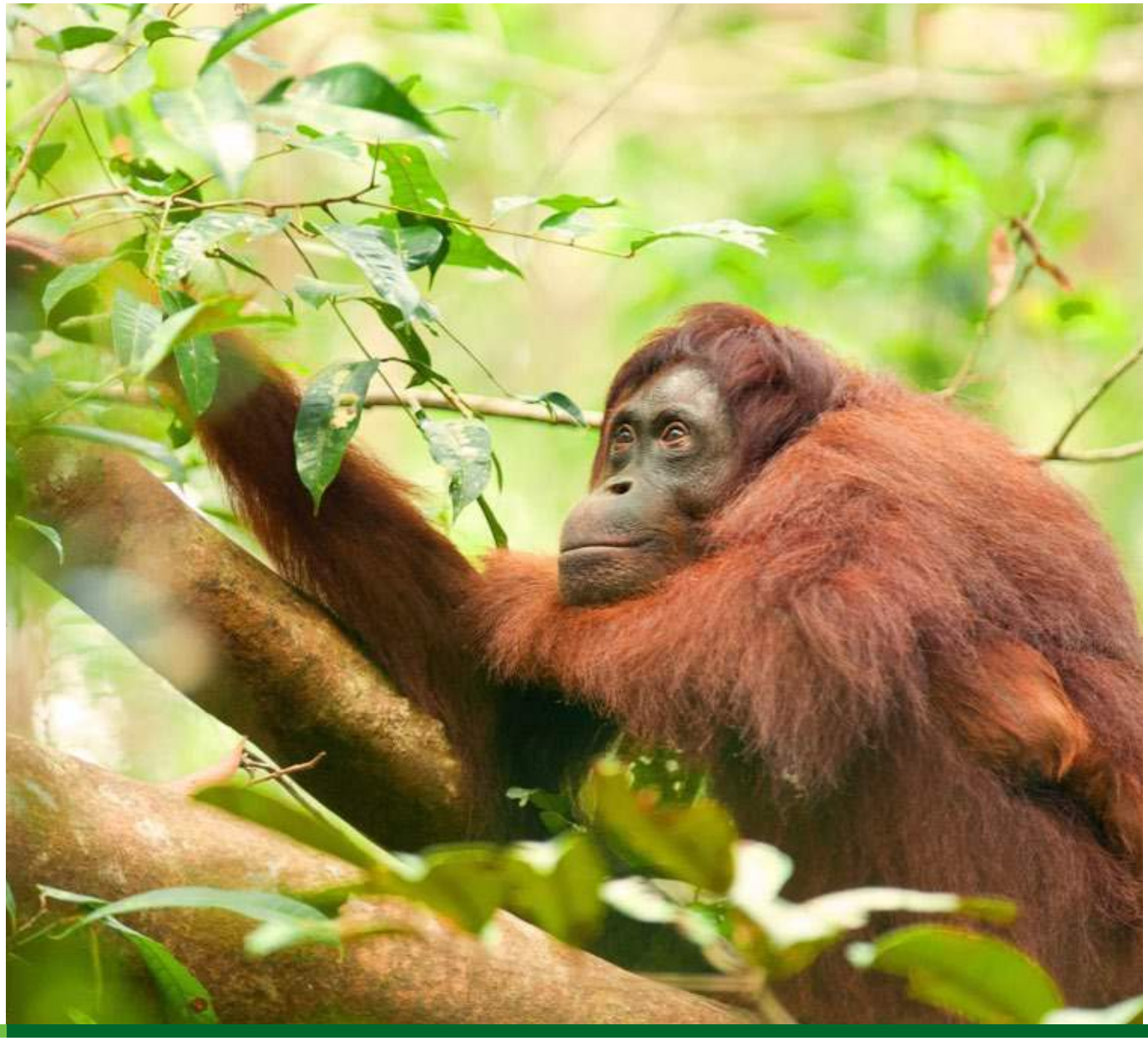
March 2019 | Report

Biodiversity, Forest Structure & Conservation Importance of the Mungku Baru Education Forest, Rungan, Central Kalimantan, Indonesia



Borneo Nature Foundation (BNF) in collaboration with:

Universitas Muhammadiyah Palangkaraya (UMP) & University of Exeter (UoE)

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Contents

Praises to the presence of Allah “Glory to Him, the Exalted”, for His approval that allowed us to complete the expedition and report as expected.

This report is the result of the exceptional collaboration of researchers conducting studies within the Mungku Baru Education Forest, one of the most biodiverse places still left in Kalimantan. Through the results contained within this report, we want to present the importance of this area, which should be protected and preserved. The work done is testimony of the Muhammadiyah University of Palangkaraya’s (UMP) committed efforts in safeguarding the forest and we hope it aids us in our dedication to teach the surrounding communities on the importance of forest preservation.

I offer a great thank you on behalf of UMP to the Borneo Nature Foundation for their help and partnership in the ongoing activities in the Education Forest. This international collaboration is a new breakthrough in forest governance in the form of an Educational Forest. UMP hope that through our management and activities we will inspire other forest researchers and conservationist to follow this blueprint and share our goal to preserve the remaining forest in Kalimantan. Our aim is that our positive activities can serve as an example, to be continued involving more parties, specifically surrounding communities, to accomplish a sustainable forest and become a model for education forest management in Indonesia.

Ibu Siti Maimunah

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The Rungan forest landscape represents an extremely important refuge for an abundance of endangered fauna and flora species. This significance is due in part to its virtually unique habitat composition, comprising a mosaic of kerangas (heath), peat-swamp and lowland Dipterocarp forest, with a high abundance of protected ulin (Borneo ironwood: *Eusideroxylon zwageri*) trees. The enduring pristine nature of this unprotected landscape is even more remarkable considering its close proximity to the bustling provincial capital, Palangka Raya.

We first became aware of the landscape's importance for conservation in 2010, during a two-month survey of the biodiversity and ape populations in the Mungku Baru cultural Ulin Forest. Subsequent to this, a nearby 4,910 hectare research forest (Kawasan Hutan Dengan Tujuan Khusus -Forest Area with Special Purpose: Research and Education) was created in 2016, under the management of Universitas Muhammadiyah Palangkaraya (UMP) in collaboration with the local people of Mungku Baru village.

In July-August 2016 and 2017, UMP, BNF and the people of Mungku Baru undertook two extensive surveys of the KHTDK area. These expeditions included orangutan nest surveys and gibbon call triangulation surveys to estimate ape population densities, line-transect surveys and camera traps to assess vertebrate fauna biodiversity, fish and butterfly surveys, plus intensive habitat assessments.

Our results to date are quite astounding, identifying over 32 mammal species in the KHDTK, including an impressive five wild cat and six primate species. Of the mammal species identified, seven are endemic to Borneo, two are classed by the IUCN as "Critically Endandered" and four as "Endangered", while 17 are legally protected in Indonesia. We have also identified 118 avian species in the KHDTK, of which one, the helmeted hornbill, is classed by IUCN as "Critically Endandered"; three are Borneo endemic and 22 are protected under Indonesian law.

Based primarily on surveys by BNF, the eastern portion of the Rungan landscape containing the KHDTK is thought to contain between 1364 and 2034 orangutans, at an estimated density of 1.75 to 2.61 individuals per km^2 (Utami-Atmoko et al., 2017). Gibbon density is estimated to be 2.79 groups per km^2, translating into a population of approximately 4,000 gibbons living in the landscape. In addition we have identified 108 tree species and a number of other rare plants and flowers.

Despite this wealth of wildlife and forest resources, the Rungan forest landscape and its wildlife are currently threatened by conversion to oil-palm and acacia plantations, potential coal mining concessions, gold mining in surrounding rivers and wildlife hunting. In order to fully realise the conservation potential of the Rungan landscape we need to continue to gather robust scientific data within the KHDTK to establish the case to preserve this incredible ecosystem.

The KHDTK and the surrounding forests of the Rungan landscape contain a wealth of vertebrate fauna and flora, including a number of species at risk of extinction. The habitat in the region is of high quality, including large areas of virgin rainforest. Many forest resources are also harvested by the local communities, and the forest is important for local culture and identity. Despite this richness, much of the Rungan landscape is currently threatened by conversion to oil-palm, acacia plantations and coal mining concessions. It is imperative to continue scientific work within the KHDTK and beyond to provide further rigorous scientific evidence to aid conservation planning. Consequently, we recommend:

1. Maintaining the existing research camp, trail system and encouraging continued ecological research in the KHDTK and social research in nearby villages;

2. In addition to the continued protection of the 4,910 ha KHDTK forest at Mungku Baru, we recommend further forest protection across the Rungan landscape to conserve the valuable biodiversity found in the region and prevent further forest conversion. Based on the high conservation value in the KHDTK and our GIS land cover assessments, we consider the whole Rungan landscape to be of similar conservation importance. As a consequence we also recommend further surveys across the landscape.

3. Working with the local community of Mungku Baru village to initiate a participatory forest management system and promote development of sustainable economies in the area;

4. Encouraging further funding and establishment of local NGOs / community working groups to enhance protection of Mungku Baru Forest;

5. Obtaining further government support for conservation of the valuable natural resources of Mungku Baru under a participatory village management system, including from the regional Department of Nature Conservation (BKSDA), regional Departments of the Environment and Forestry, Kabupaten Gunung Mas and Kotamadya Palangka Raya;

6. Encouraging regulation of gold-mining in rivers to improve water quality, safe-guard public health and allow the recovery of fish stocks;

7. Investigating the potential of ecotourism in Mungku Baru as a means of generating income and sustainable forest use. This is a potentially good area for ecotourism as this site is close to Palangka Raya, has relatively easy terrain on which to walk, and has a high abundance and diversity of fauna.

8. Implement a programme of environmental education in schools/villages, including connecting to international schools through BNF's global network; and

9. Develop and support community-led conservation activities to protect and restore at-risk forest habitat, including the establishment of fire-fighting and forest patrol units.

The Borneo Nature Foundation (BNF) is a not-for-profit conservation and research organisation. We work to protect some of the most important areas of tropical rainforest in Borneo, and safeguard the wildlife, environment and indigenous culture that are found here.

BNF runs several field programmes that include high-quality scientific research as a basis for protecting and managing forests. We have particular expertise in monitoring the distribution, population status, behaviour and ecology of Borneo's flagship ape species; the critically endangered Bornean orangutan and endangered white-bearded gibbon. Wide-ranging biodiversity and forestry research is used to provide an evidence base to inform conservation strategies and demonstrate the impacts of logging, fire and forest conversion. BNF provides training and capacity building for local students, researchers and conservation-area managers, and works with a number of local partners to implement successful conservation projects.

BNF supports and empowers community-led initiatives to protect forest and biodiversity, including anti-logging patrols, fire-fighting teams, environmental education programmes and restoration of damaged forests. As a direct result of these programmes, illegal logging in BNF's work area in Sabangau was stopped in 2005, and twelve different fire-fighting units were equipped and supported during the devastating dry-season fires of 2015. BNF undertakes long-term ecological research in collaboration with local university partners, with key studies examining temporal trends in the distribution, abundance and behaviour of both orangutans and gibbons; contributing to habitat restoration efforts through tree-replanting and dam-building projects; and contributing on how best to manage forest habitat for ape conservation in Borneo.

The Rungan Conservation Programme is BNF's newest programme, working with local stakeholders to preserve this critical habitat that contains one of the largest populations of orangutans outside of protected areas on Borneo. Here BNF has partnered with Universitas Muhammadiyah Palangka Raya, one of the fastest-growing and most ambitious universities in the region. UMP and BNF work together in the Mungku Baru KHDTK, developing a long-term field station and implementing research, capacity building and training activities. BNF is also collaborating with the community in Mungku Baru to support the development of a community anti-logging and fire-fighting unit, and to introduce community education, outreach and sustainable development initiatives.

ACKNOWLEDGEMENTS

We are grateful to University Muhammadiyah Palangkaraya for collaborating with us and supporting permits for this survey work, and the University of Exeter for their collaboration. We thank the people of Mungku Baru village for their hospitality and assistance with the logistical aspects of this survey, especially Pak Yuli. We are grateful to the staff and volunteers of the Borneo Nature Foundation, the undergraduate students from University Muhammadiyah Palangkaraya and the international students from University of Exeter who contributed to the survey effort; and to van Walt Ltd. for loaning the soil moisture apparatus used.

We thank the Indonesian State Ministry of Research and Technology (RISTEK) for their permission to conduct our research. Author contributions: Field coordination and data collection led by Siti Maimunah, Agnes Ferissa, Nityasa Namaskari, Iwan, Santiano, Admadyanto and Salahudin; Ben Buckley and Nick Boyd contributed with data collection and analysis (Research permit SIP numbers: 229/SIP/FRP/E5/Dit.KI/VIII/2017, 35/EXT/SIP/FRP/E5/Dit.KI/VIII/2018 and 238/SIP/FRP/E5/Dit.KI/VII/2016). Methodology, data analysis and GIS support provided by Bernat Ripoll, Mark E. Harrison and Susan M. Cheyne. Fish identification and methodology advice provided by Frank van Veen. Contents review and editing: Simon Husson.

We would also like to thank the governmental departments of Dinas Lingkungan Hidup, Dinas Kehutanan Provinisi and Balai Konservasi dan Sumber Daya Alam (BKSDA) for their continuing support and assistance.

1. INTRODUCTION

The Rungan landscape describes the region of Borneo, north of Palangkaraya city between the Rungan and Kahayan rivers (Figure 1). It spans three administrative districts of Central Kalimantan, Kotamadya Palangka Raya, Kabupaten Gunung Mas and Kabupaten Pulang Pisau. This extensive forest landscape was until recently a conservation afterthought, with no scientific surveys or conservation activities ever undertaken. Yet this forest, at over 150,000 ha in size, is one of the largest relatively-intact forest blocks on Borneo, possibly containing the largest orangutan population remaining in an area designated for conversion to plantation. The southern parts of these forests also comprise sizeable peat deposits storing large amounts of carbon and, to the north, the forests still contain large amounts of ulin (*Eusideroxylon zwageri*), the threatened Borneo ironwood tree.

BNF first became involved in this region in 2010, when we undertook a short biodiversity study in the Mungku Baru ulin forest (Harrison et al., 2010). We carried out this study at the bequest of the people of Mungku Baru, who sought to safeguard their community forest which holds great cultural significance for them, but is at risk from oil palm and acacia plantation companies. Mungku Baru and other villages in the region wish to protect areas of forest as Hutan Desa and Hutan Adat, because of the cultural significance of this region. A 4,910 hectare research forest (Kawasan Hutan Dengan Tujuan Khusus (Forest Area with Special Purpose: Research and Education) has since been created under the management of Universitas Muhammadiyah Palangkaraya to conduct research and training activities, and the Borneo Nature Foundation has partnered with UMP to achieve these aims. This includes running the first international scientific expeditions to the KHDTK in 2016 and 2017.

BNF's surveys are the first ever to be carried out in this vast landscape and our detailed biodiversity inventories within the KHDTK have brought to attention the rich array of wildlife found here, many of which are at risk of extinction and in need of focused conservation efforts. In order to fully realise the conservation potential of the Rungan landscape, the entire region must be mapped and described, including the distribution and abundance of Borneo's flagship species, the orangutan. It is thus imperative to collect credible scientific data on the importance of the area for biodiversity and gain community support for its conservation from the outset.

BNF is currently therefore undertaking a landscape-wide survey of the Rungan forest, to enable the status of the endangered and protected wildlife species of Rungan to be properly assessed; to determine areas of High Conservation Value and High Carbon Stock; to ensure community-engagement with these objectives and enable in-situ community-led conservation; and, to recommend measures for the sustainable development of this landscape that protects key biodiversity and prevents destruction of Kalimantan's natural heritage.

