Elang Ikan Kepala Kelabu	Grey-Headed Eagle	Accipitridae	Melintang Lake, Bolowan River, Jempang Lake, Enggelam River.
20	Elang Brontok	Changeable Hawk-Eagle	Accipitridae	Mahakam, Kedang Rantau River
21	Elang Ular Bido	Crested Serpent-Eagle	Accipitridae	Mancong River
22	Elang Hitam	Black Eagle	Accipitridae	Kedang Rantau River
23	Alap-alap Capung	Black-Thighed Falconet	Falconidae	Mahakam, Belayan River, Melintang Lake, Baroh River, Siran Lake
24	Alap-alap Kawah	Peregrine Falcon	Falconidae	Baroh River, Keliran River, Tubuhan Lake, Mahakam
25	Mandar Besar	Purple Swamphen	Rallidae	Semayang Lake, Tempatung Lake, Wis lake
26	Mandar Batu	Coomon Moorhen	Rallidae	Jempang lake, Semayang Lake, Tempatung Lake, Wis lake, Siran Lake, Belayan River, Tubuhan Lake, Melintang Lake.
27	Kareo Padi	White-Breasted Waterhen	Rallidae	Rebak Rinding River, Wis Lake, Bolowan River, Tubuhan River, Mahakam, Belayan River.
28	Tikusan Merah	Ruddy-Breasted Crane	Rallidae	Jempang Lake
29	Tikusan Alis Putih	White-Browed Crane	Rallidae	Jempang Lake
30	Dara Laut Sayap Putih	White-Winged Tern	Sternidae	Jempang Lake, Tempatung Lake, Melintang Lake
31	Dara Laut Tengkul Hitam	Black-Naped Tern	Sternidae	Jempang Lake, Tempatung Lake, Melintang Lake

