Biodiversity of the Sebangau tropical peat swamp forest, Indonesian Borneo

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SUMMARY

The importance of Southeast Asia's tropical peat swamp forests for biodiversity is becoming increasingly recognised. Information on species presence within peatland areas is scant, however, limiting our ability to develop species conservation strategies and monitor responses to human activities. We compile species presence records for the Sebangau forest in Indonesian Borneo since 1993 and present the most complete Bornean PSF biodiversity inventory yet published. Including morpho-species that are likely to represent true species, this list comprises 215 tree, 92 non-tree flora, 73 ant, 66 butterfly, 297 spider, 41 dragon/damselfly, 55 fish, 11 amphibian, 46 reptile, 172 bird and 65 mammal taxa. Of these, 46 species are globally threatened and 59 are currently protected in Indonesia; 22 vertebrate species are Borneo endemics. Because our sampling is both biased and incomplete, the true number of species found at this site is likely to be much higher. Little is known about many of these taxa in Sebangau and peat swamp forests elsewhere. Many of these species are considered forest dependent, and the entire community is expected to be important for maintaining the resilience of the peat swamp forest ecosystem and the environmental services that it provides. This highlights the need for urgent conservation of Sebangau and its diverse biological community.

KEY WORDS: biodiversity, Central Kalimantan, conservation, Sebangau, species presence

INTRODUCTION

Indonesia's tropical peatlands cover 206,950 km^2 (Page *et al.* 2011) yet, with the exception of some early botanical studies (e.g., Sewandono 1937, 1938; Anderson 1963, 1976), received relatively little attention from the scientific and conservation communities until the end of the 20th century. Ecologists long regarded tropical peat swamp forest (PSF) as less interesting than other forest types in the region, namely the highly biodiverse dryland dipterocarp forests (Prentice & Parish 1992, Yule 2010). The obvious swampy nature of PSFs, plus difficulty of access, further dissuaded scientists from working in these environments. This resulted in an overall impression that PSFs were neither interesting nor important, which combined with most PSF areas not being claimed by local communities, resulted in most PSFs in Indonesia being designated as production or agricultural forests by previous national governments.

Studies over the last twenty years have begun to reverse this impression, however, and the high value of Indonesia's peatlands for carbon sequestration, storage and emissions is now widely appreciated (Page *et al.* 2002, Hooijer *et al.* 2009, Page *et al.* 2011). PSFs are also appreciated for their role in providing other ecosystem services of importance to local and international communities, such as flood prevention and provision of non-timber forest products (Graham 2013, Harrison 2013, Giesen 2015).

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Alongside this increased awareness of PSF ecosystem functions and services, studies have revealed that, contrary to earlier beliefs, these forests are home to a wide variety of flora and fauna (Page *et al.* 1997, Yule 2010, Posa *et al.* 2011). Indeed, compilation of species records across sites indicates that at least 1,524 plant, 123 mammal, 268 bird, 75 reptile, 27 amphibian and 219 fish species can be found in Southeast Asia's PSFs (Posa *et al.* 2011), although this does not necessarily translate into high levels of habitat endemicity (e.g., plants: Giesen *et al.* 2018). Studies have also revealed the importance of these forests - which still cover large areas, particularly in Indonesia - for conservation of threatened animal species including primates (*Pongo* spp.: Morrogh-Bernard *et al.* 2003, Wich *et al.* 2008; Hylobatidae: Campbell *et al.* 2008, Cheyne *et al.* 2008; *Presbytis rubicunda*: Ehlers Smith & Ehlers Smith 2013), clouded leopard (*Neofelis diardi*) and other felid species (Cheyne *et al.* 2011, 2013b) and wetland birds, such as the Storm's stork (*Ciconia stormi*: Cheyne *et al.* 2014) and white-winged duck (*Asarcornis scutulata*: Silvius & Verheugt 1986).

Despite this increased appreciation, Indonesia's PSFs remain threatened by human activities including drainage and subsequent fire, conversion for agriculture (especially oil palm), plus logging and wildlife hunting (Morrogh-Bernard *et al.* 2003, Struebig *et al.* 2007, Harrison *et al.* 2009a, Page *et al.* 2009b, Miettinen & Liew 2010, Harrison *et al.* 2011a, Meijaard *et al.* 2011, Posa *et al.* 2011, Miettinen *et al.* 2012a, Miettinen *et al.* 2012b). These threats have led to the loss of 1.8 Mha of PSF in Borneo, Sumatra and Peninsular Malaysia from 2007 to 2015; equivalent to an annual deforestation rate of 4.1 % (Miettinen *et al.* 2016). Further advancing our understanding of PSF biodiversity, its distribution and responses to disturbance is important for providing the enhanced knowledge base needed to make better PSF conservation management decisions and monitor the impacts of management (or lack thereof) on PSF biodiversity (Harrison *et al.* 2012).