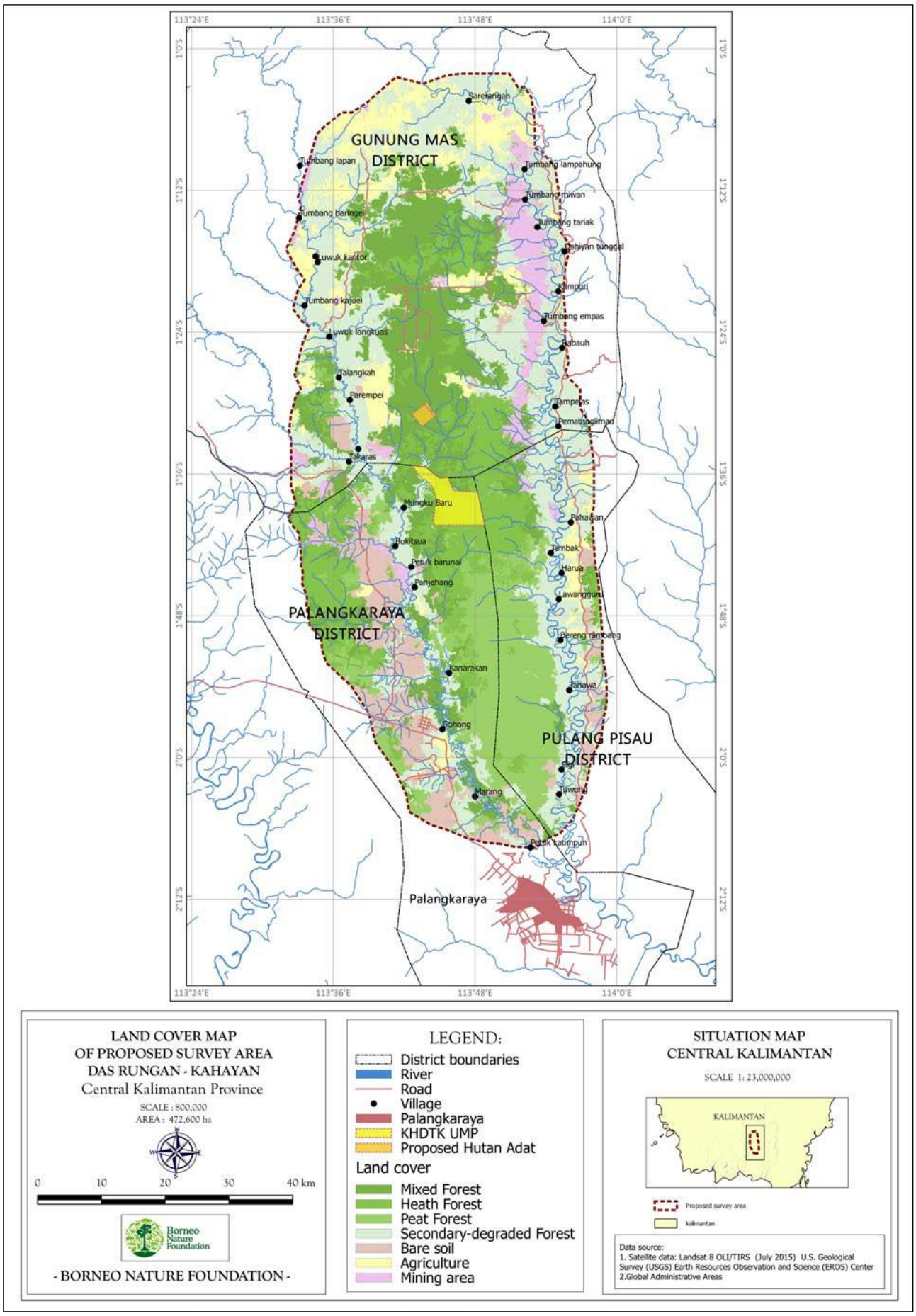


Figure 1: Map of Rungan Landscape with the KHDTK highlighted in yellow.

2. AIMS

BNF has a long-term commitment to the Rungan landscape, KHDTK and the surrounding communities. Our aims within the KHDTK are to:

1. Describe the ecology, flora and fauna of the Mungku Baru KHDTK forest to highlight the conservation value of the ecosystem;
2. Promote the site at a local, national and international level;
3. Develop education, outreach and sustainable livelihood initiatives to support conservation in the area;
4. Build our collaboration with UMP and contribute to capacity building for Indonesian students and researchers; and
5. Use this basis to support advocacy, awareness and fund-raising activities for conservation in the KHDTK and across the wider Rungan landscape.

The primary research objectives for these 2016-17 KHDTK expeditions were to:

1. Describe the habitat types present and their defining characteristics;
2. Describe the abiotic factors influencing the distribution of these habitat types (soil, hydrology, topography);
3. Ground truth and accurately map the above, building upon habitat classification analyses already conducted from satellite images of the area;
4. Compile a biological inventory, including describing the abundance and distribution of key flora and fauna species, in particular orangutans, gibbons and felids; and
5. Share these findings widely at both a local and international level.

The Mungku Baru KHDTK comprises predominantly kerangas (heath), peat-swamp and riverine forest habitat types in a lowland forest mosaic (Figure 2). Whilst the area lies at low altitude (ca. 60 m above sea level), its undulating topography creates this mosaic of habitat types, intersected by a number of small rivers/streams. In addition, there are areas of alluvial beach-like forest close to the rivers; fresh-water swamp/peat forest not far from the rivers in areas of poor drainage, containing a number of common swamp tree species, such as *Diospyros, Palaquium, Santiria, Xylopia* and *Syzygium*; very low-canopy kerangas forest with lots of small poles; and natural open areas with ferns. Fire has encroached upon some of these natural clearings and there is an area which is believed to have been impacted by a high wind event, perhaps a tornado, which is currently regenerating. The understory in some forest areas contains an abundance of small to medium-size rattan vines (*Calamus spp.*).

The KHDTK is situated approximately 5 km west of the village of Mungku Baru. It has 15 trails which cover approximately 31.5 km of forest. Along these trails we have completed 36 habitat plots (3.24 ha) spread across the various habitat types. The semi-permanent research camp is situated at the confluence of two small rivers in the south-east of the research area. The KHDTK is bounded by the PT. Taiyoung Engreen concession to the north and a logging road to the west. To the east the habitat becomes dense low-canopy peat-swamp forest and to the south patchy transitional/mixed peat-swamp forest.

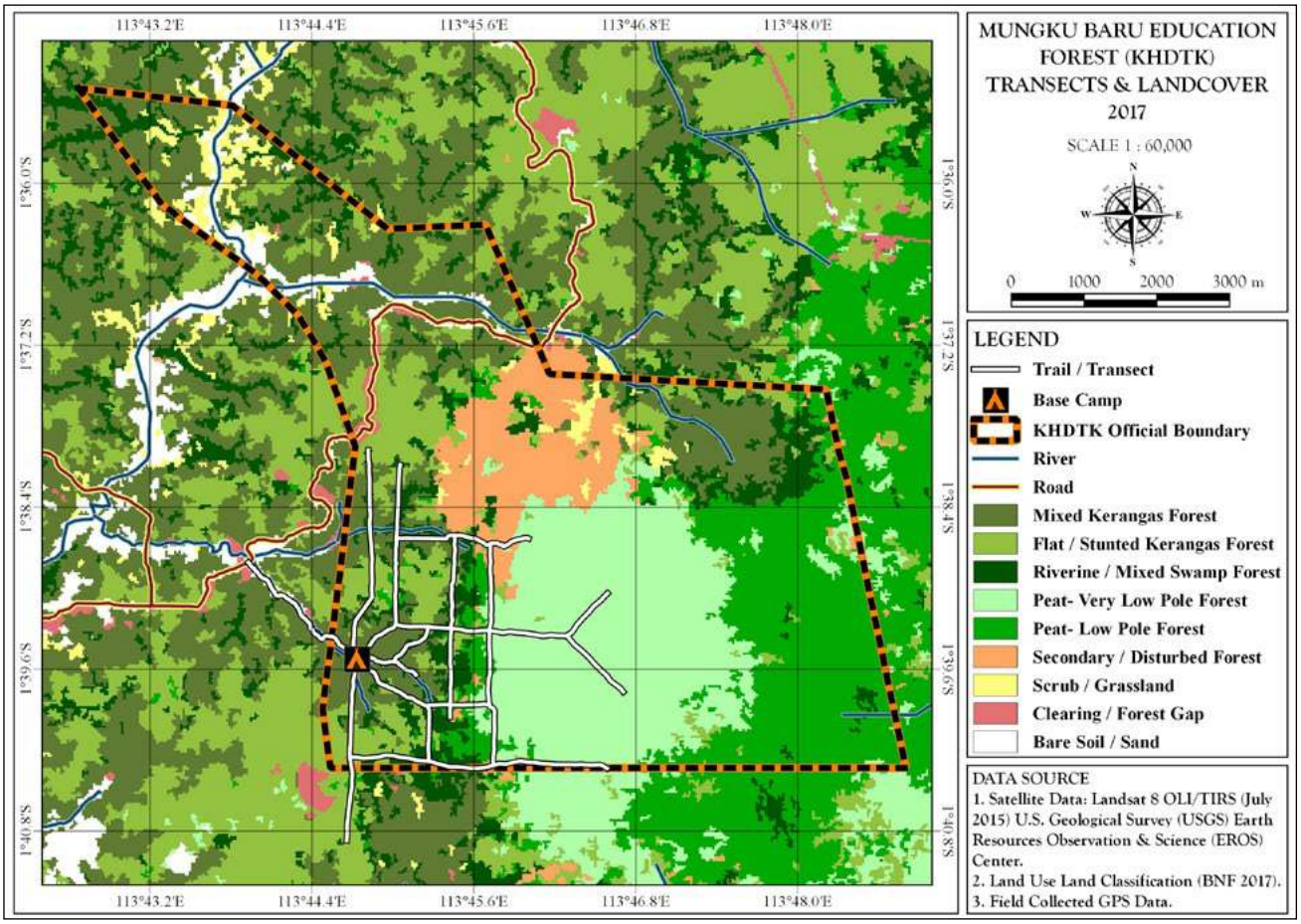


Figure 2: Map of the current KHDTK trail system and habitat types.

Data collection in the KHDTK was primarily completed during two expeditions, from 11 July-5 August 2016 and 11 July-9 August 2017. Both expeditions included an initial four days of camp set-up, health and safety briefings, and training of all expedition participants in relevant research techniques. Additional camera trap and botanical identification data collection was also conducted outside of these expeditions, with opportunistic sightings of species not previously recorded in the area also contributing towards the species lists provided herein.

4.1 Forest Structure

A total 36 vegetation plots were established across the KHDTK forest; each location was selected and determined in advance based on mapping and habitat assessments. The plots, each 0.09 ha (30 x 30 m) were located in an specific habitat type and divided into nine 10 x 10 m sub-plots, within which all trees ≥ 10 cm DBH (31 cm circumference) were measured and tagged (Figure 3). Within even-numbered sub-plots, nested plots (5 x 5 m) were established and sapling abundance (trees < 10 cm DBH and ≥ 1m in height) and various other flora characteristics (number of orchids, pitcher plants, lianas, etc.) were recorded; a 2 x 2 m plot was also established to record the seedling abundance and data on soil properties. Each plot was assigned to a forest type, based on soil features, forest structure and by habitat comparison; obtaining the following sub-habitats: (i) riverine, (ii) kerangas black soil, (iii) kerangas white soil, (iv) transitional/mixed swamp, (v) low-canopy swamp and (vi) logged-secondary kerangas forest.

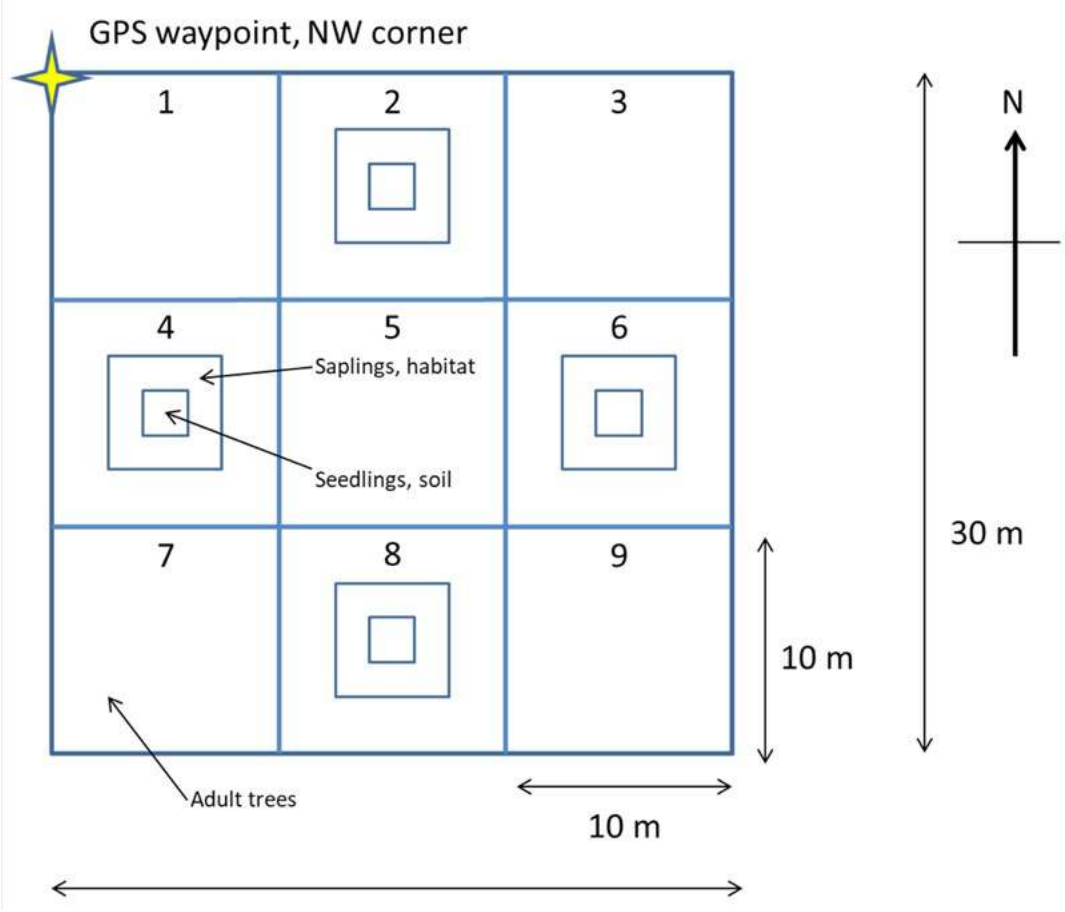


Figure 3: Plot layout.

4.2 Land Cover and Ground Truthing / Verification

Habitat types were visually identified and measured at 100-m intervals along each main forest transect and other paths that covered potential habitat type transitions of interest. If a habitat type transition was particularly abrupt, assessments were performed at shorter intervals.

All assessment locations were marked and GPS coordinates recorded. The following data were collected at each sampling location, within an estimated 5-m radius of the GPS waypoint:

i. **Habitat type,** categorised as: Mineral dryland/dipterocarp forest; Tall kerangas; Medium kerangas; Stunted kerangas; Mixed-swamp forest (MSF) peat; Low-pole forest (LPF) peat; Transitional kerangas-peat; Riparian; Transitional (other); Burned; Anthropogenic use; and Other.

ii. **Average canopy height**, estimated as: Very low, < 10 m; Low, 11-15 m; Medium, 16-20 m; Medium-tall, 21-25 m; Tall, 26-30 m; Very tall, > 31 m.

iii. **Canopy cover**, subjectively classified as: Complete; Broken-some gaps; Broken-many gaps; No identifiable dominant canopy layer; Deforested.

iv. **Soil type**, subjectively categorised as: Peat; Heath (kerangas, white sand underneath, thin layer of peat atop); "Black" heath (as above, but organic material abundant in upper sand layer); Mineral-silt; Mineral-clay; Other.

v. **Topography**, subjectively characterised as: Flat plain-elevated; Flat plain-depression; Gentle slope; Steep slope; Ridge; River bed/bank; Other.

vi. **Hydrology**, subjectively characterised as: Flooded; Near watercourse; (expected frequent inundation); Damp underfoot; Dry underfoot.