32	Dara Laut Kumis	Whiskered Tern	Sternidae	Jempang Lake, Tempatung Lake, Mahakam, Melintang Lake
33	Gelatik	Java Sparrow	Ploceidae	Jempang Lake
34	Bondol Rawa	Tri-Coloured Munia	Ploceidae	Mahakam
35	Pergam Hijau	Green Imperial Pigeon	Columbidae	Mahakam, Rebaq Rinding River
36	Tekukur Biasa	Spotted-Dove	Columbidae	Mahakam, Jempang Lake, Tubuhan Lake, Keliran River, Rebaq Rinding River, Belayan river
37	Punai Kecil	Little Green-Pigeon	Columbidae	Kedang Pahu River
38	Layang-layang Batu	Pacific Swallow	Hirundinidae	Melintang Lake, Bolowan River
39	Bubut Alang-alang	Lesser Coucal	Cuculidae	Rebak Rinding River, Mancong River, Mahakam
40	Tuwur Asia	Asian Koel	Cuculidae	Baroh River
41	Kadalan Birah	Chesnut-Breasted Malkoha	Cuculidae	Rebak Rinding River
42	Trinil Rumbai	Ruff	Scolopacidae	Baroh River
43	Trinil Pantai	Common Sandpiper	Scolopacidae	Rebak Rinding River
44	Berkik Ekor Lidi	Pintail Snipe	Scolopacidae	Kedang Rantau River
45	Cekakak Hutan Melayu	Rufous-Collared Kingfisher	Accediniidae	Baroh River
46	Pekaka Emas	Stork-Billed Kingfisher	Accediniidae	Mahakam, Baroh River, Belayan River, Rebaq Rinding River, Kedang Pahu River, Bolowan River, Abid River, Tempatung Lake, Melintang Lake, Enggelam River, Tubuhan Lake, Sebintulung River
47	Burung Sepatu Jengger	Comb-Crested Jacana	Tacanidae	Tubuhan Lake
48	Rangkong Badak	Rhinoceros Hornbill	Bucerotidae	Baroh River
49	Kangkareng Hitam	Asian Black Hornbill	Bucerotidae	Baroh River
50	Kangkareng Perut Putih	Oriental Pied Hornbill	Bucerotidae	Mahakam, Baroh River, Kedang Rantau River, Jelau River, Bolowan River, Abid River, Belayan River
51	Caladi Belacan	Grey-Capped Woodpecker	Picidae	Jempang Lake, Melintang Lake
52	Caladi Tikotok	Grey-and-Buff Woodpecker	Picidae	Mancong River
53	Caladi Tilik	Sunda woodpecker	Picidae	Kedang Rantau River
54	Sempur Hujan Sungai	Black-and-Red Broadbill	Eurylaimidae	Baroh River
55	Kepudang Sungu Gunung	Sunda Cuckoo-Shrike	Champephagidae	Mahakam
56	Sikatan Rimba Gunung	Eye-Browed Jungle-Flycatcher	Muscicapidae	Mahakam
57	Bangau Tong-tong	Lesser Adjutant	Ciconidae	Mahakam, Jempang lake, Tempatung Lake, Rebak Rinding river, Melintang Lake, Wis Lake, Semayang lake, Belayan River, Tubuhan Lake, Siran Lake, Kedang Kepala River, Kedang Pahu River, Bolowan River, Abid River
58	Cabak Kota	Savannah Nightjar	Caprimulgidae	Melintang Lake
59	Pecuk Ular Asia	Oriental Darter	Anhingidae	Semayang Lake, Belayan River, Perian Lake, Tubuhan Lake, Jempang Lake, Melintang Lake, Aloh River, Bolowan river, Kedang Rantau River, Wis Lake.
60	Srigunting Batu	Greater Racket-Tailed Drongo	Dicruridae	Belayan River
61	Sempidan Biru	Crested Fireback	Phasianidae	Mahakam
62	Walet Sarang Hitam	Black-Nest Swiftlet	Apodidae	Mahakam, Jempang Lake, Rebak Rinding River, Melintang Lake, Bolowan River, Tempatung Lake, Enggelam River, Kedang Kepala River, .
MAMMALS & REPTILES				
63	Lutung Kelabu	Silvered Langur	Chercopithecidae	Mahakam, Melintang Lake, Kedang Pahu River, Jelau River, Baroh River, Enggelam River, Belayan River, Kedang Kepala River .
64	Bekantan Kahau	Proboscis Monkey	Chercopithecidae	Mahakam, Mancong River, Kedang Pahu River, Abid River, Baroh River, and Jempang Lake
65	Kera Ekor Panjang	Long-Tailed Macaque	Chercopithecidae	Mahakam, Jempang Lake, Baroh River, Mancong River, Rebak Rinding River, Belayan River, Kedang Pahu River, Kedang Rantau River, Bolowan River, Enggelam River, Semayang Lake, Tubuhan Lake
66	Biawak Kalimantan	Borneo Lizard		Jempang Lake, Rebaq Rinding River, Mahakam and Bongan River.

67	Pesut	Irrawaddy Dolphin	Delphinidae	Jelau Mouth, Baroh River, Semayang Lake.
68	Tupai	Prevost's Squirrel	Sciuridae	Mahakam, Abid River, Melintang Lake, Kedang Pahu River, Rebaq Rinding River, Enggelam River, Semayang Lake
69	Berang-berang	Smooth Otter	Mustelidae	Baroh River
70	Buaya Sapit	False Gavial		Belayan River
71	Ular Cincin Emas	Gold-Coil Snake		Kadang Pahu River
72	Ular Rawa	Swamp Snake		Siran Lake

Appendix 2. Species identified, number of sightings, total numbers sighted and groupsizes per water level condition