In this article we present a list of flora and fauna species documented in the Natural Laboratory of Peat swamp Forest (NLPSF), Sebangau, in the southern lowlands of Central Kalimantan, Indonesia. Building on earlier preliminary lists for the area (e.g., Page *et al.* 1997, Shepherd *et al.* 1997), we compile 25 years of records and list the species found, highlighting records of particular note and making recommendations for conservation management. We hope that this research will help stimulate further studies describing PSF biodiversity in the region, raise the profile of PSF conservation efforts and improve our baseline knowledge of this ecosystem, thus contributing towards better informed and more successful conservation management.

METHODS

Study site

Species presence records described here were collected in the 500 km^2 NLPSF, part of the 7,347 km^2 Sebangau peat dome in Central Kalimantan, Indonesia (2° 19′ S, 113° 54′ E, Figure 1). This site has been the focus of intensive research efforts on many aspects of PSF ecology and management by the Centre for International Cooperation in Sustainable Management of Tropical Peatlands at the University of Palangka Raya (UPT CIMTROP UPR), the Universities of Nottingham and Leicester, the Borneo Nature Foundation and other institutions since 1993. Sebangau is a truly ombrogenous peat swamp forest; i.e. it receives all its nutrient influx from aerial sources (rain, aerosols and dust; Page *et al.* 1999), with the exception of the riverine margins which are almost entirely deforested. Consequently, it is relatively poor in plant nutrients, which has resulted in fewer forest strata and a lower canopy height (15–25 m) than in forests on mineral soils (Page *et al.* 1999).

Borneo's inland PSFs typically comprise a number of different habitat sub-types, with the following occurring in the NLPSF (Page *et al.* 1999, Morrogh-Bernard *et al.* 2003, Cheyne *et al.* 2008, Husson *et al.* 2015; Figure 1):

- Mixed swamp forest: found on the shallowest peat, from the limits of river flooding to 5.5 km inland from the forest edge. Characterised by intermediate tree size (15–25 m closed canopy height), species richness and ape population densities. Contains many commercial timber trees and consequently suffered relatively high logging disturbance. Its proximity to forest edge and greater accessibility leads to relatively high encroachment and hunting prevalence.
- Low pole forest: a relatively stunted, depauperate forest, found 5.5–10 km from the forest edge on peat of 6–10 m depth. Characterised by small tree size (12–15 m closed canopy), species richness and ape population densities. Contains few trees of commercial timber size and has consequently suffered little from direct logging disturbance.
- Tall interior forest: a productive, diverse forest crowning the top of the dome on peat 10–13 m thick. Characterised by relatively tall trees (maximum 45 m upper canopy height), high species richness and ape population densities.