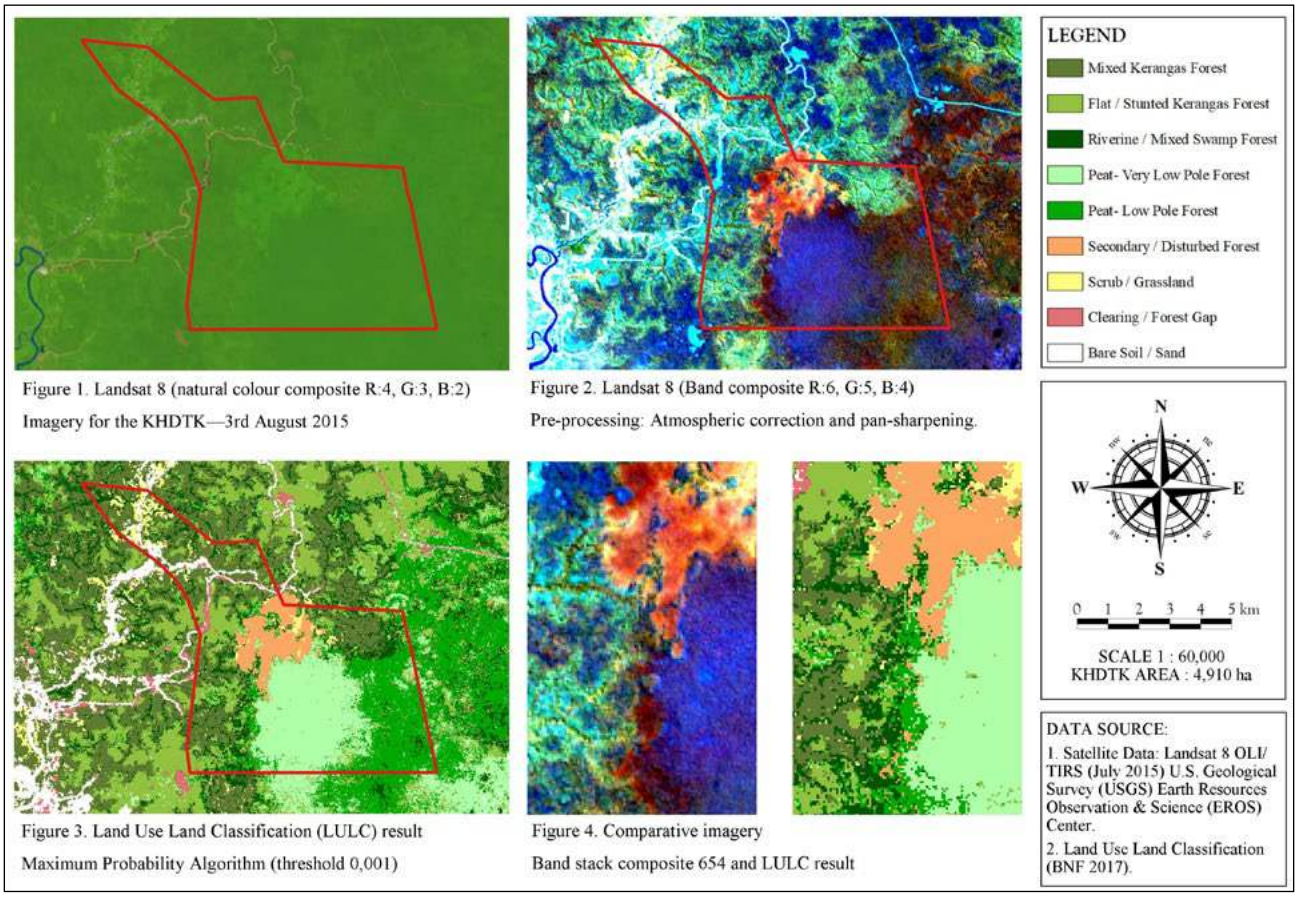


Figure 1. Landsat 8 (natural colour composite R:4, G:3, B:2) Imagery for the KHDTK—3rd August 2015

Figure 2. Landsat 8 (Band composite R:6, G:5, B:4) Pre-processing: Atmospheric correction and pan-sharpening.

Figure 3. Land Use Land Classification (LULC) result Maximum Probability Algorithm (threshold 0,001)

Figure 4. Comparative imagery Band stack composite 654 and LULC result

Figure 4: Methological summary of the GIS land classification of habitats within the KHDTK.

vii. **Undergrowth**, subjectively characterised as: Dense – tree/shrub/vine/liana dominated; Light – tree/shrub/vine/liana dominated; Dense – pandan dominated; Light – pandan dominated; Very light/ none.

Free cloud imagery from Landsat 8 OLI/TIRS (July 2016) was used to run a Land Use and Land Cover (LULC) habitat classification algorithm analysis (Figure 4). A pre-processing atmospheric correction and pan-sharpening was applied to the selected spectral bands before stacking as a 654 Band Composite. The final habitat classification was obtained by running a Maximum Probability Algorithm (threshold 0.001) and post-processing filtering was applied (threshold 6, connectivity 4). A post-processing accuracy assessment was used to validate the LULC model, allowing us to improve the precision of the habitat classifications. Ground truthing verification data was examined against the LULC extracted data to run an error matrix test.

4.3 Soil composition

The following soil properties were recorded in four sub-plots from each tree plot visited (sub-plots #2, 4, 6 and 8):

- Habitat / soil type – based on the same criteria used for ground truthing.

- Peat depth – a hole was dug in the centre of the sub-plot using an auger and peat depth was measured using a ruler/tape measure. Because our auger was only 1 m long, it was only possible to record peat depth to a maximum 1 m.

- Soil moisture – measured using a van Walt Pico HD2 soil metre with Pico 64 TDR probe, calibrated to the appropriate soil type, at the centre of the sub-plot and then 1-m from this centre location at right-angles to each other (to create a square diamond shape). Where the vertical soil column was relatively homogenous, this was only recorded in the top soil layer; but where the vertical soil column was more homogenous, both top and lower soil layers were sampled. Because of the kit's limitations, this was not possible when the top soil layer was less than ~ 10 cm deep.

- Soil pH – measured at the soil surface using a Field Scout SoilStik Pro Metre soil pH kit at the same five points in each sub-plot as described for soil moisture. For lower soil layers, the pH metre was inserted into the holes dug with the auger to a depth appropriate for that layer, where pH was measured.

- Soil temperature – measured using the soil moisture kit at the same five locations in each sub-plot.

- Slope – measured diagonally between opposite corners of each sub-plot using a clinometer and two sticks marked at 1.5 m height.

4.4 Camera Traps

From July 2016 to May 2018, a total 44 camera traps were set in fixed forest areas to primarily investigate diversity, relative abundance and activity patterns of Bornean wild cats. In total, 34 *Maginon WK2* and 10 *Bushnell Trophy Cam HD* camera traps were placed along established human-made or animal trails, located so as to maximise the success rate of photographic 'detections' (Wilting *et al.*, 2006, Gordon *&* Stewart 2007, Cheyne *&* Macdonald 2011, Cheyne *et al.*, 2013, Adul *et al.*, 2015). Two cameras were positioned in the canopy. Cameras were placed individually to maximise the effective trap area or in opposing pairs at locations where cats had been detected previously to capture imagery of both sides of the animal for identification. The passive infrared sensor was set at ca. 50 cm height. The cameras have a pre-set minimum 30 second delay between triggers and use an infrared flash. The infrared cameras have no white-light flash, which is considered better for long-term use to avoid potential trap shyness from flash photography (Rowcliffe *&* Carbone 2008, Rowcliffe *et al.*, 2008). Cameras were placed generally at cross-roads or near fallen logs, which may facilitate felid movements during the flooded swampy areas in wet season. The distance between cameras was typically ~0.5 km. No bait or lure was used, and batteries were changed every 40 days.

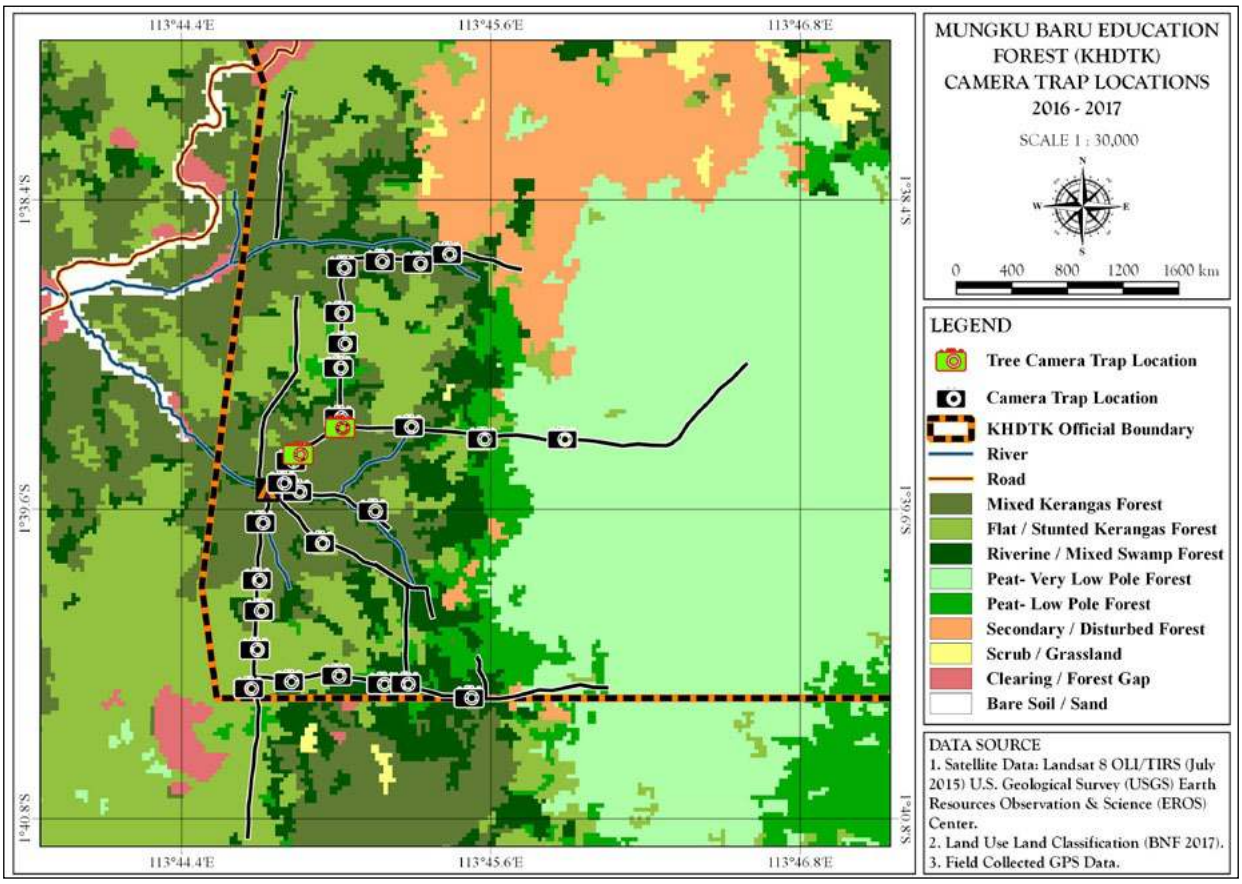


Figure 5: Camera trap locations used in the KHDTK. Camera symbol indicates ground level camera trap, green symbols indicate camera traps placed 10-12m in the canopy.

4.5 Orangutans

Standard straight-line transect methods were used to survey orangutan population density through nest counts, with a target to detect at least 50-100 nests in each major habitat type (van Schaik *et al.*, 1995). Orangutans build a new nest each night for sleeping and occasionally construct nests during the day for feeding or resting, so nests are a suitable indicator of abundance that can be compared between sites and to monitor trends over time (Husson *et al.*, 2007, 2009). Nest density is converted into orangutan density using Distance sampling methods, which include standardised nest-building parameters, nest degradation rates and correction factors (Husson *et al.*, 2009).

Orang-utan nests were surveyed along 11.5 km (2016) and 21.6 km (2017) of transects. This distance was distributed across 11 transects covering areas of lowland dipterocarp, riparian, kerangas and peat-swamp forest (see Figure 6). Because of the fine mosaic of habitats, especially to the north of the base camp, it was not possible to locate transects specifically within a single habitat type. Thus, habitat type and slope were recorded at regular intervals along transects and stratification by habitat type was conducted post hoc. The start point of each transect was at least 50 m from any river or other access route (e.g. road) and ran perpendicular from it. Transects were situated as to avoid crossing or running parallel to navigable waterways, logging trails or roads, very steep terrain, ridgelines, etc.

Line transects require a significant amount of time to conduct as it is imperative that observers do not walk too fast and care is taken to ensure that no nests are missed, consequently progress is usually only 1-2 km per day. Each transect was surveyed once by a three-man team, collecting data on nest location, habitat type, nest height, nest position and estimated nest age (5 classes from new to very old). Perpendicular distance from the transect to the nest was also measured, and the effective strip width and orangutan

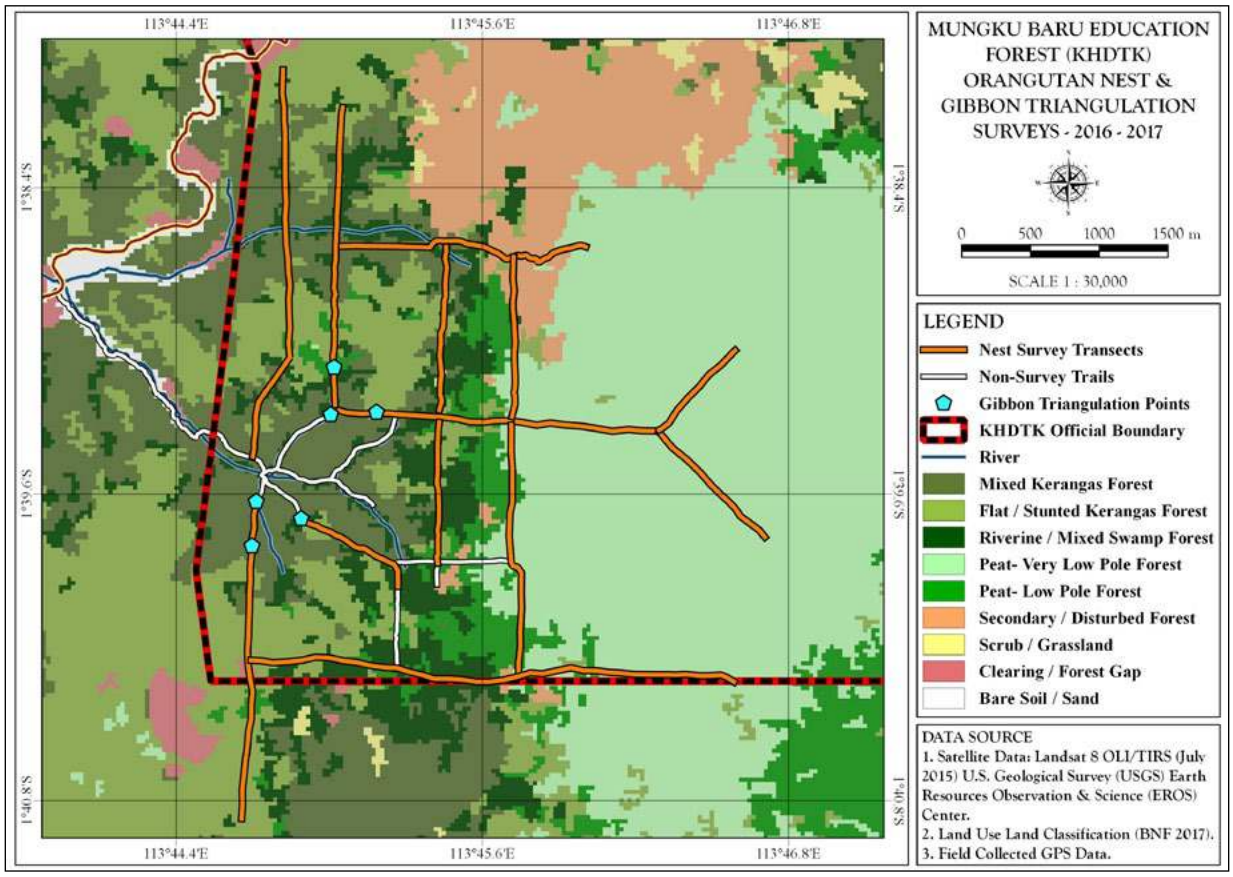


Figure 6: Orangutan nest and gibbon triangulation survey locations in KHDTK.

nest density was estimated using the computer programme DISTANCE (Thomas *et al.*, 2010). These density estimates were then extrapolated over each habitat type based on the LULC assessment to calculate estimates of orangutan abundance in the KHDTK.