No	International Name	Scientific Name	High Water Levels			Low Water Levels		
			n	N best (low-max) estimate	Mean G of best estimate	n	N best (low-max) estimate	Mean G of best estimate
BIRDS								
1	Purple Heron	<i>Ardea purpurea</i>	3	10	3 (1-7)	7	30	12 (2-33)
2	Cattle Egret	<i>Bubulcus ibis</i>	7	218 (205-231)	31 (1-55)	4	247(200-368)	63 (50-75)
3	Intermediate Egret	<i>Egretta intermedia</i>	3	180 (174-189)	60 (55-61)	5	373(310-384)	87 (6-156)
4	Great Egret	<i>Egretta alba</i>	2	48 (46-51)	24 (1-47)	8	313(270-338)	75 (8-212)
5	Little Egret	<i>Egretta garzetta</i>	12	205 (194-216)	17 (1-55)	-	-	-
6	Javan Pond-Heron	<i>Ardeola speciosa</i>	7	143 (159-176)	20 (1-112)	16	983(620-1346)	50 (4-175)
7	Lesser Adjutant	<i>Leptoptilos javanicus</i>	14	57	4 (1-15)	10	68	3 (1-10)
8	Wandering Whistling-Duck	<i>Dendrocygna arcuata</i>	1	1	1	4	1424(1050-1799)	28 (7-150)
9	Java Sparrow	<i>Padda oryzivora</i>	-	-	-	5	20	3 (1-5)
10	Tri-Coloured Munia	<i>Lonchura mallacca</i>	-	-	-	1	20	20
11	White-Shouldered Ibis	<i>Pseudibis davisoni</i>	1	6	6	-	-	-
12	Tufted Duck	<i>Aythya fuligula</i>	2	4	2 (1-3)	-	-	-
13	Grey Duck	<i>Anas superciliosa</i>	1	2	2	-	-	-
14	Asian Pied Starling	<i>Sturnus contra</i>	2	3	1 (1-2)	2	3	3
15	Brahminy Kite	<i>Haliastur indus</i>	17	31	2 (1-4)	15	39	9 (1-15)
16	Lesser Fish-Eagle	<i>Ichthyophaga humilis</i>	1	1	1	-	-	-
17	White-Bellied Fish-Eagle	<i>Haliaeetus leucogaster</i>	1	1	1	6	6	2 (1-3)
18	Grey-Headed Eagle	<i>Ichthyophaga ichthyaetus</i>	2	2	1	2	2	1 (1-2)
19	Changeable Hawk-Eagle	<i>Spizaetus cirrhatus</i>	1	1	1	1	1	1
20	Wallace's Hawk-Eagle	<i>Spizaetus nanus</i>	-	-	-	3	3	1 (1-2)
21	Crested Serpent-Eagle	<i>Spilornis cheela</i>	1	1	1	-	-	-
22	Black Eagle	<i>Ictinaetus malayensis</i>	1	1	1	1	1	1

	International Name	Scientific Name	HWL			LWL		
			n	N best (low-max) estimate	Mean G of best estimate	n	N best (low-max) estimate	Mean G of best estimate
23	Black-Thighed Falconet	<i>Microhierax fringillarius</i>	3	15 (10-19)	5 (1-15)	3	15	1 (1-2)
24	Peregrine Falcon	<i>Falco peregrinus</i>	1	1	1	2	4	-
25	Pacific Swallow	<i>Hirundo tahitica</i>	-	-	-	1	2	2
26	Comb-Crested Jacana	<i>Iredipara gallinacea</i>	-	-	-	1	2	2
27	Lesser Coucal	<i>Centropus bengalensis</i>	1	1	1	1	2	1 (1-2)
28	Purple Swamphen	<i>Porphyrio porphyrio</i>	3	18 (17-19)	6 (1-8)	5	17	13 (10-15)
29	Coomon Moorhen	<i>Gallinula chloropus</i>	2	56	25 (20-29)	4	83	13 (10-15)
30	White-Winged Tern	<i>Chlidonias leucopterus</i>	2	362 (293-431)	181 (6-312)	-	-	-
31	Black-Naped Tern	<i>Sterna sumatrana</i>	3	397 (328-543)	132 (25-375)	5	977(648-1464)	125 (75-175)
32	Whiskered Tern	<i>Chlidonias hybridus</i>	4	659 (532-788)	165 (25-560)	6	1594(1265-1956)	210 (50-500)
33	Green Imperial Pigeon	<i>Ducula aenea</i>	1	1	1	1	2	2
34	Spotted-Dove	<i>Streptopelia chinensis</i>	3	3	1 (1-2)	6	15	2 (1-4)
35	Little Green-Pigeon	<i>Treron olax</i>	1	1	1	1	5	5
36	Asian Koel	<i>Eudynamys scolopacea</i>	1	1	1	-	-	-
37	Rufous-Collared Kingfisher	<i>Actenoides concretus</i>	1	2	2	-	-	-
38	Stork-Billed Kingfisher	<i>Pelargopsis capensis</i>	3	3	1	12	38	2 (1-3)
39	Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	1	1	1	-	-	-
40	Asian Black Hornbill	<i>Anthracoceros malayanus</i>	1	1	1	-	-	-
41	Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	6	11	2 (1-3)	6	14	3 (2-9)
42	Grey-Capped Woodpecker	<i>Dendrocopos canicapillus</i>	2	3	1 (1-2)	1	1	1
43	Grey-and-Buff Woodpecker	<i>Hemicircus concretus</i>	1	1	1	-	-	-
44	Sunda woodpecker	<i>Dendrocopos moluccensis</i>	-	-	-	1	1	1
45	Black-and-Red Broadbill	<i>Cymbirhynchus macrorhynchos</i>	1	1	1	-	-	-
46	Sunda Cuckoo-Shrike	<i>Coracina larvatus</i>	1	1	1	-	-	-
47	Eye-Browed Jungle-Flycatcher	<i>Rhinomyias gularis</i>	1	1	1	-	-	-
48	Striated Heron	<i>Butorides striatus</i>	1	1	1	-	-	-
49	Savannah Nightjar	<i>Caprimulgus affinis</i>	2	38 (36-40)	19 (1-35)	-	-	-
50	White-Breasted Waterhen	<i>Amaurornis phoenicurus</i>	1	1	1	5	9	1 (1-2)
51	Oriental Darter	<i>Anhinga melanogaster</i>	2	2	1	10	27	3 (2-9)