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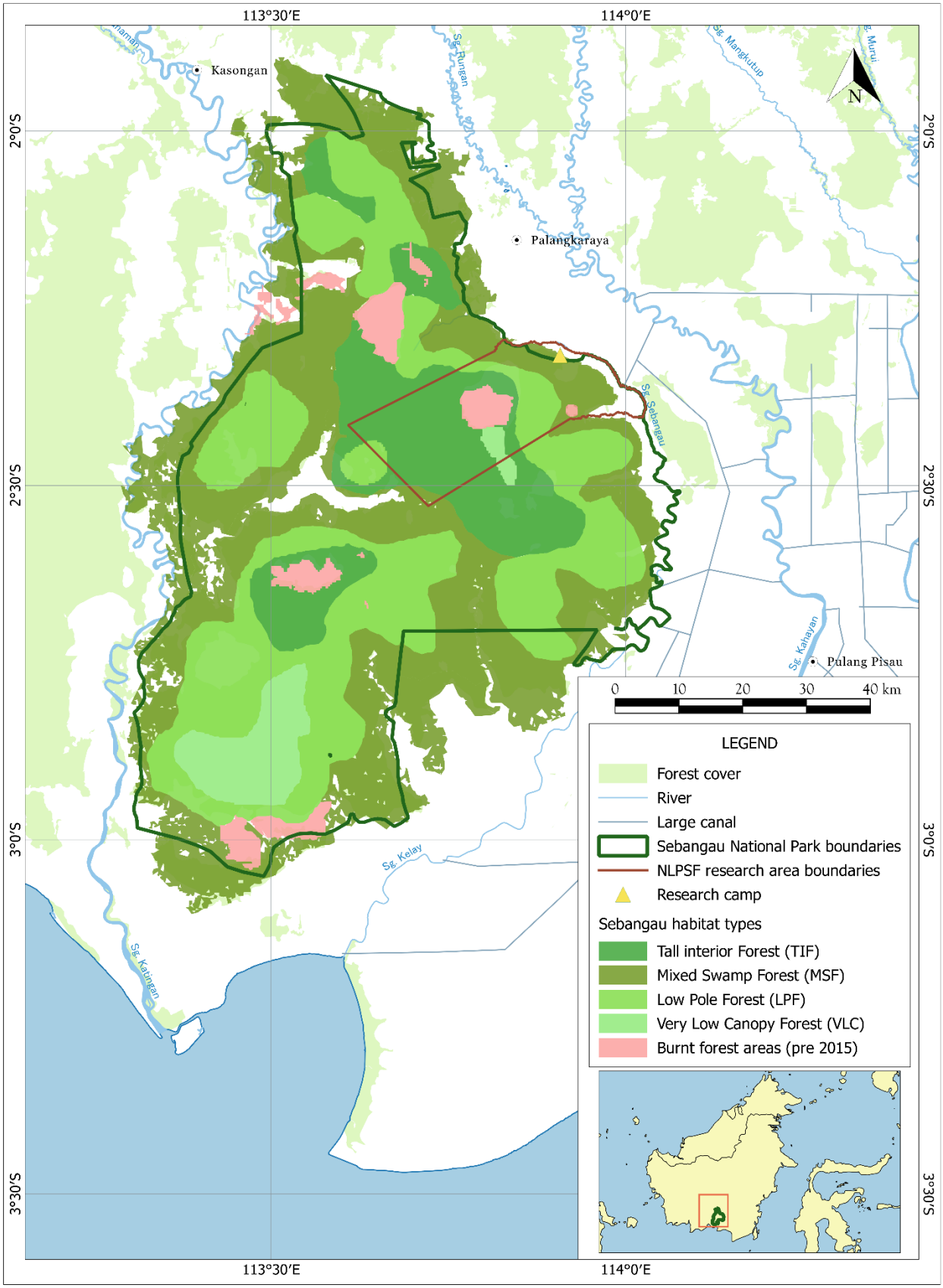

Figure 1. Map showing the location of Sebangau in Indonesian Borneo (inset), with forest cover (before the 2015 fires, when most of the species records were obtained) and distribution of habitat sub-types within the Sebangau forest. Peat swamp forest habitat outside the Sebangau forest is not differentiated into sub-types. White areas are not forested. Adapted from Ehlers Smith & Ehlers Smith (2013).

Contains many commercial timber trees and has consequently suffered relatively high logging disturbance.

- Very low canopy forest: covers ~78 km^2 at the highest point in the catchment. Characterised by permanently high water table and very large pools up to 1 m deep, with few trees exceeding 1.5 m in height. Not sampled during this study, owing to extreme difficulty of access.

The Sebangau catchment was selectively logged over a period of ~40 years by legal timber concessions and illegal hand-logging. The latter was particularly widespread and indiscriminate, but was stopped in our research area by a locally-led Community Patrol Team in 2004 (Husson *et al.* 2015). The timber extraction canals (typically 1–2 m wide, 0.3–1.3 m deep and often extending many kilometres into the forest) dug into the peat by the illegal loggers remain, however, causing ongoing peat drainage, which has resulted in peat subsidence and a heightened dry-season fire risk (Harrison *et al.* 2009a). Exploitation of wildlife still occurs for some species and has occurred until recently for some others in the area, including fishing (Yulentine *et al.* 2007), hunting of *Pteropus vampyrus* fruit bats (Struebig *et al.* 2007, Harrison *et al.* 2011a) and bearded pigs (*Sus barbatus*), plus capture of green leafbirds (*Chloropsis* spp.) for sale in local markets. This history of disturbance is typical of that experienced in most of southern Borneo's "relatively intact" PSFs.