4.6 Gibbons

For rapid assessment of gibbon density under time and financial constraints, the call triangulation method is frwquently used (Cheyne *et al.*, 2008, 2016, Hamard *et al.*, 2010, Höing *et al.*, 2013, Gilhooly *et al.*, 2015). On both expeditions, two sets of three triangulation listening posts were therefore set up, one in the north and one in the south of the KHDTK. Surveys were carried out by teams of at least two people, across four consecutive days when weather permitted and gibbons groups could be heard calling. Calls can be heard up to approximately 1

km away. Compass bearing and estimated distance from observers stationed at the listening posts were collected for each group heard between 04:30 and at least 30 minutes after the last calls were heard.

4.7 Biodiversity Surveys

Biodiversity surveys were conducted on each day of the main block of fieldwork during the 2016 and 2017 expeditions. These surveys involved a combination of different methods, as the objective of these surveys was to maximise the number of species sighted by (a) sampling all habitat types; (b) using a variety of survey methods, as different methods are more effective for detecting different taxa. Any casual sightings of previously unrecorded species were also noted. Surveys were focused on avian, fish, lepidopteran and mammalian fauna, with additional surveys of reptiles and amphibians.

Bird species were identified by sight and call by an ornithologist experienced with Bornean avi-fauna. The ability to identify bird species by call is particularly important in tropical forests, due to the thick vegetation and low visibility in this habitat (Dragiewicz, 2005). Avian diversity was assessed through a combination of methods, including line-transect methods and point surveys (Barlow *et al.*, 2007; Husson *et al.*, 2007; Gardner *et al.*, 2008).

Fish were surveyed using traditionally baited (tempeh and fermented shrimp paste) wire traps in rivers, canals and forest pools; interviews with local fishermen (species were only included when commonly mentioned by multiple fishermen); and ad hoc observations (cf. Thornton, 2017). These trapping methods are biased against larger fish and those not attracted to the bait types used.

Reptiles and amphibians were surveyed using visual encounter and (for amphibians) manual acoustic (calling) surveys along line transects (Doan, 2003; Dorcas *et al.*, 2009), plus ad hoc observations. This list is biased towards species most easily seen or heard by ground-based observers, and will be particularly incomplete for quieter, inconspicuous, canopy-dwelling species. Butterflies were sampled using 20 fruit-baited canopy traps for a 16 day period. Methods and identification followed previous studies by BNF researchers in Sabangau (Houlihan *et al.*, 2012; Marchant *et al.*, 2015; Purwanto *et al.*, 2015).

5.1 Forest Cover and Habitat Types

The preliminary Land Use Land Cover (LULC) model enabled the definition and classification of five habitat sub-types in the KHDTK (transitional/mixed peat, low canopy peat, stunted kerangas, mixed kerangas and secondary disturbed forest). Kerangas black- and white- soil could not be distinguished when running the LULC model.

Table 1. Land Use Land Cover (LULC) percentage of each sub-habitat type within the KHDTK boundaries and model accuracy assessment showing the percentage of the dataset positively classified as the same habitat type.

Land Cover	Area (ha)	Percentage of KHDTK	% Accuracy
Peat - Very Low Canopy Forest	1172	23.60%	85.88%
Mixed Kerangas Forest	1107	22.30%	85.88%
Peat – Low Pole Forest	926	18.70%	33.33%
Flat / Stunted Kerangas Forest	569	11.50%	37.69%
Riverine / Mixed Swamp Forest	467	9.40%	37.50%
Secondary / Disturbed Forest	414	8.40%	80.00%
Scrub / Grassland	132	2.70%	-
Bare Soil / Sand	136	2.70%	-
Clearing / Forest Gap	34	0.70%	-
Total :	4957	100.00%	Average : 60.05%

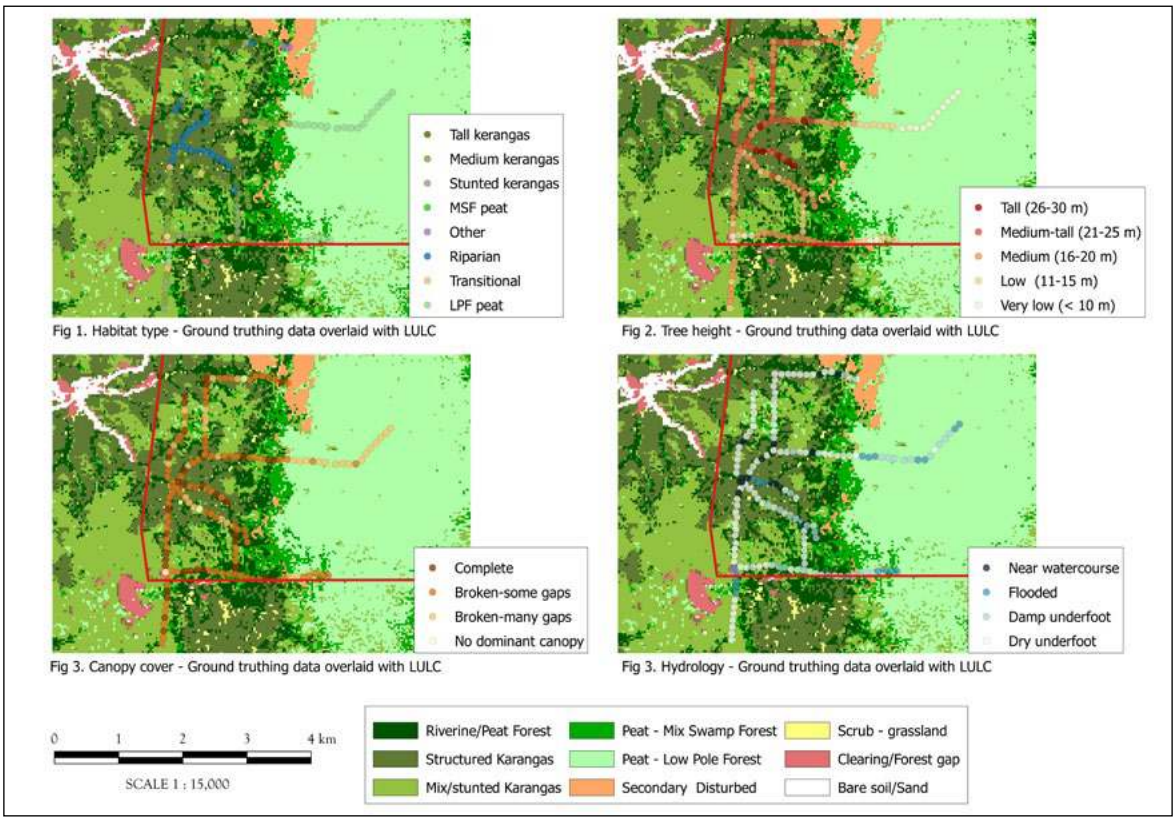


Figure 7. Ground truthing data obtained during the field surveys in the KHDTK. These data were used to run a post-processing accuracy assessment and validate the LULC model.

We obtained more than 23.2 km of ground truthing data with 282 independent ground verification datapoints. The accuracy assessment test revealed the habitat classification model has limitations when trying to identify certain habitat types, such as the thin strips of riparian and kerangas forest. Although the average percentage of accuracy is 60% (80% is typically regarded as a reliable figure), we consider this satisfactory for a preliminary classification. Further analysis and an extended dataset will help improve the habitat classification and refine the habitat type distribution across the landscape.

5.2 Tree Diversity and Forest Structure

From 2,710 trees surveyed, a total 108 tree species have been identified to genus or species level in the KHDTK. Differences in diversity, abundance and composition or trees and other flora were found across habitat (sub-)types (Tables 2 and 3). To standardise and compare between habitat (sub-)types, the number of species per 100 stems was used (equivalent to the number of tree species confirmed from in plots / total no trees sampled in those plots x 100). Many of the tree species are present through all the described habitat (sub-)types, but with variations in abundance and sizes between these, and most habitat (sub-)types are also dominated by a small number of tree species (Table 4).

Based on these data, five habitat (sub-)types can be defined from a floral perspective in the KHDTK forest: (i) kerangas black soil forest, (ii) kerangas white soil forest, (iii) low-canopy swamp forest, (iv) transitional/mixed swamp forest and (v) riverine forest. The distribution of these appears to be determined by the soil characteristics, hydrological regime and, surface topography. Overall they represent a forest continuum with variations, gradients and transitional habitats. Historical human disturbance (mainly logging and small scale mining) in the area is still apparent in some kerangas forest patches, which we have defined as a further habitat condition: (vi) secondary logged. Further field work and a better understanding of historical human activity are required to describe these disturbed areas in more detail.

Table2. Standardised forest structure and speciesmetrics across sub-habitats types in the KHDTK.

	Kerangas-Black		Kerangas-White		Low-canopy Peat-swamp		Trans/ Mixed Peat-swamp		Riverine		Secondary Logged	
	X	± SD	X	± SD	X	± SD	X	± SD	X	± SD	X	± SD
No. species / 100 stems	12.05	-	15.74	-	6.43	-	19.67	-	12.23	-	27.43	-
Total Basal Area (m^2 ha^{-1})	32.04	-	26.53	-	19.57	-	23.45	-	36.16	-	17.76	-
DBH (cm)	18.96	11.77	18.65	9.78	14.39	6.24	16.98	8.01	20.57	12.72	17.03	8.42
No. stems ≥ 10 cm DBH / ha^{-1}	820	-	762	-	1013	-	847	-	788	-	628	-

Table 3. Tree structure composition by DBH category (percentage of trees ≥ 10 DBH)

Tree DBH	Kerangas - Black	Kerangas - White	Low-canopy Peat-swamp	Trans/ mixed Peat-swamp	Riverine	Secondary Logged
10 - 20 cm	70.03%	71.43%	89.50%	76.72%	65.20%	76.99%
20 - 30 cm	17.47%	16.62%	6.58%	15.41%	19.28%	15.93%
30 -40 cm	7.53%	7.00%	2.51%	6.23%	7.99%	3.54%
40 -50 cm	3.01%	3.50%	1.25%	0.66%	3.76%	3.54%
> 50 cm	1.96%	1.46%	0.16%	0.98%	3.76%	0.00%

Table 4: Dominant tree species and percentage abundance of these in each habitat sub-type.

Kerangas - Black	Kerangas - white	Low Peat-swamp	Mixed Peat-swamp	Riverine	Secondary Logged
Syzygium sp.	*Vatica rassak*	*Euginia sp.*	*Palaquium leiocarpum*	*Eugina sp.*	*Lithocarpus sp.*
11.7%	13.1%	23.5%	8.2%	9.9%	10.6%
Vatica rassak	*Shorea teysmanniana*	*Calophyllum pulcherrimum*	*Tetractomia / Linociera tetrandra / spp.*	*Vatica rassak*	*Syzygium sp.*
7.5%	7.3%	16.5%	7.9%	4.5%	8.8%
Shorea uliginosa	*Syzygium sp.*	*Combretocarpus rotundatus*	*Syzygium sp.*	*Shorea uliginosa*	*Calophyllum inophyllum.*
6.3%	5.8%	8.5%	5.6%	4.4%	8.0%
Euginia sp.	*Shorea acuminatisima*	*Dactylocladus stenostachys*	*Shorea sp.*	*Shorea teysmanniana*	*Shorea uliginosa*
5.9%	5.8%	8.2%	5.6%	3.9%	7.1%
Palaquium leiocarpum	*Madhuca cf. pierri*	*Tristaniopsis sp.*	*Alseodaphne macrocarpa / Litsea umbelliflora*	*Syzygium sp.*	*Calophyllum sp.*
4.8%	5.2%	7.4%	5.2%	2.8%	6.2%
Calophyllum sp.	*Eugenia spicata*	*Madhuca cf. pierri*	*Calophyllum pulcherrimum*	*Palaquium chochlearium*	*Palaquium chochlearium*
4.7%	5.0%	5.8%	4.9%	2.7%	6.2%
Tristaniopsis sp.	*Shorea sp.*	*Syzygium sp.*	*Cratoxylon glaucum / arborescens*	*Mitragyna speciosa*	*Agathis borneensis*
3.9%	4.7%	5.2%	3.6%	2.5%	4.4%

5.3 Soil structure and Composition

Although sample size in most habitat/soil types was too small for formal statistical analysis, a preliminary comparison of the soil data collected suggests that soil pH is highly acidic in all habitat/soil types, with pH of the upper peat layer higher than in the lower sand layer of kerangas soil. Moreover, the riverine areas should be least stressful for vegetation growth, as they are regularly flooded and provided with nutrients, which also keeps pH slightly elevated and less acidic than other habitats; in riverine areas, the peat retains some water during drier periods, but the slopes prevent excessive waterlogging. In contrast, the high acidity of both the kerangas and non-river peat areas, plus the very dry nature of the former (particularly in areas with thinner peat) and very wet nature of the latter, would be expected to create more stressful conditions for vegetation growth. (Table 5 highlights the differences in soil properties between habitat/soil types).

Table 5: Soil properties by habitat sub-type within the KHDTK.

Habitat / Soil Type	Soil Layer	No. Sub-plots	Mean Value (± SD)				
			Peat Depth (cm)	Moisture (%)	pH	Temp (C)	Slope (deg)
Kerangas – Black	Top / Peat	3	13.3 (6.4)	21.65 (3.0)	1.8 (0.1)	27.2 (0.8)	2.7 (0.3)
	Lower / Sand	14	9.2 (4.6)	14.1 (8.9)	2.4 (0.4)	27.5 (0.5)	2.4 (0.9)
Kerangas – Black / Riverine	Top / Peat	1	24.4	26.7	3.3	27.6	9
	Lower / Sand	3	8.0 (1.4)	5.9 (3.0)	2.7 (0.1)	27.5 (0.0)	7.3 (3.3)
Kerangas – White	Lower / Sand	19	5.6 (2.5)	11.3 (8.5)	2.7 (0.5)	27.1 (1.4)	3.3 (1.3)
Peat – Riverine	Top / Peat	5	84.0 (35.8)	56.0 (27.1)	2.8 (0.1)	26.7 (0.5)	5.4 (3.4)
Peat – Low Canopy	Top / Peat	4	> 100	66.9 (11.8)	2.0 (0.1)	27.6 (1.1)	2.8 (1.3)
Peat – Transitional / mixed	Top / Peat	4	52.0 (27.5)	78.2 (5.8)	2.5 (0.2)	27.0 (0.3)	2.8 (1.7)

[a] For black kerangas, the top peat layer was not sampled in all sub-plots and values therefore indicate the number of sub-plots from which these data were obtained.