52	Greater Racket-Tailed Drongo	<i>Dicrurus paradiseus</i>	1	2	2	1	1	1
53	Black-Crowned Night Heron	<i>Nycticorax nycticorax</i>	1	1	1	4	6	1 (1-2)
54	Chesnut-Breasted Malkoha	<i>Phaenicophaeus curvirostris</i>	-	-	-	1	4	4
55	Crested Fireback	<i>Lophura erythrophthalma</i>	1	1	1	-	-	-
56	Black-Nest Swiftlet	<i>Collocalia maxima</i>	3	66 (61-70)	22 (5-50)	4	434(375-472)	4 (1-20)
57	Ruddy-Breasted Crake	<i>Porzana fusca</i>	1	1	1	-	-	-
58	White-Browed Crake	<i>Porzana cinerea</i>	1	1	1	-	-	-
59	Common Sandpiper	<i>Tringa hypoleucos</i>	-	-	-	1	2	2
60	Ruff	<i>Philomachus pugnax</i>	1	1	1	-	-	-
61	Pintail Snipe	<i>Gallinago stenura</i>	-	-	-	1	2	2
62	Black Bittern	<i>Ixobrychus flavicollis</i>	2	2	1	4	8	1 (1-2)
			139	2572 (2278-2996)		177	6798 (5191-8580)	
Total number of species			53 (HWL)			40 (LWL)		

No	International Name	Scientific Name	High Water Levels			Low Water Levels		
			n	N best (low-max) estimate	Mean G of best estimate	n	N best (low-max) estimate	Mean G of best estimate
MAMMALS & REPTILES								
63	Silvered Langur	<i>Presbytis cristata</i>	7	52 (49-55)	7 (2-16)	3	26	5 (2-30)
64	Proboscis Monkey	<i>Nasalis larvatus</i>	9	39 (44-48)	4 (1-15)	3	15	20 (1-25)
65	Long-Tailed macaque	<i>Macaca fascicularis</i>	22	169 (157-179)	8 (1-35)	13	80(35-106)	18 (3-35)
66	Borneo Lizard	<i>Varanus boornesis</i>	2	2	1	2	2	1 (1-2)
67	Irrawaddy Dolphin	<i>Orcaella brevirostris</i>	3	9	3 (2-4)	-	-	-
68	Prevost's Squirrel	<i>Callosciurus prevostii</i>	4	4	1	3	3	1 (1-2)
69	Smooth Otter	<i>Lutra (Lutrogale) Perspicillata</i>	1	2	2	-	-	-
70	False Gavial	<i>Tomistoma schigeli</i>	1	1	1	-	-	-
71	Gold-coil Snake	<i>Boiga dendrophila</i>	1	1	1	-	-	-
72	Swamp Snake		1	1	1	-	-	-
Total numbers			51	280 (270-302)		24	126 (81-152)	
Total number of species			10 (HWL)			5 (LWL)		

N = total abundance; n = number of sightings; G = groupsize

Appendix 3a. Species and individual occurrence per habitat at high water levels.