Survey methods

Species records were collected between 1993 and 2018. Records for the following species groups are summarised here: plants, ants, butterflies, spiders, dragon/damselflies, fish, amphibians, reptiles, birds, mammals. Compilation of species lists for plants, amphibians, reptiles, birds and mammals began in 1993, for butterflies in 2004, dragon/damselflies in 2012, fish in 2014 and spiders in 2015. The data include records obtained from all habitat sub-types at the site, but most effort was expended in the mixed swamp forest habitat sub-type, which is the site of the NLPSF base camp, has a well-established camp and trail system, and is subject to year-round ecological research. Our lists build upon previously published lists and incorporate taxonomic changes as necessary. Any dubious records have been removed.

The variety of survey methods employed across the different species groups is summarised below. A brief description of potential sampling bias for each group is also provided.

- Plants: seedling, sapling and mostly "adult" tree (≥6 cm diameter at breast height) plots (Page *et al.* 1999), plus ad hoc observations. This list is strongly biased towards woody plants and trees in particular, and is very incomplete for other plant types. High survey effort, with many hectares of plots sampled by multiple observers for over two decades.
- Ants: 120 honey-baited pitfall traps sampled each month for a one-year period (Schreven *et al.* 2014, 2018). This list is heavily biased towards ground-dwelling ants attracted to sugar baits and is very incomplete for ants occupying other niches. It also includes a number of genera or morpho-species for which species-level identifications could not be completed.
- Butterflies: fruit- and carrion-baited canopy traps, with additional records obtained through hand netting and ad hoc observations (Houlihan *et al.* 2012, Houlihan *et al.* 2013, Tremlett 2014, Marchant *et al.* 2015). High survey effort for fruit-baited canopy traps, including ≥120 trap days per month continuously since January 2012; total 1,200 canopy-baited trap days. The list is biased towards species attracted to fruit- and carrion-baited canopy traps.
- Spiders: nocturnal searches within plots from ground leaf litter to maximum overhead head level (Hore & Uniyal 2008, Pinto-Leite & Rocha 2012, Dowds 2015) and ad hoc observations. Records are biased against canopy and diurnal species and, as for ants, include a large number of genera or morpho-species for which species-level identifications could not be completed.
- Dragon/damselflies: visual encounter surveys and hand netting along transects (Dow & Silvius 2014), plus ad hoc observations. One survey day was completed in June 2012 (Dow & Silvius 2014) and a total of 50 surveys were completed from April 2017 to October 2017. The species list is biased towards species that perch from ground level to just above head height.
- Fish: traditionally baited (using tempeh and fermented shrimp paste) wire traps in rivers, canals and forest pools; interviews with local fishermen (species were included only when commonly mentioned by multiple fishermen); and ad hoc observations (Page *et al.* 1997, Ng & Tan 2011, Schindler & Linke 2013, Thornton *et al.* 2018). Total trapping effort was 1,300 trap nights in the river and 600 trap nights in the forest. These trapping methods are biased against smaller fish and those not attracted to the bait types used.

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- Amphibians: visual encounter and manual acoustic (calling) surveys along line transects (Doan 2003, Dorcas *et al.* 2009), and ad hoc observations. In total, 314 acoustic surveys were completed; the total number of visual encounter surveys was not recorded but represents a fairly low annual survey effort covering at least a period from 2001 to the present. This list is biased towards species easily seen or heard by ground-based observers, and will be particularly incomplete for quieter, inconspicuous and canopy-dwelling species.
- Reptiles: visual encounter surveys (Doan 2003); ad hoc observations. List bias and sampling effort as for amphibians.
- Birds: point counts, transect surveys, camera traps and ad hoc observations, based on both sight and sound (Bibby *et al.* 1998). The total number of camera trap nights since data collection began in 2008 was > 90,000 at the time of writing. Full details of all point/transect surveys are no longer available, but these represent several blocks of intensive surveys during ornithologist visits, each of a few months' duration. Records may show some bias against quieter and more discreet species.
- Mammals: visual encounter surveys along line transects, camera trapping (Cheyne *et al.* 2010, Cheyne & MacDonald 2011) and ad hoc observations. Camera trap survey effort as for birds; line transect survey effort as for reptiles and amphibians. Records may show some bias against quieter and more discreet species. Bats were sampled by harp trapping over 15 trap nights (Struebig *et al.* 2006); these records are limited to species flying in the forest understorey.