5.4 Habitat (Sub-)type Descriptions

a) Kerangas (black soil) forest

This forest sub-type is characterised by a thin surface peat layer (8.8 ± 4.7 cm), followed by a large white sand horizon. It occurs on elevated plateaus and gentle slopes, and represents one of the most extensive non-peat forest sub-types in the KHDTK. Soil moisture content is low in black kerangas soil, with a thin peat layer and porous sand layer (14.1%). It has a fairly low tree species diversity (12.1 species/100 stems) dominated by *Syzygium sp*. (Ehang Jambu) *Vatica Rassak* (Rasak), *Shorea uliginosa* (Meranti batu) and *Euginia sp*. (Jambu), representing 31.5 % of all trees. The genus *Shorea* (Dipterocarpaceae) dominates the tallest canopy trees (the few specimens above 30 m height), which includes *Shorea uliginosa* (Meranti batu), *Shorea acuminatisima* (Pelepek) and *Shorea teysmanniana* (Mahambung). The average DBH for trees in this sub-habitat is 18.96 cm and it contains high seedling and sapling densities (2.44 and 2.57/m^2 respectively). Orchid abundance (0.064/m^2) is high compared with other habitats (sub-)types.

b) Kerangas (white soil) forest

This habitat sub-type is characterised by a very thin surface peat layer (4.6 ± 2.8 cm). The porous white sand horizon dominates the soil structure, resulting in low water retention and moisture content (11.9%). It mainly occurs on slopes (high drainage) and in disturbed areas, and represents a significant proportion of the forest area in the KHDTK. A structured and tall forest, it contains a relatively average tree species diversity (15.74 species/100 stems), mainly dominated by *Vatica Rassak* (Rasak), *Shorea teysmanniana* (Mahambung), *Syzygium sp*. (Ehang Jambu) and *Shorea acuminatisima* (Pelepek) representing 32.1% of all trees. Average DBH is 18.65 cm, slightly lower than the black-soil kerangas forest and average tree height is similar at 17.96m. Orchid abundance (0.072/m^2) is the highest of all the habitat (sub-) types.

c) Low canopy peat-swamp forest

This very low (average 14.9 m tall trees) and open canopy peat forest sub-type is characterised by a thick surface peat layer (> 1 m), plus the presence of permanent high soil-water tables,large pools and a high soil moisture content of 77.1%. Tree species diversity is lowest of all the habitat (sub-) types (6.4 species/100 stems) and is heavily dominated (40% of all trees) by small *Euginia sp*. (Jambu) and *Calophyllum pulcherrimum* (Jinjit). This forest type occurs across the large flat expanse in the central and eastern areas of the KHDTK. The dense undergrowth, with obvious hummocks and hollows, is dominated by large *Pandanus sp*. Substantial amounts of *pneumatophores* (1.01/m^2) and pitcher plants (0.70/m^2) are abundant above the pools. Small trees (10 – 20 cm DBH) represent 89.5% of the total, providing this low and dense forest structure.

d) Transitional/mixed peat-swamp forest

This transitional forest type is scarcely represented in the KHDTK, occurring in the southern flat plain and the transitional areas of the kerangas to low canopy peat forest. Its soil profile combines an irregular peat horizon (140.5 ± 66.7 cm thick) with white sand underneath and a high moisture content (82.8 %). Undergrowth is sparcest of all the habitats, with the lowest seedling and sapling densities (0.97 and 1.60 / m^2 respectively), a large number of hummocks and hollows and trees with stilted roots. Tree diversity is highest of all the habitat (sub-) types except secondary logged areas (19.7 species /100 stems) and includes typical peat-forest dominant species, such as *Palaquium leiocarpum* (Hangkang), T*etractomia*/ *Linociera tetrandra*/ *spp*. (Rambangun), S*yzygium sp*. (Ehang Jambu), *Calophyllum pulcherrimum* (Jinjit), *Cratoxylon glaucum* (Garunggang) and others from the *Shorea* and *Palaquium* genus. Interestingly this habitat has the lowest abundance of orchids (0.004/m^2).

e) Riverine forest

Riverine forest occurs next to the streams and adjacent slopes, spreading from east to west through the stream network of the KHDTK forest. It features a varied peat horizon (54.2 ± 53.6 cm thick), owing to accumulation of organic litter carried by the recurrent floods, with a white sand horizon underneath. Unlike all other habitat types, riverine areas occasionally have steeper slopes between 5 and 10.5° and soil moisture is intermediate (25.9%) in the thicker peat of the sloped riverine areas. On average, trees in this (sub-) habitat type are the tallest (20.2 ± 6.5 m) with the largest DBH (20.6 ± 12.72 cm). Riverine forest is dominated by large, tall *Euginia sp*. (Jambu), *Vatica Rassak* (Rasak), *Shorea teysmanniana* (Mahambung), *Syzygium sp*. (Ehang Jambu), and *Palaquium chochlearium* (Nyatu Getah) trees. It contains a relatively average species diversity (12.2 species/100 stems), but big trees account for a large proportion of trees present (15.5% > 30 cm DBH), including specimens above 37 m tall of *Dipterocarpus oblongifolius* (Keruing), *Shorea teysmanniana* (Mahambung) and *Shorea uliginosa* (Meranti batu) species.

f) Secondary logged forest

This habitat (sub-) type is the least sampled of our habitats and as such the sample size is small and results must be regarded as provisional. This forest type consists of forest areas selectively logged in the mid-1990s. These logged areas were situated within Kerangas forest so many of the characteristics (peat depth, soil moisture, etc) reflect this. Many of the larger commercial tree species are missing or uncommon in these areas, represented by the low proportion (29%) of total tree species found in the KHDTK and high number of seedings and saplings (3.54 and 2.27 / m^2 respectively). The predominant species present in these areas are *Lithocarpus sp*. (Pampaning), *Syzygium sp*. (Ehang Jambu), *Calophyllum inophyllum* (Panaga Jangkar), *Shorea uliginosa* (Meranti batu).

Figure 8 illustrates the distribution of these habitat sub-types in the KHDTK and how the different forest structure variables compare between these.

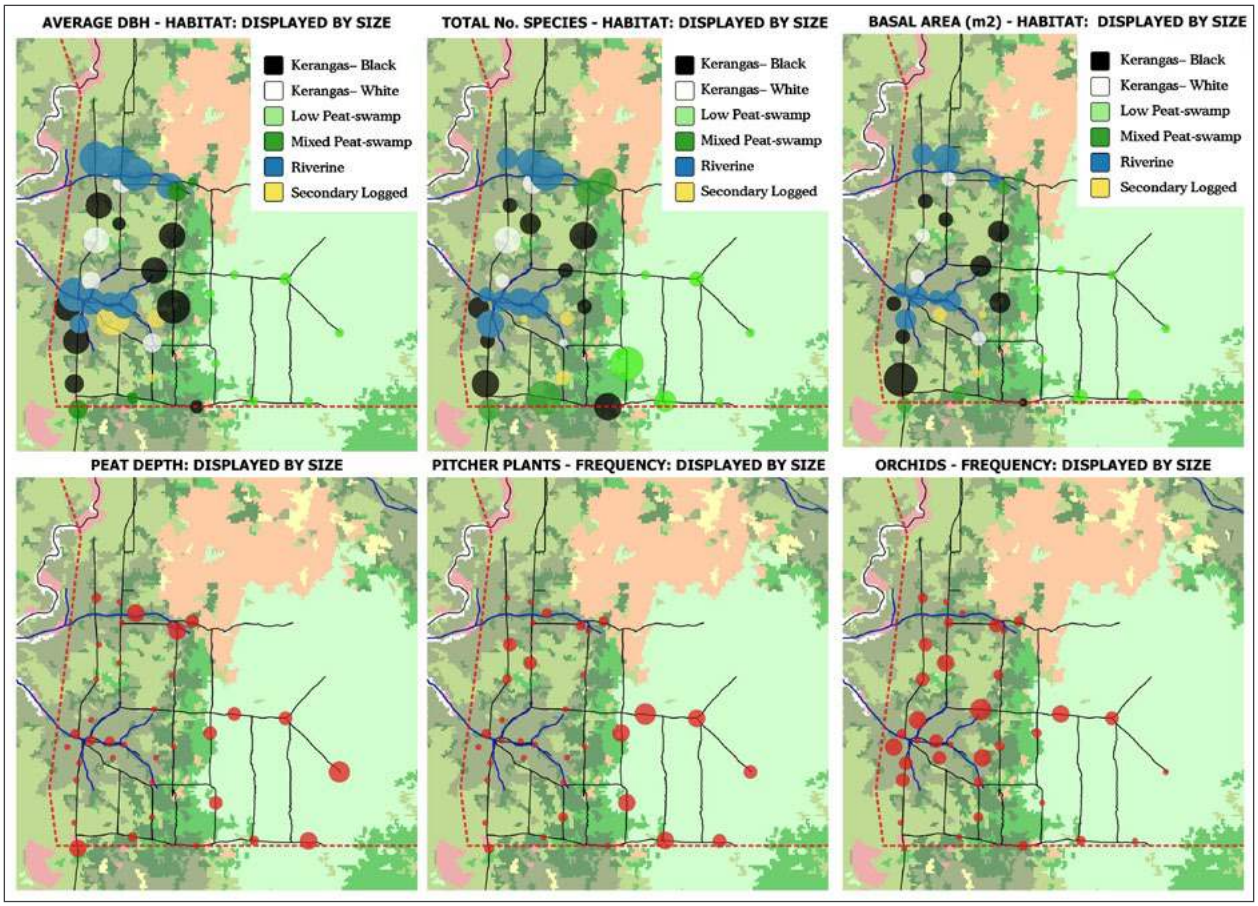


Figure 8. KHDTK forestry plot locations with associated habitat, soil and forest structure variables. Larger circle sizes indicate higher values of these variables.

See Section 7 for full species list for each fauna group.

6.1 Orangutans

Orangutans were sighted regularly by the survey team, photographed on camera traps, and the long calls of adult flanged males were heard frequently. In 2016 a total of 11.5 km of transects were surveyed for orang-utan nests, and 273 nests were spotted, yielding a nest density of 23.7 nests/km of transect. In 2017, 21.6 km of transect were surveyed and 368 nests were found, yielding a nest density of 17.0 nests/km. As shown in Table 6, orangutan densities were highest in the riverine and mixed swamp areas situated amidst and along the edges of kerangas forest; and lowest in the highly disturbed secondary forest and the low productivity, low canopy swamp forest.

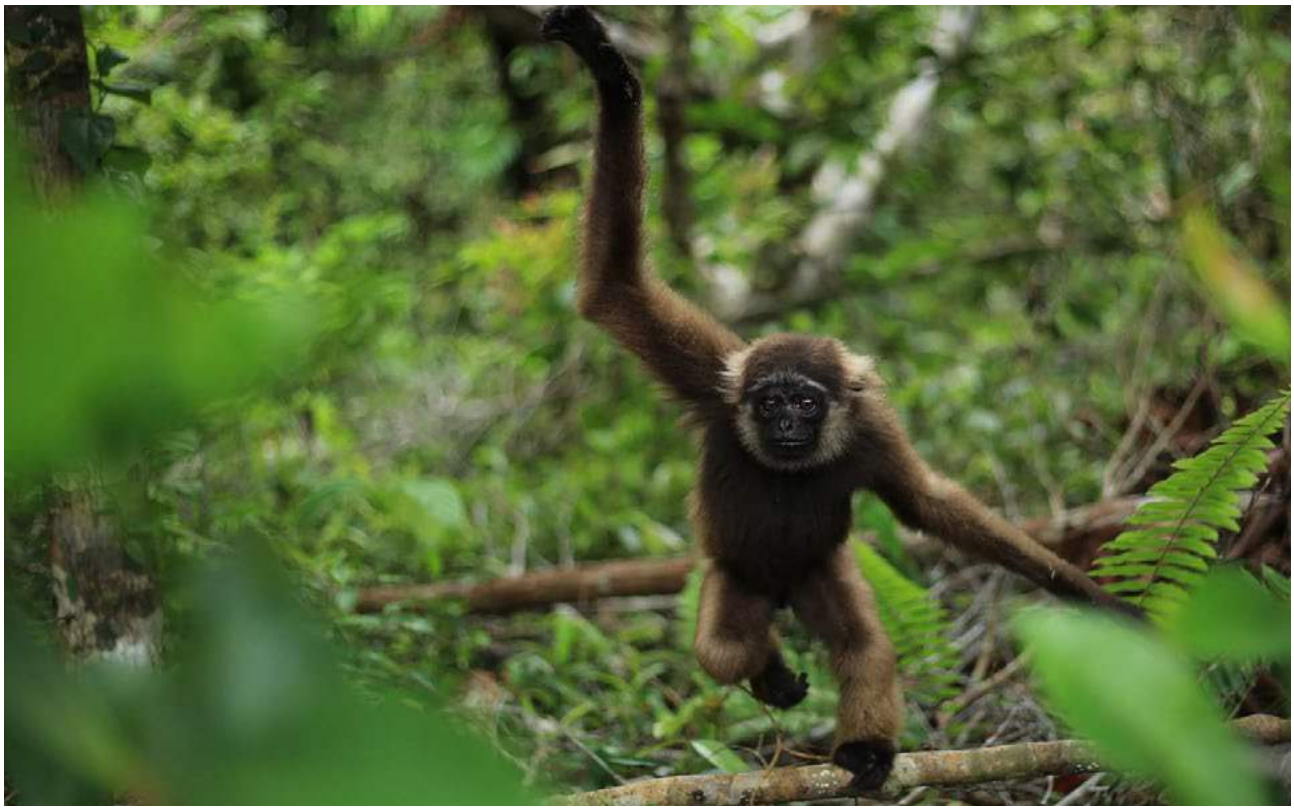
Following on from these surveys in the KHDTK, we are currently conducting further surveys across the Rungan landscape and now consider this landscape to be an extremely important stronghold for orangutans outside of protected areas, with a total population likely to be in the region of between 2,116 and 3,121 individuals distributed across several habitat types. Ongoing surveys in the southern mixed peat-swamp forest and in the concession areas of the landscape will complement the current dataset and enable us to refine estimates for orangutan population size in the region.

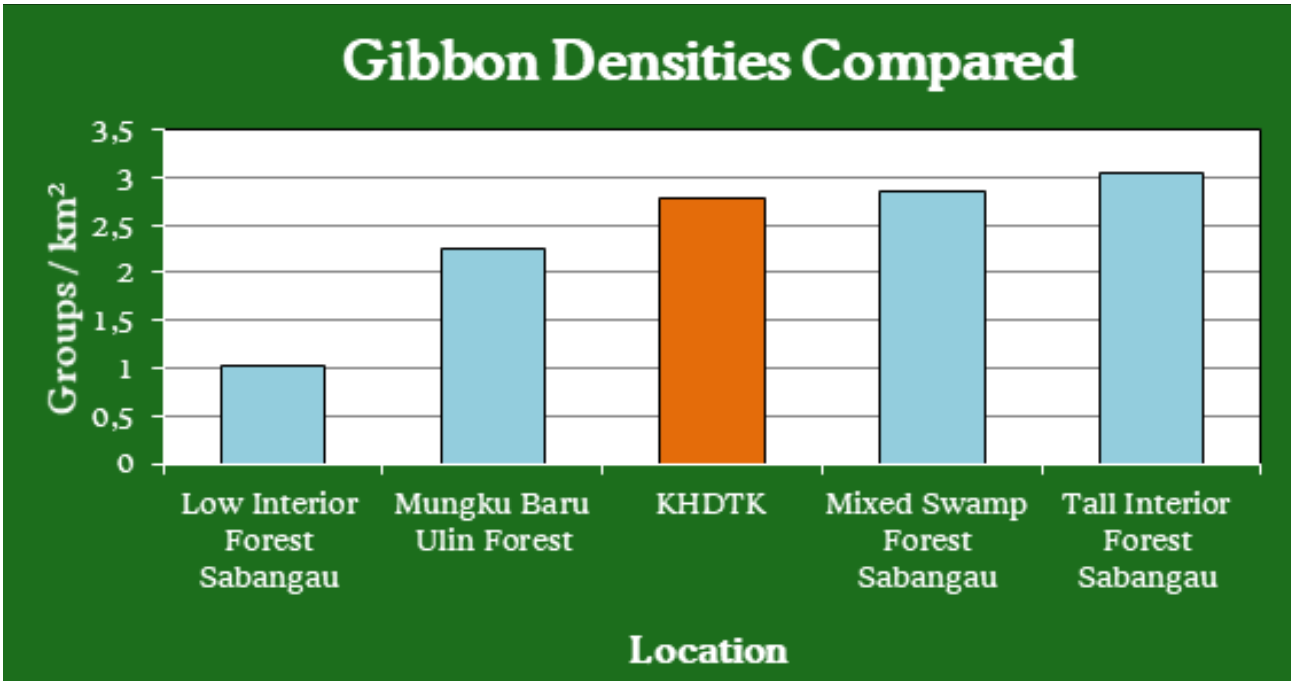
Table 6: Orangutan population densities and estimated population for each habitat in KHDTK.

Habitat	Area (ha)	Area (Km²)	Orangutan Density (Ind/ Km²)		Estimated Orangutan Population	
			Survey	Corrected	Survey	Corrected
Secondary / Disturbed Forest	414	4.14	0.41	0.6	2	2
Peat - Very Low Canopy Forest	1,172	11.72	0.52	0.77	6	9
Peat – Low Pole Forest	926	9.26	1.17	1.74	11	16
Riverine / Mixed Swamp Forest	467	4.67	1.98	2.92	9	14
Mixed Kerangas Forest	1,676	16.76	1.39	2.06	23	35
Total	4,655	46.55	-	-	51	76

6.2 Gibbons

The average density of gibbons from our surveys was 2.79 groups/km², indicating a healthy gibbon population in the KHTDK area. More accurate gibbon population estimates require further surveys in different areas of the Rungan landscape. The density of gibbons in the KHTDK is similar to that found in the mixed-swamp forest in Sabangau (2.85 groups/km², Figure 9) further supporting the hypothesis that the Rungan landscape is of significant importance for gibbon conservation.