No.	International Name	OS	LF	OW	RF
	BIRDS				
1	Purple Heron	8	1	-	1
2	Cattle Egret	205 (218-131)	-	-	-
3	Intermediate Egret	180 (170-189)	-	-	4
4	Great Egret	47 (45-50)	-	-	1
5	Little Egret	175 (164-186)	-	3	27
6	Javan Pond-Heron	148 (132-165)	-	-	11
7	Lesser Adjutant	-	21	1	35
8	Wandering Whistling-Duck	27	-	1	3
9	White-Shouldered Ibis	-	6	-	-
10	Tufted Duck	3	-	-	1
11	Grey Duck	-	-	2	-
12	Asian Pied Starling	3	-	-	-
13	Brahminy Kite	1	17		13
14	Lesser Fish-Eagle	-	1	-	-
15	White-Bellied Fish-Eagle	-	1	-	-
16	Grey-Headed Eagle	-	2	-	-
17	Changeable Hawk-Eagle	-	1	-	-
18	Crested Serpent-Eagle	-	4	-	-
19	Black Eagle	-	-	-	1
20	Peregrine Falcon	-	-	-	1
21	Black-Thighed Falconet	-	15 (10-19)	-	-
22	Purple Swampphen	17 (18-19)	-	-	
23	White-Breasted Waterhen	-	-	-	1
24	Eye-Browed Jungle-Flycatcher	-	-	-	1
25	Lesser Coucal		-	-	1
26	Coomon Moorhen	46	8	2	-
27	White-Winged Tern	356 (287-425)	-	-	6
28	Black-Naped Tern	389 (320-535)	-	-	8
29	Whiskered Tern	640 (517-765)	-	4	15 (11-19)
30	Black-Nest Swiftlet	-	-	-	66 (61-70)
31	Green Imperial Pigeon	-	-	-	1
32	Spotted-Dove	-	2	-	1
33	Asian Koel	-	-	-	1
34	Little Green-Pigeon	-	-	-	1
35	Rufous-Collared Kingfisher	-	-	-	2
36	Stork-Billed Kingfisher	-	-	-	3
37	Rhinoceros Hornbill	-	-	-	1
38	Asian Black Hornbill	-	-	-	1
39	Oriental Pied Hornbill	-	-	-	11

40	Grey-Capped Woodpecker	-	3	-	-
41	Grey-and-Buff Woodpecker	-	-	-	1
No.	International Name	OS	LF	OW	RF
42	Black-and-Red Broadbill	-	-	-	1
43	Sunda Cuckoo-Shrike	-	-	-	1
44	Ruff	-	-	-	1
45	Ruddy-Breasted Crake	1	-	-	-
46	White-Browed Crake	1	-	-	-
47	Black-Crowned Night Heron	-	-	-	1
48	Striated Heron	-	-	-	1
49	Savannah Nightjar	38 (36-40)	-	-	-
50	Oriental Darter	-	-	1	1
51	Greater Racket-Tailed Drongo	-	-	-	2
52	Crested Fireback	-	-	-	1
53	Black Bittern	2	-	-	-
MAMMALS & REPTILES					
54	Silvered Langur	-	16	-	33
55	Proboscis Monkey	-	-	-	38 (44-48)
56	Long-Tailed macaque	-	55 (53-57)	-	114 (104-124)
57	Borneo Lizard	1	-	-	1
58	Irrawaddy Dolphin	-	-	2	7
59	Prevost's Squirrel	-	2	-	2
60	Smooth Otter	-	-	-	2
61	False Gavial	-	-	-	1
62	Gold-coil Snake	-	-	-	1
63	Swamp Snake	1	-	-	-

OS = Open Swamp; **LF** = Lake Forest; **OW** = Open Lake Water ; **RF** = River Forest

Appendix 3b. Species and individual occurrence per habitat at low water levels.