Species were identified with the aid of appropriate field guides (D'Abrera 1985, Payne & Francis 1985, D'Abrera 1986, Kottelat *et al.* 1993, Bolton 1994, Inger & Stuebing 1997, Liat & Das 1999, Stuebing & Inger 1999, Deeleman-Reinhold 2001, Otsuka 2001, Orr 2003, Das 2004, Atack 2006, Myers 2009, Phillipps & Phillipps 2009, Thomas 2013, Koh & Tzi Ming 2014) and consultation with external experts where necessary. Nomenclature follows these sources, plus APG IV (2016) and the Taxonomic Name Resolution Service (Boyle *et al.* 2013) for angiosperms, Fishbase.org for fish, Wilson & Reeder (2005) and Duckworth & Pine (2003) for mammals, and Roos *et al.* (2014) for primates. Previously published accounts of species presence in the area (Page *et al.* 1997, Shepherd *et al.* 1997, Page *et al.* 1999, Struebig *et al.* 2006, Hamamoto *et al.* 2007, Mirmanto 2010, Haryono 2012, Houlihan *et al.* 2012, Dow & Silvius 2014, Schreven *et al.* 2014, Tremlett 2014, Thornton 2017) were cross-checked against the above and various other published sources along with our own unpublished records, as well as with external experts. This resulted in some additions, removals and alterations to species names provided in previously published accounts of species presence in Sebangau.

Records for some groups include morpho-species within genera, for which species-level identifications could not be confirmed. These are included within our dataset to provide a rough indication of the potential number of species in these groups. We consider this preferable to completely omitting these records or only presenting figures for species with identification to species level confirmed beyond doubt, which would under-estimate the true number of species. Furthermore, all of our lists are very likely to be incomplete owing to the various sampling biases outlined above. All IUCN threat status assessments were current at the time of writing, and Indonesian protected status assessments were based on the newly updated government protected species list (MENLHK 2018).

RESULTS

A summary of the total number of species recorded across all groups is provided in Table 1, and group-by-group Tables of all species recorded, conservation listings and pertinent notes are provided in Tables A1–A10 in the Appendix. These lists include 46 species which are considered to be globally threatened by the IUCN, 59 species listed as legally protected in Indonesia, and 22 vertebrate species that are endemic to the island of Borneo.

DISCUSSION

To our knowledge, these lists represent the most complete account of Bornean PSF biodiversity currently available and thus make a major contribution towards our understanding of this unique and important ecosystem. This account builds upon previous records from the Sebangau NLPSF by increasing the number of species recorded and providing data for additional taxonomic groups (Table 1). It also builds upon previously published tree species lists for other (neighbouring and distant) parts of the Sebangau PSF, which documented 100 (Anderson 1976) and 152 (Widjaja *et al.* 2007) tree species, compared to the 215 recorded in our study.

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Table 1. Summary of total number of species recorded in the NLPSF, Sebangau by taxonomic group and comparison to previous published data for the area. "Threatened" species are those considered Vulnerable (VU), Endangered (EN) or Critically Endangered (CR) by the IUCN.

Taxa	THIS STUDY					PAST STUDY
	Total[1]	Min. % of total for SEA PSF[2]	Threatened	Protected in Indonesia	Borneo endemics	Total[3]
Trees	215 (111)	-	10	2	-	104
Non-tree flora	92 (14)	-	0	0	-	2
Ants	73 (24)[4]	-	0	0	-	-
Butterflies	66 (63)[5]	-	0	0	0	-
Spiders	297 (29)	-	0	0	-	-
Dragon/damselflies	41 (37)	-	0	0	11	14
Freshwater fish	55 (51)[6]	25	1	0	10	35
Amphibians	11 (10)	37	1	0	0	-
Reptiles	46 (41)	55	5	3	2	-
Birds	172 (172)[7]	64	10	35	4	150
Mammals	65 (65)[8]	52	19	19	6	35

[1] Expected total number of species, assuming that morpho-species and species with uncertain species designations ("/" in Species columns in Tables A1–A10) represent distinct true species. Figures in parentheses indicate numbers of definitively identified species. Note that these totals incorporate species records from previously published lists (see Methods).