6.3 Other Primate Species

In addition to the KHDTK's flagship ape species, the orangutan and gibbon, our surveys within the KHDTK found evidence of another four species of primate, all of which are threatened with extinction. The southern pig-tailed macaque (*Macaca nemestrina*) is listed as "Vulnerable" by the IUCN and the red langur (*Presbytis rubicunda*) is a protected species in Indonesia. All species are in decline throughout their range, primarily due to habitat loss, with hunting for food and capture for the pet and medical trades as additional threats. We also found evidence of two small elusive nocturnal primates, Horsfield's tarsier (*Tarsius bancanus borneanus*) and the Philippine slow loris (*Nycticebus menagensis*) both currently listed as "Vulnerable" by the IUCN.

Though not identified within the KHDTK, our work in the wider Rungan landscape has also identified the presence of proboscis monkey (*Nasalis larvatus*), classified as "Endangered" by the IUCN (2016), silver langur (*Trachypithecus cristatus*, "Near Threatened") and long-tailed macaque (*Macaca fascicularis*, "Least Concern"). Few areas in Borneo currently support this many primate species living side-by-side, and so the forests of the Rungan landscape are of clear importance for primate conservation in Borneo.

6.4 Cats

Incredibly in such a short survey period, all five of the species of wild cat in Borneo were found in the KHDTK; the Bornean bay cat (*Catopuma badia*) and the Sunda clouded leopard (*Neofelis diardi borneensis*) are classified by the IUCN (2016) as "Endangered", the marbled cat (*Pardofelis marmorata*) as "Vulnerable", and the leopard cat (*Prionailurus bengalensis*), due to its wide distribution across Asia, is classified as "Least Concern". The final cat species, the flat-headed cat (*Prionailurus planiceps*) has also been reported by local communities, and since the 2016 expedition we have confirmed presence of this species from a photograph on our camera traps. In light of these findings, this landscape is very special in its importance for felid conservation, as there are only few remaining regions on Borneo that still support all five cat species together.

The presence of the Borneo bay cat in the Rungan landscape is highly significant as this species is the most enigmatic and least studied member of the cat family. Found only on Borneo, this rare forest-dependent species has never before been recorded in this lowland forest mosaic habitat and this record is 64 km south-east of the known range depicted by the IUCN (Cheyne *et al*. 2017). It has been suggested that lowland forests are the preferred habitat of this species, especially in close vicinity to rivers and other water bodies. Future surveys across this landscape will help us determine how vital this region of Central Kalimantan is to the future of this species.

Bornean bay cat (Catopuma badia)

Sunda clouded leopard (Neofelis diardi borneensis)

Our camera trap surveys have also revealed another important cat species active in the KHDTK, the Sunda clouded leopard. This cat is Borneo's largest feline and apex predator, adept at climbing trees and pouncing on its prey, but due to its highly secretive nature, we are only recently beginning to understand this species' ecology and map its distribution on an island-wide scale. Field observations have shown that the clouded leopard's diet comprises an extremely diverse range of prey species, including primates, ungulates, birds, as well as several species of small mammal. This species presence in the Rungan Forest therefore indicates a diverse, healthy ecosystem.

Across Borneo, habitat conversion and degradation, as well as sporadic hunting for skin and body parts has led to a patchy distribution of cats, with vast areas formerly inhabited habitat now devoid of cats. As top predators in the forest, cats naturally occur at low density, but the high abundance of deer, other mammals and birds in the area (based on both sighting frequencies and the number of pictures of mammalian prey caught on camera traps within the study period) indicates that the Rungan forest supports healthy cat populations. Such information is an essential element in the assessment of their conservation status and in the development of conservation action plans.

6.5 Sun Bears

Our camera traps have photographed sun bears on 58 different occasions, representing a surprisingly large number of instances for a species that is known to occur at low densities and are particularly difficult to see. Reliable estimates of sun bear populations on Borneo are lacking and although widespread, the sun bear is threatened by the rapid habitat conversion and degradation of the low-altitude forest to which it is restricted (Fredriksson *et al.*, 2008). The active exploitation of wild sun bears for their gall bladders and other body parts in traditional medicines also represents a severe threat (Meijaard, 1999; Fredriksson *et al.*, 2006, 2008). As a consequence, it is classified as "Vulnerable" by the IUCN and is protected in Indonesia. Preliminary results of our camera trap surveys in the KHDTK indicate that this forest supports a substantial population of this vulnerable species.

Malayan sun bear (Helarctos malayanus)

6.6 Pangolins

The Sunda pangolin is severely threatened by intensive hunting, primarily for traditional medicine (Corlett, 2007; Duckworth *et al.*, 2008), and is now classified as "Critically Endangered" throughout its range (IUCN, 2016) and protected by Indonesian law. Through our camera trap surveys we have found a small but significant population of pangolins in the KHDTK forest, leading us to suspect that this forest is an important pangolin habitat considering the relatively intact nature of this heterogeneous forest. This species is notoriously difficult to detect and virtually no accurate information is available on pangolin population levels in any part of Asia. However, based on previous camera trap surveys across the peat-swamp forests of East and Central Kalimantan conducted by BNF in 2012, the abundance of this species is understood to be low in these habitats on Borneo, in line with our findings in KHDTK.

Sunda Pangolin (Manis javanica)

6.7 Birds

A total of 118 bird species were confirmed as present in the. Of these, one species, the helmeted hornbill (*Rhinoplax vigil*), is listed by the IUCN as "Critically Endangered", six species are listed as "Vulnerable", 32 as "Near Threatened" and the remaining 77 are "Least Concern"; 22 are protected species in Indonesia.

Because of the relatively limited temporal and spatial scope of our bird observations, it is possible that some species were not detected in our surveys, but are actually present in the area. Those species that may have been missed include: (i) migratory species that are only present at certain times of year; (ii) species that occur only in habitat types that we were unable to sample; (iii) species that are very secretive or nocturnal; and (iv) very rare species.

In addition, a further 21 species were identified within the Rungan landscape, outside of the KHDTK research area. These additional species, which should be considered as potentially present in the KHDTK, include the critically endangered white-shouldered ibis (*Pseudibis davisoni*) and the endangered storm stork (*Ciconia stormii*) as well as the three remaining species of hornbill on Borneo (*rhinoceros hornbill, Buceros rhinoceros; oriental pied hornbill, Anthracoceros albirostris ; and wrinkled hornbill, Aceros corrugatus*).

6.8 Fish, Reptiles, Amphibians and Butterflies

Creating species lists for other taxa was very difficult, due to the huge abundance of different, yet frequently similar-looking, species and their often secretive, aquatic or nocturnal habits. A total of 10 reptile, 7 amphibian, 28 fish and 15 butterfly species were recorded, but these lists are incomplete owing to our limited survey effort and habitat type coverage, meaning that the true number of species will be much higher. Of these, with the exception of the Southeast Asian box turtle ("Vulnerable"), no species are considered threatened by the IUCN and none are listed as legally protected in Indonesia.

7.1 Mammals

Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 / 2018)	Borneo Endemic?
Cercopithecidae	*Macaca fascicularis*	Long-tailed/ crab-eating macaque	Monyet ekor panjang	LC (Decline)	No	-
Cercopithecidae	*Macaca nemestrina*	Southern pig-tailed macaque	Beruk	VU (Decline)	No	-
Cercopithecidae	*Presbytis rubicunda*	Maroon / Red langur	Lutung merah	LC (Decline)	Protected	Endemic
Cervidae	*Muntiacus atherodes*	Bornean yellow muntjac	Muncak kuning Kalimantan	NT (Decline)	Protected	Endemic
Cynocephalidae	*Galeopterus borneanus*	Bornean colugo	Kubung	LC (Decline)	No	Endemic sub-species
Erinaceidae	*Echinosorex gymnura*	Moonrat	Landak berbulu	LC (Unknown)	No	-
Felidae	*Catopuma badia*	Bornean bay cat	Kuching merah	EN (Decline)	Protected	Endemic
Felidae	*Neofelis diardi borneensis*	Bornean clouded leopard	Macan dahan	EN (Decline)	Protected	Endemic sub-species
Felidae	*Pardofelis marmorata*	Marbled cat	Kucing batu	NT (Decline)	Protected	-
Felidae	*Prionailurus bengalensis*	Leopard cat	Kucing kuwuk	LC (Stable)	Protected	-
Felidae	*Prionailurus planiceps*	Flat-headed cat	Kucing Tandang	EN (Decline)	Protected	
Hominidae	*Pongo pygmaeus*	Bornean orangutan	Orang utan	CR (Decline)	Protected	Endemic
Hylobatidae	*Hylobates albibarbis*	Bornean agile / white-bearded gibbon	Owa kalawet	EN (Decline)	Protected	Endemic
Hystricidae	*Trichys fasciculata*	Long-tailed porcupine	Landak ekor panjang	LC (Stable)	No	-
Manidae	*Manis javanica*	Sunda pangolin	Trenggiling	CR (Decline)	Protected	-
Mustelidae	*Martes flavigula*	Yellow-throated marten	Musang leher-kuning	LC (Decline)	No	-
Mustelidae	*Mustela nudipes*	Malay weasel	Cerpelai tanah	LC (Decline)	No	-
Prionodintidae	*Prionodon linsang*	Banded linsang	Linsang	LC (Decline)	Protected	-

Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 / 2018)	Borneo Endemic?
Sciuridae	*Nannosciurus melanotis*	Black-eared pygmy squirrel	Bajing-kerdil telinga-hitam	LC (Decline)	No	-
Sciuridae	*Iomys horsfieldi*	Horsfield's flying squirrel	Bajing terbang/ cukbo ekor merah	LC (Stable)	Protected	-
Sciuridae	*Ratufa affinis*	Pale giant squirrel	Jelarang Bilalang	NT (Decline)	No	-
Suidae	*Sus barbatus*	Bearded pig	Babi hutan	VU (Decline)	No	-
Tarsiidae	*Tarsius / Cephalopachus bancanus borneanus*	Western / Horsfield's tarsier	Tarsius bangka	VU (Decline)	Protected	-
Tragulidae	*Tragulus kanchil*	Lesser mouse-deer	Pelanduk kancil	LC (Unknown)	Protected	-
Tragulidae	*Tragulus napu*	Greater mouse-deer	Pelanduk napu	LC (Decline)	Protected	-
Ursidae	*Helarctos malayanus*	Malayan sun-bear	Beruang madu	VU (Decline)	Protected	-
Viverridae	*Arctogalidia trivirgata*	Small-toothed / Three-striped palm civet	Musang akar	LC (Decline)	No	-
Viverridae	*Cynogale bennettii*	Otter civet	Musang air	EN (Decline)	Protected	-
Viverridae	*Hemigalus derbyanus*	Banded civet	Musang belang	NT (Decline)	No	-
Viverridae	*Herpestes brachyurus*	Short-tailed mongoose	Bambun Ekor Pendek	NT (Decline)	No	-
Viverridae	*Paradoxurus hermaphroditus*	Common palm civet	Musang luwak	LC (Decline)	No	-
Viverridae	*Viverra tangalunga*	Malay civet	Tenggalong	LC (Stable)	No	-
IUCN: CR = Critically endangered; EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC= Least Concern						

7.2 Birds

Order / Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 /2018)	Borneo endemic?
Accipitridae	*Accipiter trivirgatus*	Crested goshawk	Elang-alap jambul	LC (Decline)	Protected	-
Accipitridae	*Nisaetus nanus*	Wallace's hawk-eagle	Elang Wallace	VU (Decline)	Protected	-
Accipitridae	*Spilornis cheela*	Crested serpent eagle	Elang-ular bido	LC (Stable)	Protected	-
Aegithinidae	*Aegithina viridissima*	Green iora	Cipoh jantung	NT (Decline)	No	-
Alcedinidae	*Alcedo meninting*	Blue-eared kingfisher	Rajaudang meninting	LC (Decline)	No	-
Alcedinidae	*Ceyx rufidorsa*	Rufous-backed kingfisher / oriental dwarf kingfisher	Udang punggung-merah	LC (Decline)	No	-
Alcedinidae	*Lacedo pulchella*	Banded kingfisher	Cekakak batu	LC (Decline)	No	
Apodidae	*Aerodramus fuciphagus*	Edible-nest swiftlet	Walet sarang-putih	LC (Decline)	No	-
Apodidae	*Hemiprocne comata*	Whiskered treeswift	Tepekong rangkang	LC (Decline)	No	-
Apodidae	*Hemiprocne longipennis*	Grey-rumped treeswift	Tepekong jambul	LC (Unknown)	No	-
Apodidae	*Rhaphidura leucopygialis*	Silver-rumped swift/needletail	Kapinisjarum kecil	LC (Stable)	No	-
Bucerotidae	*Anorrhinus galeritus*	Bushy-crested hornbill	Enggang klihingan	LC (Decline)	Protected	-
Bucerotidae	*Anthracoceros malayanus*	(Asian) black hornbill	Kangkareng hitam	NT (Decline)	Protected	-
Bucerotidae	*Rhinoplax vigil*	Helmeted hornbill	Rangkong gading	CR (Decline)	Protected	-
Bucerotidae	*Rhyticeros undulatus*	Wreathed Hornbill	Julang emas	LC (Decline)	Protected	-
Campephagidae	*Coracina fimbriata*	Lesser cuckooshrike	Kepu-dangsungu kecil	LC (Decline)	No	-
Campephagidae	*Pericrocotus igneus*	Fiery minivet	Sepah tulin	NT (Decline)	No	-
Campephagidae	*Pericrocotus speciosus/ flammeus*	Scarlet minivet	Sepah hutan	LC (Stable)	No	-
Caprimulgidae	*Caprimulgus concretus*	Bonaparte's/ Sunda nightjar	Cabak kolong	VU (Decline)	Protected	-
Caprimulgidae	*Eurostopodus temminckii*	Malaysian Eared nightjar	Taktarau melayu	LC (Stable)	No	-

Order / Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 /2018)	Borneo endemic?
Chloropseidae	*Chloropsis cochinchinensis*	Blue-winged leafbird	Cicadaun sayap-biru	NT (Decline)	Protected	-
Chloropseidae	*Chloropsis cyanopogon*	Lesser green leafbird	Cicadaun kecil	NT (Decline)	Protected	-
Chloropseidae	*Chloropsis sonnerati*	Greater green leafbird	Cicadaun besar	VU (Decline)	Protected	-
Cisticolidae	*Orthotomus atrogularis*	Dark-necked Tailorbird	Cinenen belukar	LC (Stable)	No	-
Cisticolidae	*Orthotomus ruficeps*	Ashy tailorbird	Cinenen kelabu	LC (Stable)	No	-
Cisticolidae	*Orthotomus sericeus*	Rufous-tailed tailorbird	Cinenen merah	LC (Stable)	No	-
Columbidae	*Chalcophaps indica*	Emerald dove	Delimukan zamrud	LC (Decline)	No	-
Columbidae	*Ducula aenea*	Green imperial-pigeon	Pergam hijau	LC (Decline)	No	-
Columbidae	*Treron curvirostra*	Thick-billed green-pigeon	Punai lengguak	LC (Stable)	No	-
Corvidae	*Platylophus galericulatus*	Crested Jay	Tangkar ongklet	NT (Decline)	Protected	
Corvidae	*Platysmurus leucopterus*	(Bornean) black magpie	Tangkar kambing	NT (Decline)	Protected	
Cuculidae	*Cacomantis merulinus*	Plaintive cuckoo	Wiwik kelabu	LC (Stable)	No	-
Cuculidae	*Cacomantis sonneratii*	Banded bay cuckoo	Wiwik lurik	LC (Stable)	No	-
Cuculidae	*Centropus sinensis*	Greater coucal	Bubut besar	LC (Stable)	No	-
Cuculidae	*Chrysococcyx xanthorhynchus*	Violet cuckoo	Kedasi ungu	LC (Stable)	No	-
Cuculidae	*Phaenicophaeus curvirostris*	Chestnut-breasted malkoha	Kadalan birah	LC (Stable)	No	-
Cuculidae	*Rhinortha chlorophaeus*	Raffle's malkoha	Kadalan selaya	LC (Stable)	No	-
Cuculidae	*Rhopodytes sumatranus*	Chestnut-bellied malkoha	Kadalan saweh	NT (Decline)	No	-
Cuculidae	*Surniculus lugubris*	Drongo cuckoo	Kedasi hitam	LC (Decline)	No	-
Cuculidae	*Zanclostomus javanicus*	Red-billed malkoha	Kadalan kembang	LC (Stable)	No	-
Dicaeidae	*Dicaeum chryssorheum*	Yellow-vented flowerpecker	Cabai rimba	LC (Stable)	No	
Dicaeidae	*Dicaeum trigonostigma*	Orange-bellied flowerpecker	Cabai bunga-api	LC (Stable)	No	-
Dicaeidae	*Prionochilus maculatus*	Yellow-breasted flowerpecker	Pentis raja	LC (Stable)	No	-