No.	International Name	OS	LF	OW	RF	M	AGE
BIRDS							
1	Purple Heron	1	29	-	-	-	A/J
2	Cattle Egret	212(175-324)	35(25-44)	-	-	-	A/J
3	Intermediate Egret	369(310-384)	6	-	-	-	A/J
4	Great Egret	258(220-279)	55(50-59)	-	-	-	A/J
5	Javan Pond-Heron	570(360-780)	-	413(260-566)	-	-	A/J
6	Lesser Adjutant	-	-	52	16	-	A/J
7	Wandering Whistling-Duck	837(500-1174)	10	163(150-175)	-	424(400-450)	A/J
8	Black Bittern	8	-	-	-	-	A
9	Java Sparrow	-	5	-	15	-	A
10	Tri-Coloured Munia	-	-	-	20	-	A
11	Asian Pied Starling	-	-	-	3	-	A
12	Brahminy Kite	-	3	-	36	-	A/J
13	White-Bellied Fish-Eagle	-	3	-	3	-	A/J
14	Grey-Headed Eagle	-	1	-	1	-	A/J
15	Changeable Hawk-Eagle *	-	1	-	1	-	A
16	Wallace's Hawk-Eagle *	-	-	-	3	-	A/J
17	Black Eagle	-	-	-	1	-	A
18	Peregrine Falcon	-	-	-	4	-	A

19	Black-Thighed Falconet	-	-	-	15	-	A
No.	International Name	OS	LF	OW	RF	M	AGE
20	Pacific Swallow	-	-	2	-	-	A
21	Comb-Crested Jacana *	2	-	-	-	-	A
22	Lesser Coucal	-	-	-	2	-	A
23	Coomon Moorhen	55	23	5	-	-	A/J
24	Purple Swampphen	10	5	2	-	-	A/J
25	Black-Crowned Night Heron	-	6	-	-	-	A
26	Black-Naped Tern	-	-	-	-	212(200-225)	A/J
27	Whiskered Tern	-	-	-	-	550(500-600)	A/J
28	Green Imperial Pigeon	-	-	-	2	-	A
29	Spotted-Dove	-	2	-	13	-	A/J
30	White-Breasted Waterhen	-	2	-	7	-	A
31	Little Green-Pigeon	-	-	-	5	-	A/J
32	Chesnut-Breasted Malkoha	-	-	-	4	-	A
33	Common Sandpiper	-	-	-	2	-	A
34	Pintail Snipe	-	-	-	2	-	A/J
35	Stork-Billed Kingfisher	-	9	-	29	-	A
36	Oriental Pied Hornbill	-	-	-	14	-	A/J
37	Sunda Woodpecker	-	-	-	1	-	A
38	Black-Nest Swiftlet	-	399(345-433)	-	35	-	A
39	Oriental Darter	-	13	-	14	-	A/J
40	Greater Racket-Tailed Drongo	-	-	-	1	-	A
MAMMALS & REPTILES							
41	Long-Tailed macaque	-	7	-	73	-	A/J
42	Proboscis Monkey	-	-	-	15	-	A/J
43	Silvered Langur	-	-	-	23	-	A/J
44	Prevost's Squirrel	-	-	-	3	-	A

OS = Open Swamp; **LF** = Lake Forest; **OW** = Open Lake Water ; **RF** = River Forest; **M** = Mudflat; **A** = Adult;
J = Juveniles present

APPENDIX 4. Species observed and their status

No	International	Scientific	IUCN Red List 2004					MMA		National Protection*
			EN	NT	Vu	CR	LC	Com	Rare	P
BIRDS										
1	Purple Heron	<i>Ardea purpurea</i>	-	-	-	-	□	□	-	□
2	Cattle Egret	<i>Bubulcus ibis</i>	-	-	-	-	□	□	-	□
3	Intermediate Egret	<i>Egretta intermedia</i>	-	-	-	-	□	□	-	□
4	Great Egret	<i>Egretta alba</i>	-	-	-	-	□	□	-	□
5	Little Egret	<i>Egretta garzetta</i>	-	-	-	-	□	□	-	□
6	Javan Pond-Heron	<i>Ardeola speciosa</i>	-	-	-	-	□	□	-	-
7	Lesser Adjutant	<i>Leptoptilos javanicus</i>	-	-	□	-	-	□	-	□
8	Wandering Whistling-Duck	<i>Dendrocygna arcuata</i>	-	-	-	-	□	□	-	-
9	Java Sparrow	<i>Padda oryzivora</i>	-	-	□	-	-	-	□	-
10	Tri-Coloured Munia	<i>Lonchura mallacca</i>	-	-	-	-	□	-	□	-
11	White-Shouldered	<i>Pseudibis davisoni</i>	-	-	-	□	-	-	□	□

Ibis										
No	International	Scientific	EN	NT	Vu	CR	LC	Com	Rare	P
12	Tufted Duck	<i>Aythya fuligula</i>	-	-	-	-	☐	-	☐	-
13	Grey Duck	<i>Anas superciliosa</i>	-	-	-	-	☐	-	☐	-
14	Asian Pied Starling	<i>Sturnus contra</i>	-	-	-	-	☐	-	☐	-
15	Brahminy Kite	<i>Haliastur indus</i>	-	-	-	-	☐	☐	-	☐
16	Lesser Fish-Eagle	<i>Ichthyophaga humilis</i>	-	☐	-	-	-	-	☐	☐
17	White-Bellied Fish-Eagle	<i>Haliaeetus leucogaster</i>	-	-	-	-	☐	☐		☐
18	Grey-Headed Eagle	<i>Ichthyophaga ichhyaetus</i>	-	☐	-	-	-	-	☐	☐
19	Changeable Hawk-Eagle	<i>Spizaetus cirrhatus</i>	-	-	-	-	☐	-	☐	☐
20	Wallace's Hawk-Eagle	<i>Spizaetus nanus</i>	-	-	☐	-		-	☐	☐
21	Crested Serpent-Eagle	<i>Spilornis cheela</i>	-	-	-	-	☐	-	☐	☐
22	Black Eagle	<i>Ictinaetus malayensis</i>	-	-	☐	-		-	☐	☐
23	Peregrine Falcon	<i>Falco peregrinus</i>	-	-	-	-	☐	-	☐	☐
24	Black-Thighed Falconet	<i>Microhierax fringillarius</i>	-	-	-	-	☐	-	☐	☐
25	Pacific Swallow	<i>Hirundo tahitica</i>	-	-	-	-	☐	-	☐	-
26	Comb-Crested Jacana	<i>Iredipara gallinacea</i>	-	-	-	-	☐	-	☐	-
27	Lesser Coucal	<i>Centropus bengalensis</i>	-	-	-	-	☐	-	☐	-
28	Purple Swampphen	<i>Porphyrio porphyrio</i>	-	-	-	-	☐	☐	-	-
29	Coomon Moorhen	<i>Gallinula chloropus</i>	-	-	-	-	☐	☐	-	-
30	White-Winged Tern	<i>Chlidonias leucopterus</i>	-	-	-	-	☐	☐	-	☐
31	Black-Naped Tern	<i>Sterna sumatrana</i>	-	-	-	-	☐	☐	-	☐
32	Whiskered Tern	<i>Chlidonias hybrida</i>	-	-	-	-	☐	☐	-	☐
33	Green Imperial Pigeon	<i>Ducula aenea</i>	-	-	-	-	☐	-	☐	-
34	Spotted-Dove	<i>Streptopelia chinensis</i>	-	-	-	-	☐	☐	-	-
35	Little Green-Pigeon	<i>Treron olax</i>	-	-	-	-	☐	-	☐	-
36	Asian Koel	<i>Eudynamys scolopacea</i>	-	-	-	-	☐	-	☐	-
37	Rufous-Collared Kingfisher	<i>Actenoides concretus</i>	-	☐	-	-	-	-	☐	-
38	Stork-Billed Kingfisher	<i>Pelargopsis capensis</i>	-	-	-	-	☐	☐	-	-
39	Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	-	☐	-	-		-	☐	☐
40	Asian Black Hornbill	<i>Anthracoceros malayanus</i>	-	☐	-	-	-	-	☐	☐
41	Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	-	-	-	-	☐	☐	-	☐
42	Sunda Woodpecker	<i>Dendrocopus moluccensis</i>					☐	-	☐	
43	Grey-Capped	<i>Dendrocopus</i>	-	-	-	-	☐	-	☐	-