Order / Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 /2018)	Borneo endemic?
Dicaeidae	*Prionochilus thoracicus*	Scarlet-breasted flowerpecker	Pentis kumbang	NT (Decline)	No	-
Dicruridae	*Dicrurus paradiseus*	Greater racket-tailed drongo	Srigunting batu	LC (Decline)	No	-
Estrildidae	*Lonchura fuscans*	Dusky munia	Bondol Kalimantan	LC (Stable)	No	-
Eurylaimidae	*Calyptomena viridis*	(Asian) Green broadbill	Madihijau kecil	NT (Decline)	No	-
Eurylaimidae	*Eurylaimus ochromalus*	Black-and-yellow broadbill	Sempurhujan darat	NT (Decline)	No	-
Hirundinidae	*Hirundo rustica*	Barn swallow	Layanglayang Asia	LC (Decline)	No	-
Hirundinidae	*Hirundo tahitica*	Pacific /house swallow	Layanglayang batu	LC (Unknown)	No	-
Incertae	*Hemipus hirundinaceus*	Black-winged flycatcher-shrike	Jingjing batu	LC (Decline)	No	-
Incertae	*Philentoma pyrhopterum*	Rufous-winged philentoma	Philentoma sayap-merah	LC (Decline)	No	-
Irenidae	*Irena puella*	Asian fairy-bluebird	Kecembang gadung	LC (Decline)	No	-
Meropidae	*Merops viridis*	Blue-throated bee-eater	Kirikkirik biru	LC (Stable)	No	-
Monarchidae	*Hypothymis azurea*	Black-naped monarch	Kehicap ranting	LC (Stable)	No	-
Monarchidae	*Terpsiphone paradisi*	Asian paradise flycatcher	Seriwang Asia	LC (Stable)	No	-
Muscicapidae	*Copsychus malabaricus*	White-rumped shama	Kucica hutan	LC (Decline)	No	-
Muscicapidae	*Muscicapa sibirica*	Dark-sided flycatcher	Sikatan sisi-gelap	LC (Stable)	No	-
Muscicapidae	*Rhinomyias umbratilis*	Grey-chested jungle-flycatcher	Sikatanrimba dada-kelabu	NT (Decline)	No	-
Muscicapidae	*Trichixos pyrrhopygus*	Rufous-tailed shama	Kucica ekor-kuning	NT (Decline)	No	-
Nectarinidae	*Anthreptes malacensis*	Brown / plain-throated sunbird	Burungmadu kelapa	LC (Stable)	No	-
Nectarinidae	*Anthreptes simplex*	Plain sunbird	Burung madu polos	LC (Decline)	No	-
Nectarinidae	*Arachnothera chrysogenys*	Yellow-eared spiderhunter	Pijantung telinga-kuning	LC (Decline)	No	-
Nectarinidae	*Arachnothera crassirostris*	Thick-billed spiderhunter	Pijantung kampung	LC (Decline)	No	-
Nectarinidae	*Arachnothera longirostra*	Little spiderhunter	Pijantung kecil	LC (Stable)	No	-
Nectarinidae	*Arachnothera robusta*	Long-billed spiderhunter	Pijantung besar	LC (Decline)	No	

Order / Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 /2018)	Borneo endemic?
Nectarinidae	*Chalcoparia singalensis*	Ruby-cheeked sunbird	Burung madu belukar	LC (Stable)	No	-
Nectarinidae	*Cinnyris jugularis*	Olive-backed sunbird	Burung madu sriganti	LC (Stable)	No	-
Nectarinidae	*Hypogramma hypogrammicum*	Purple-naped sunbird	Burung madu rimba	LC (Stable)	No	-
Nectarinidae	*Leptocoma brasiliana / sperata*	Van Hasselt's / purple-throated sunbird	Burung madu pengantin	LC (Stable)	No	-
Oriolodae	*Oriolus xanthonotus*	Dark-throated oriole	Kepudang hutan	NT (Decline)	No	-
Pachycephalidae	*Pachycephala cinerea*	Mangrove whistler	Kancilan bakau	LC (Stable)	No	-
Phasianidae	*Lophura erythrophthalma*	Crestless fireback	Sempidan merah	NT (Decline)	No	-
Phasianidae	*Melanoperdix nigra*	Black partridge	Puyuh hitam	VU (Decline)	No	-
Picidae	*Celeus brachyurus*	Rufous woodpecker	Pelatuk kijang	LC (Decline)	No	-
Picidae	*Dryocopus javensis*	White-bellied woodpecker	Pelatuk ayam	LC (Decline)	No	"Endemic sub-species"
Picidae	*Hemicircus concretus*	Grey and buff woodpecker	Caladi tikotok	LC (Decline)	No	
Picidae	*Mulleripicus pulverulentus*	Great slaty woodpecker	Pelatuk kelabu-besar	VU (Decline)	Protected	-
Picidae	*Picus puniceus*	Crimson-winged woodpecker	Pelatuk sayap-merah	LC (Decline)	No	
Picidae	*Reinwardtipicus validus*	Orange-backed woodpecker	Pelatuk kundang	LC (Stable)	No	-
Picidae	*Sasia abnormis*	Rufous piculet	Tukik tikus	LC (Stable)	No	-
Pittidae	*Pitta granatina*	Garnet pitta	Paok delima	NT (Decline)	Protected	-
Pityriaseidae	*Pityriasis gymnocephala*	Bornean bristlehead	Tiongbatu Kalimantan	NT (Decline)	No	Endemic
Psittacidae	*Loriculus galgulus*	Blue-crowned hanging parrot	Serindit melayu	LC (Stable)	Protected	-
Pycnonotidae	*Iole olivacea*	Buff-vented bulbul	Brinji mata-putih	NT (Decline)	No	-
Pycnonotidae	*Pycnonotus atriceps*	Black-headed bulbul	Cucak kuricang	LC (Stable)	No	-
Pycnonotidae	*Pycnonotus Aurigaster*	Sooty-headed bulbul	Cucak Kutilang	LC (Decline)	No	
Pycnonotidae	*Pycnonotus eutilotus*	Puff-backed bulbul	Cucak rumbai-tungging	NT (Decline)	No	-

Order / Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 /2018)	Borneo endemic?
Pycnonotidae	*Pycnonotus melanoleucos*	Black-and-white bulbul	Cucak sakit-tubuh	NT (Decline)	No	-
Pycnonotidae	*Pycnonotus simplex*	Cream-vented bulbul	Merbah corok-corok	LC (Decline)	No	-
Pycnonotidae	*Setornis criniger*	Hook-billed bulbul	Empuloh paruh-kait	VU (Decline)	Protected	-
Pycnonotidae	*Tricholestes criniger*	Hairy-backed bulbul	Brinji rambut-tunggir	LC (Decline)	No	-
Ramphastidae	*Caloramphus fuliginosus*	Brown barbet	Takur ampis	LC (Decline)	No	Endemic
Ramphastidae	*Megalaima australis*	Blue-eared barbet	Takur tenggeret	LC (Decline)	No	-
Ramphastidae	*Megalaima mystacophanos*	Red-throated barbet	Takur warna-warni	NT (Decline)	No	-
Ramphastidae	*Megalaima rafflesii*	Red-crowned barbet	Takur tutut	NT (Decline)	No	-
Rhipiduridae	*Rhipidura javanica*	Pied fantail	Kipasan belang	LC (Stable)	Protected	-
Sittidae	*Sitta frontalis*	Velvet-fronted nuthatch	Munguk beledu	LC (Decline)	No	-
Strigidae	*Strix leptogrammica*	Brown wood-owl	Kukuk beluk	LC (Decline)	No	-
Sturnidae	*Gracula religiosa*	(Common) hill-mynah	Tiong emas	LC (Decline)	Protected	-
Timaliidae	*Alcippe brunneicauda*	Brown Fulvetta	Wergan coklat	NT (Decline)	No	
Timaliidae	*Macronous bornensis*	Bold-striped tit-babbler	Ciungair coreng	LC (Stable)	No	-
Timaliidae	*Macronous ptilosus*	Fluffy-backed tit-babbler	Ciungair pongpong	NT (Decline)	No	-
Timaliidae	*Malacocincla malaccensis*	Short-tailed babbler	Pelanduk ekor-pendek	NT (Decline)	No	-
Timaliidae	*Malacocincla sepiaria*	Horsfield's babbler	Pelanduk semak	LC (Decline)	No	-
Timaliidae	*Malacopteron cinereum*	Scaly-crowned babbler	Asi topi-sisik	LC (Stable)	No	-
Timaliidae	*Malacopteron magnum*	Rufous-crowned babbler	Asi besar	NT (Decline)	No	-
Timaliidae	*Ophrydornis albogularis*	Grey-breasted babbler	Asi dada-kelabu	NT (Decline)	No	-
Timaliidae	*Pellorneum capistratum*	Black-capped babbler	Pelanduk topi-hitam	LC (Decline)	No	-
Timaliidae	*Pomatorhinus montanus*	Chestnut-backed scimitar babbler	Cicakopi melayu	LC (Stable)	No	-
Timaliidae	*Stachyris erythroptera*	Chestnut-winged babbler	Tepus merbah-sampah	LC (Decline)	No	-

Order / Family	Latin Name	English Name	Indonesian Name	IUCN Status & Population Trend (2016)	Protected in Indonesia (PP No. 20 /2018)	Borneo endemic?
Timaliidae	*Stachyris maculata*	Chestnut-rumped babbler	Tepus tunggir-merah	NT (Decline)	No	-
Timaliidae	*Stachyris nigricollis*	Black-throated babbler	Tepus kaban	LC (Decline)	No	-
Timaliidae	*Stachyris rufifrons*	Rufous-fronted babbler	Tepus dahi-merah	LC (Stable)	No	-
Timaliidae	*Trichastoma rostratum*	White-chested babbler	Pelanduk dada-putih	NT (Decline)	No	-
Trogonidae	*Harpactes diardii*	Diard's trogon	Luntur Diard	NT (Decline)	Protected	-
Trogonidae	*Harpactes duvaucelii*	Scarlet-rumped trogon	Luntur putri	NT (Decline)	Protected	-
Trogonidae	*Harpactes kasumba*	Red-naped trogon	Luntur kasumba	NT (Decline)	Protected	-
IUCN: CR = Critically endangered; EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC= Least Concern						

7.3 Herpetofauna

Order	Family	Latin Name	English Name	IUCN listing	Borneo Endemic ?
Squamata	Colubridae	*Dendrelaphis caudolineatus*	Striped bronzeback	NL	-
Squamata	Elapidae	*Naja sumatrana*	Sumatran cobra	LC	-
Squamata	Natricidae	*Macropisthodon flaviceps*	Orange-lipped keelback	LC	-
Squamata	Viperidae	*Tropidolaemus subannulatus*	Bornean keeled green pit viper	LC	-
Squamata	Varanidae	*Varanus rudicollis*	Black rough-necked monitor	NL	-
Squamata	Varanidae	*Varanus salvator*	Common water monitor lizard	LC	-
Squamata	Agamidae	*Bronchocela cristatella*	Green crested lizard	LC	-
Squamata	Agamidae	*Gonocephalus bornensis*	Bornean angle-headed lizard	NL	Yes
Testudines	Geoemydidae	*Cuora amboinensis*	Southeast Asian box turtle	VU	-
Testudines	Geoemydidae	*Cyclemys dentata*	Asian leaf turtle	NT	-
Anura	Dicroglossidae	*Limnonectes paramacrodon*	Lesser swamp frog / Tawau wart frog	NT	-
Anura	Microhylidae	*Kalophrynus sp.*	Sticky frog	DD	-
Anura	Ranidae	*Hylarana baramica*	Brown marsh frog	LC	-
Anura	Ranidae	*Hylarana raniceps*	Copper-cheeked frog / White-lipped frog	LC	-
Anura	Rhacophoridae	*Polypedates colletti*	Collett's tree frog	LC	-
Anura	Rhacophoridae	*Nyctixalus pictus*	Cinnamon frog	NT	-
Anura	Bufonidae	*Pseudobufo subasper*	Aquatic swamp toad	LC	-
No species listed are protected in Indonesia					

7.4 Fish

Family	Latin Name	English Name	Borneo Endemic ?
Anguilidae	*Anguila borneensis*	Borneo longfinned eel	Borneo endemic
Bagridae	*Hemibagrus capitulum*	Catfish sp.	-
Channidae	*Channa bankanensis*	Bangka snakehead	-
Clariidae	*Clarias leiacanthus*	Forest-walking catfish	-
Cyprinidae	*Desmopuntius rhomboocellatus*	Rhombo / snakeskin barb	Endemic to Central and West Kalimantan
Cyprinidae	*Desmopuntius trifasciatus*	No common name	Borneo endemic
Cyprinidae	*Desmopuntius johorensis*	Striped barb	-
Cyprinidae	*Osteochilus bleekeri*	No common name	-
Cyprinidae	*Osteochilus pentalineatus*	Barb sp.	Endemic to southern Borneo
Cyprinidae	*Osteochilus spilurus*	Barb sp.	-
Cyprinidae	*Rasbora cephalotaenia*	Ray fin sp. / Raspora sp.	-
Cyprinidae	*Rasbora kalochroma*	Clown raspora	-
Cyprinidae	*Rasbora patrickyapi*	Neon green rasbora	Borneo endemic
Cyprinidae	*Rasbora sp. cf sumatrana*	Ray fin sp. / Raspora sp.	-
Cyprinidae	*Paedocypris sp.*	No common name	-
Cyprinidae	*Sundadanio retiarius*	Danio sp.	Endemic to southern Borneo
Cyprinidae	*Trigonopoma gracile*	No common name	-
Gastromyzontidae	*Protomyzon sp.*	Loach sp.	-
Hemiramphidae	*Hemiramphodon chrysopunctatus*	Viviparous Halfbeak sp. / Light-Point Half-Squid	Endemic to southern Borneo
Mastacembelidae	*Mastacembelus sp.*	Spiney eel sp.	-
Nemacheilidae	*Nemacheilus sp.*	Stone loach sp.	-
Osphronemidae	*Betta anabatoides*	Giant betta	Borneo endemic
Osphronemidae	*Betta sp. cf foerschi*	Gourami sp.	-
Osphronemidae	*Luciocephalus pulcher*	Giant pikehead	-
Osphronemidae	*Sphaerichthys selatanensis*	Crossband chocolate gourami	Endemic to southern Borneo
Siluridae	*Silurichthys ligneolus*	Brown leaf catfish	Borneo endemic
Siluridae	*Silurichthys phaiosoma*	Sheathfish sp.	-
Siluridae	*Kryptopterus sp.*	No common name	-
No species listed by IUCN or protected in Indonesia			

7.5 Butterflies

Family	Sub Family	Latin Name	English Name
Nymphalidae	Charaxinae	*Prothoe franck*	Blue begum
Nymphalidae	Charaxinae	*Agatasa calydonia*	Glorious begum
Nymphalidae	Charaxinae	*Charaxes bernardus*	Tawny rajah
Nymphalidae	Charaxinae	*Charaxes borneensis borneensis*	No common name
Nymphalidae	Limenitidinae	*Dophla evelina*	Red-spot duke
Nymphalidae	Limenitidinae	*Lexias pardalis*	Common archduke
Nymphalidae	Limenitidinae	*Tanaecia clathrata*	Violet-bordered Viscount
Nymphalidae	Limenitidinae	*Tanaecia munda*	No common name
Nymphalidae	Limenitidinae	*Tanaecia sp.*	No common name
Nymphalidae	Morphinae	*Zeuxidia aurelius*	Giant Saturn
Nymphalidae	Morphinae	*Zeuxidia doubledayi horsfieldi*	No common name
Nymphalidae	Morphinae	*Zeuxidia sp.*	No common name
Nymphalidae	Satyrinae	*Melanitis leda*	Common evening brown
Nymphalidae	Satyrinae	*Mycalesis patiana*	Eliot's Bush Brown
Nymphalidae	Satyrinae	*Mycalesis pitana*	Bushbrown sp.
No species listed by IUCN or protected in Indonesia			