No	International	Scientific	EN	NT	Vu	CR	LC	Com	Rare	P
	Woodpecker	<i>canicapillus</i>								
44	Grey-and-Buff Woodpecker	<i>Hemicircus concretus</i>	-	-	-	-	□	-	□	-
45	Pintail Snipe	<i>Gallinago stenura</i>					□	-	□	
46	Black-and-Red Broadbill	<i>Cymbirhynchus macrorhynchos</i>	-	-	□	-	-	-	□	-
47	Sunda Cuckoo-Shrike	<i>Coracina larvatus</i>	-	-	-	-	□	-	□	-
48	Eye-Browed Jungle-Flycatcher	<i>Rhinomyias gularis</i>	-	-	□	-	-	-	□	-
49	Striated Heron	<i>Butorides striatus</i>	-	-	□	-	-	-	□	-
50	Savannah Nightjar	<i>Caprimulgus affinis</i>	-	-	-	-	□	-	□	-
51	White-Breasted Waterhen	<i>Amaurornis phoenicurus</i>	-	-	-	-	□	-	□	-
52	Oriental Darter	<i>Anhinga melanogaster</i>	-	□	-	-	-	□	-	□
53	Greater Racket-Tailed Drongo	<i>Dicrurus paradiseus</i>	-	-	-	-	□	-	□	-
54	Black-Crowned Night Heron	<i>Nycticorax nycticorax</i>	-	-	-	-	□	-	□	-
55	Chesnut-Breasted Malkoha	<i>Phaenicophaeus curvirostris</i>	-	-	-	-	□	-	□	-
56	Crested Fireback	<i>Lophura ignita</i>	-	-	□	-	-	-	□	-
57	Black-Nest Swiftlet	<i>Collocalia maxima</i>	-	-	□	-	-	□	-	-
58	Ruddy-Breasted Crake	<i>Porzana fusca</i>	-	-	-	-	□	-	□	-
59	White-Browed Crake	<i>Porzana cinerea</i>	-	-	-	-	□	-	□	-
60	Ruff	<i>Philomachus pugnax</i>					□			
61	Common Sandpiper	<i>Tringa hypoleucos</i>	-	-	-	-	□	-	□	-
62	Black Bittern	<i>Ixobrychus flavicollis</i>	-	-	-	-	□	-	□	-
MAMMALS & REPTILES										
63	Silvered Langur	<i>Presbytis cristata</i>	-	-	-	-	-	□	-	-
64	Proboscis Monkey	<i>Nasalis larvatus</i>	□	-	-	-	-	-	□	□
65	Long-Tailed macaque	<i>Macaca fascicularis</i>	-	□	-	-	-	□	-	-
66	Borneo Lizard	<i>Varanus bornensis</i>	-	-	-	-	-	-	□	□
67	Irrawaddy Dolphin	<i>Orcaella brevirostris</i>	-	-	-	□	-	-	-	□
68	Prevost's Squirrel	<i>Callosciurus prevostii</i>	-	-	-	-	□	-	□	-
69	Smooth-Coated Otter	<i>Lutra (Lutrogale) Perspicillata</i>	-	-	□	-	-	-	□	-
70	False Gavia	<i>Tomistoma schlegelii</i>	-	-	-	□	-	-	□	□
71	Gold-coil Snake	<i>Boiga dendrophila</i>	-	-	-	-	-	-	□	-
72	Swamp Snake		-	-	-	-	-	-	□	-

* = national protected status based on the list of protected fauna and flora according to national law UU. No.5 Tahun 1990 issued by Dirjen PHKA, MMA = Middle Mahakam Area, R= Rare, EN= Endangered, CR= Critical Endangered, NT= Near threatened, VU= Vulnerable, LC= Least Concern, C= (Locally) Common (> 6 sightings per survey or N>50 per survey), R = (Locally) Rare (<6 sightings per survey), P= Protected,.