7.6 Tree Flora

Family	Genus	Species *	Local Name MB
Anacardiaceae	*Bouea*	*macrophylla*	Barania Hutan
Anacardiaceae	*Campnosperma*	*auriculatum / squamatum*	Hantangan
Anacardiaceae	*Campnosperma*	*coriaceum*	Tarantang
Anacardiaceae	*mangifera*	*sp.*	Ramunia Hutan
Anacardiaceae	*Melanorrhoea*	*wallichii*	Rangas Burung/ Manuk
Anisophyllaceae / Combretocarpaceae	*Combretocarpus*	*rotundatus*	Tumih
Annonaceae	*Mezzetia*	*leptopoda*	Karipak
Annonaceae	*Mezzetia*	*parvifolia*	Mahuwi
Annonaceae	*Mezzetia*	*umbellata*	Kambalitan
Annonaceae	*Xylopia*	*cf. malayana*	Nonang
Annonaceae	*Xylopia*	*fusca*	Rahanjang
Apocynaceae	*Dyera*	*costulata*	Jelutung Darat
Apocynaceae	*Dyera*	*lowii / polyphylla*	Pantong
Aquifoliaceae	*Ilex*	*cymosa*	Kembosira Darat
Araucariaceae	*Agathis*	*borneensis*	Pilau
Bignoniaceae	*Radermachera*	*lobbii*	Kuju Langit
Burseraceae	*Santiria*	*cf. laevigata*	Irat
Burseraceae	*Santiria*	*cf.griffithi*	Kasiak
Casuarinaceae	*Casuarina*	*junghuniana*	Kayu Balau
Clusiaceae (Guttiferae)	*Calophyllum*	*cf. fragrans*	Panaga Kalakai
Clusiaceae (Guttiferae)	*Calophyllum*	*cf. soulattri*	Panaga Danum
Clusiaceae (Guttiferae)	*Calophyllum*	*inophyllum*	Panaga Jangkar
Clusiaceae (Guttiferae)	*Calophyllum*	*pulcherrimum*	Jinjit
Clusiaceae (Guttiferae)	*Calophyllum*	*soulattri*	Takal
Clusiaceae (Guttiferae)	*Calophyllum*	*sp.*	Lutan
Clusiaceae (Guttiferae)	*Calophyllum*	*wallichiianum*	Kapurnaga
Clusiaceae (Guttiferae)	*Garcinia*	*Bancana*	Manggis
Clusiaceae (Guttiferae)	*Garcinia*	*cf. beccarii*	Gantalang
Clusiaceae (Guttiferae)	*Garcinia*	*parvifolia*	Enyak Beruk
Crypteroniaceae / Melastomaceae	*Dactylocladus*	*cf. stenostachys*	Martibu
Crypteroniaceae / Melastomaceae	*Dactylocladus*	*stenostachys*	Madang Marabungkan
Dipterocarpaceae	*Dipterocarpus*	*oblongifolius*	Karuing Daun Besar
Dipterocarpaceae	*Dipterocarpus*	*verrucosus / crinitus*	Karuing Daun Kecil
Dipterocarpaceae	*Shorea*	*acuminatisima*	Plepek
Dipterocarpaceae	*Shorea*	*balangeran*	Blangiran
Dipterocarpaceae	*Shorea*	*Laevis*	Bangkirai
Dipterocarpaceae	*Shorea*	*parvifolia*	Lentang Bitik
Dipterocarpaceae	*Shorea*	*teysmanniana*	Mahambung
Dipterocarpaceae	*Shorea*	*uliginosa*	Lentang Batu

Family	Genus	Species *	Local Name MB
Dipterocarpaceae	*Vatica*	*rassak*	Rasak
Ebenaceae	*Diospyros*	*cf. evena*	Ehang Handuk
Ebenaceae	*Diospyros*	*confertiflora*	Kayu Tulang
Ebenaceae	*Diospyros*	*korthalsiana hiern*	kayu Arang
Ebenaceae	*Diospyros*	*lanceifolia*	Arang
Ebenaceae	*Diospyros*	*pseudomalabaricum*	Tutup Kabali
Ebenaceae	*Diospyros*	*siamang*	Ehang
Elaeocarpaceae	*Elaeocarpus*	*mastersii*	Mangkinang
Euphorbiaceae	*Baccaurea*	*bracteata*	Hampuak
Euphorbiaceae	*Blumeodendron*	*tokbrai*	Kenari
Euphorbiaceae	*Endospermum*	*malaccense*	Karipak Kulit Putri
Euphorbiaceae	*Neoscortechinia*	*kingii*	Pupu Pelanduk
Fabaceae (Leguminosae)	*Pithecellobium*	*angulatum*	Tapanggang
Fabaceae (Leguminosae)	*Pithecellobium*	*splendens*	Takurak
Fabaceae (Leguminosae)	*Pithecelobium*	*jiringa*	Jengkol Hutan
Fabaceae (Leguminosae)	*Sindora*	*wallichii*	Sasundur
Fagaceae	*Quercus*	*lucida*	Bahunying
Fagaceae	*Quercus*	*subsericea*	Pampaning
Gentianaceae / Loganiceae	*Fagraea*	*crenulata*	Kayu Amas
Hypericaceae	*Cratoxylon*	*glaucum /arborescens*	Garunggang
Icacinaceae / Stemonuraceae	*Cantleya*	*corniculata*	Kakal
Icacinaceae / Stemonuraceae	*Stemonurus*	*scorpioides*	Keput Bajuku
Lauraceae	*Alseodaphne*	*macrocarpa*	Madang
Lauraceae	*Cinnamomum*	*javanicum*	Sintuk
Lauraceae	*Eusideroxylon*	*cf. zwageri*	Tabalien Munyin
Lauraceae	*Eusideroxylon*	*zwageri*	Tabalien (ulin)
Lauraceae	*Litsea*	*cf. resinosa*	Madang Marakuwung
Lauraceae	*Litsea*	*cf. rufo-fusca*	Kamehas Daun Kecil
Lauraceae	*Litsea*	*umbelliflora*	Madang 2
Leguminoseae	*Koompassia*	*malaccensis*	Bangaris
Melastomataceae	*Memecylon*	*cf. sumatranse*	Tabati Himba
Melastomataceae	*Memecylon*	*sumatranse*	Kamehas
Melastomataceae	*Memecylon*	*sp.*	Kitat Pusa
Melastomataceae / Myrtaceae	*Pternandra / Syzigium*	*cf. coerulescens / galeata*	Kemuning
Meliaceae	*Chisocheton*	*sp.1*	Mariuh
Meliaceae	*Tricilia*	*hyrta*	Kayu Sapat

Family	Genus	Species *	Local Name MB
Moraceae	*Parartocarpus*	*venenosus*	Tapakan
Myristicaceae	*Gymnacranthera* / *Horsfeldia* / *knema*	*farquhariana* / *crassfolia* / *latericea*	Kumpang
Myristicaceae	*Myristica*	*lowiana*	Maruang / Panguan
Myrsinaceae	*Ardisia* / *Rodamnia*	*cinerva*	Kambasulam
Myrtaceae	*Eugenia*	*sp.*	Jambu
Myrtaceae	*Eugenia*	*spicata*	Galam Tikus
Myrtaceae	*Syzigium*	*sp.*	Ehang Jambu
Myrtaceae	*Tristaniopsis*	*maingayi*	Belawan
Myrtaceae	*Tristaniopsis*	*obovata*	Belawan Merah daun Kecil
Myrtaceae	*Tristaniopsis*	*stellata*	Belawan Punai
Myrtaceae	*Tristaniopsis*	*whiteana*	Belawan Putih
Pentaphylacaceae	*Ternstroemia*	*hosei*	Tabunter Daun Kecil
Pentaphylacaceae	*Ternstroemia*	*magnifica*	Tabunter
Pittosporaceae	*Pittosporum*	*sp.*	Parupuk Gelagah
Podacarpaceae / Araucariaceae	*Dacrydium*	*beccarii*	Alau
Podocarpaceae	*Podocarpus*	*motleyi*	Keputri
Polygalaceae	*Xanthophyllum*	*excelsum*	Tabaras Akar Tinggi
Rosaceae	*Parastemon*	*urophyllus*	Bintan
Rutaceae / Oleocarpaceae / Oleaceae	*Treatactomia* / *Linociera*	*tetranda* / *spp.*	Rambangun
Sapindaceae	*Nephellium*	*eriopetalum*	Rambutan Hutan
Sapindaceae	*Nephellium*	*maingayi*	Kalumun Buhis
Sapindaceae	*Xerospermum*	*laevigatum* / *noronhianum*	Kalumun
Sapotaceae	*Madhuca*	*cf. pierri*	Nyatu Undus
Sapotaceae	*Madhuca*	*crassipes*	Mahalilis
Sapotaceae	*Madhuca*	*mottleyana*	katiau
Sapotaceae	*Palaquium*	*cochlearifolium*	Nyatu Gagas
Sapotaceae	*Palaquium*	*cochlearium*	Nyatu Getah
Sapotaceae	*Palaquium*	*leiocarpum*	Hangkang
Sapotaceae	*Palaquium*	*rostratum*	Kajalaki
Sterculiaceae	*Sterculia*	*pierrei*	Pendu
Theaceae	*Tetramerista*	*glabra*	Kayu Asem
Thymelaeaceae	*Gonystylus*	*bancanus*	Ramin Merang
Thymelaeaceae	*Gonystylus*	*macrophyllus*	Ramin Bukit
* = legally protected in Indonesia			

8. REFERENCES

Adul, Ripoll Capilla, B., Limin, S. H., & Cheyne, S. M. (2015). Felids of Sebangau: Camera trapping to estimate activity patterns and population abundance in Central Kalimantan, Indonesia. Biodiversitas, 16(2), 151–155.

Cheyne, S. M., Adul, F. J. F. van Veen, B. Ripoll Capilla, N. Boyd, Armadiyanto and S. Maimunah (2017). First record of the bay cat in mosaic heath/peat-swamp forest, Kalimantan, Indonesia. Cat News, 65, 3.

Cheyne, S. M., Gilhooly, L. J., Hamard, M. C., Höing, A., Houlihan, P. J., Kursani, Zrust, M. (2016). Population mapping of gibbons in Kalimantan, Indonesia: Correlates of Gibbon Density and Vegetation across the species range. Endangered Species Research, 30, 133–143.

Cheyne, S. M., & Macdonald, D. W. (2011). Wild felid diversity and activity patterns in Sabangau peat-swamp forest, Indonesian Borneo. Oryx, 45(1), 119–124.

Cheyne, S. M., Stark, D., Limin, S. H., & Macdonald, D. W. (2013). First Estimates of Population Ecology and Threats to Sunda Clouded Leopards (Neofelis diardi) in a Peat-swamp Forest, Indonesia. Endangered Species Research, 22, 1–9.

Cheyne, S. M., Thompson, C. J. H., Phillips, A. C., Hill, R. M. C., & Limin, S. H. (2008). Density and Population Estimate of Gibbons (Hylobates albibarbis) in the Sabangau Catchment, Central Kalimantan, Indonesia. Primates, 49(1), 50–56.

Doan, T. M. (2003). Which methods are most effective for surveying rain forest herpetofauna? Journal of Herpetology, 37(1), 72-81.

Dorcas, M. E., Price, S. J., Walls, S. C. & Barichivich, W. J. (2009). Auditory monitoring of anuran populations. In: C. K. Dodd (Eds). Amphibian Ecology and Conservation: A Handbook of Techniques Oxford University Press, Oxford, 281-298.

Dragiewicz, M. (2005). Avian Indicators of Forest Disturbance and Recovery in the Sebangau National Park, Indonesian Borneo. Orangutan Tropical Peatland Project (OuTrop) Report, Palangka Raya, Indonesia.

Gilhooly, L. J., Rayadin, Y., & Cheyne, S. M. (2015). A Comparison of Hylobatid Survey Methods Using Triangulation on Müller's Gibbon (Hylobates muelleri) in Sungai Wain Protection Forest, East Kalimantan, Indonesia. International Journal of Primatology, 36(3), 567–582.

Gordon, C. H., & Stewart, E. A.-M. (2007). The use of logging roads by a solitary felid, the clouded leopard. Cat News, 47, 12–13.

Hamard, M. C. L., Cheyne, S. M., & Nijman, V. (2010). Vegetation correlates of gibbon density in the peat-swamp forest of the Sabangau catchment, Central Kalimantan, Indonesia. American Journal of Primatology, 72(7), 607–616.

Harrison, M. E., Hendri, M. L. Dragiewicz, S. M. Cheyne, Krisno and S. J. Husson (2010). Biodiversity of the Mungku Baru Ulin Forest, Central Kalimantan, Indonesia. The Orangutan Tropical Peatland Project, Palangka Raya, Indonesia.

Höing, A., Indrawati, Y. M., Quinten, M., Cheyne, S. M., & Waltert, M. (2013). Line transects versus triangulation: a case study on the monitoring of Kloss' gibbons (Hylobates klossii) on Siberut Island, Indonesia. International Journal of Primatology, 34(1), 148–156. The IUCN Red List of Threatened Species 2017.

Houlihan, P. R., Marchant, N. C. & Harrison, M. E. (2012) A Guide to the Butterflies of Sabangau. Orangutan Tropical Peatland Project, Palangka Raya, Indonesia.

Marchant, N. C., Purwanto, A., Harsanto, F. A., Boyd, N. S., Harrison, M. E. & Houlihan, P. R. (2015). 'Random-flight' dispersal in tropical fruit-feeding butterflies? High mobility, long lifespans and no home ranges. Ecological Entomology, 40(6), 696-706.

Rowcliffe, J. M., & Carbone, C. (2008). Surveys using camera traps: are we looking to a brighter future? Animal Conservation, 11, 185–186.

Rowcliffe, J. M., Field, J., Turvey, S. T., & Carbone, C. (2008). Estimating animal density using camera traps without the need for individual recognition. Journal of Applied Ecology, 45, 1228–1236.

Thomas, L., Buckland, S.T., Rexstad, E.A., Laake, J.L., Strindberg, S., Hedley, S.L., Bishop, J.R.B., Marques, T.A. and Burnham, K.P., 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47: 5-14.

Thornton, S. A. (2017). (Un)tangling the Net, Tackling the Scales and Learning to Fish: An Interdisciplinary Study in Indonesian Borneo PhD dissertation, University of Leicester, Leicester, UK.

Utami-Atmoko, S., K. Traylor-Holzer, M. A. Rifqi, P. G. Siregar, B. Achmad, A. Priadjati, S. Husson, S. Wich, P. Hadisiswoyo, F. Saputra, G. Campbell-Smith, P. Kuncoro, A. Russon, M. Voigt, T. Santika, M. Nowak, I. Singleton, I. Sapari, A. Meididit, D. S. Chandradewi, B. Ripoll Capilla, Ermayanti and C. M. Lees (2017). Orangutan Population and Habitat Viability Assessment: Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN.

Wilting, A., Cheyne, S. M., Mohamed, A., Hearn, A. J., Ross, J., Samejima, H., … Kramer-Schadt, S. (2016). Predicted distribution of the flat-headed cat Prionailurus planiceps (Mammalia: Carnivora: Felidae) on Borneo. Raffles Bulletin of Zoology, Supplement, 173–179.

Wilting, A., Cord, A., Hearn, A. J., Hesse, D., Mohamed, A., Traeholdt, C., … Hofer, H. (2010). Looking for a home for flat-headed cats; modelling the species distribution of an endangered Southeast Asian small cat species. PLoS One, 5(3).

Wilting, A., Fischer, F., Bakar, S. A., & Linsenmair, K. E. (2006). Clouded leopards, the secretive top-carnivore of South-East Asian rainforests: their distribution, status and conservation needs in Sabah, Malaysia. BMC Ecology, 6, 1–27.

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