[2] Minimum percentage of the total Southeast Asian PSF species complement occurring in the Sebangau NLPSF, based on the numbers of definitively identified species in our datasets and the total numbers of species in South-east Asian PSF estimated by Posa *et al.* (2011). Not calculated for trees, ants, butterflies, spiders and dragon/damselflies owing to lack of comparable data in Posa *et al.* (2011); nor for non-tree plants, owing to high incompleteness of the list we provide in Table A1.

[3] Tree species numbers from Shepherd *et al.* (1997); fauna species numbers from Page *et al.* (1997), with the exception of dragon/damselflies (Dow & Silvius 2014). Numbers for freshwater fish from Page *et al.* (1997) plus Haryono (2012). Mirmanto (2010) also studied tree species at the site, but their study is excluded because the tree species totals in different parts of the publication are contradictory and a full species list is not provided.

[4] Data from Schreven *et al.* (2014, 2018).

[5] Data from Houlihan *et al.* (2012) and Tremlett (2014), plus one additional ad hoc observation (*Zeltus amasa*, S. Schreven, personal observation).

[6] Data from Page *et al.* (1997), Ng & Tan (2011), Haryono (2012), Schindler & Linke (2013), Thornton (2017) and Thornton *et al.* (2018).

[7] Includes four species that may now be locally extinct (see Table A9 and Discussion).

[8] Bat species records from Struebig *et al.* (2006).

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Our lists comprise a potential total of 1,133 species, including 615 species for which species-level identification has been confirmed and a further 518 records for which species-level identification is currently uncertain, but which we believe are likely to represent at least one true species. Of these, 46 species are currently listed as threatened by the IUCN, 59 are legally protected in Indonesia and 22 vertebrate fauna species are endemic to Borneo. Because many IUCN and endemic status assessments are out of date and/or under revision (e.g., IUCN revisions for Odonata are scheduled to be completed by 2020), it is likely that these figures will increase over the coming years.

Comparisons of our species lists with relatively complete lists from other PSFs in the region indicate high species diversity in Sebangau, though it is likely that differences in sampling intensity and/or study duration also contributed to the (generally) higher recorded diversities in Sebangau. For example, we identified 215 tree species in Sebangau, compared to 144 recorded in PSF in Katingan, Central Kalimantan (Harrison 2011b), 127 in "tall swamp forest" in Danau Sentarum National Park, West Kalimantan (Giesen 2000), 135 in Giam Siak Kecil-Bukit Batu Biosphere Reserve (Gunawan *et al.* 2012), 115 in Berbak National Park (Giesen 1991), 32–78 from the various island and coastal sites in/off Sumatra surveyed by Sewandono (1938), and 132 in Pekan, Peninsular Malaysia (Ibrahim 1997). Likewise, we recorded, in total, 172 bird species in Sebangau, compared to: 132 in PSF in Tuanan (Posa & Marques 2012) and 111 in "swamp forest" in Tanjung Puting (Nash & Nash 1988), all in Central Kalimantan; an estimated potential 60–70 in "tall (peat) swamp" in Danau Sentarum National Park (Jeanes & Meijaard 2000); and 234 species in Berbak National Park (Silvius & Verheugt 1986, Hornskov 1987). An estimate of 30–40 mammal species has been reported in "tall (peat) swamp" in Danau Sentarum National Park (Jeanes & Meijaard 2000), compared to our record of 65 species from Sebangau, while the number of fish species recorded in Sebangau (55) is the highest from Borneo PSF to date (Thornton *et al.* 2018).

Thus, this study confirms that Sebangau is an important area for biodiversity conservation, both locally and globally; a conclusion that is further justified when considering its large size and relatively intact forest cover, and thus the large populations of many species that are likely to be present in the area. For example, owing primarily to its large size, Sebangau is believed to represent the largest contiguous protected population of the Bornean orangutan (Utami-Atmoko *et al.* 2017) and possibly the largest population of the Bornean white-bearded gibbon (Campbell *et al.* 2008, Cheyne *et al.* 2008). Similar findings can be expected for many other species that have been less well surveyed so far.

We were unable to assign concrete identifications to species level for over 45 % of the records on our list, and thus probably under-estimated the number of threatened and endemic species. For example, of the 14 species of the tree genus *Lithocarpus* listed by the IUCN, 12 are considered vulnerable/endangered, but here 7 of 9 *Lithocarpus* could not be identified below genus level. Our list thus suggests that no threatened *Lithocarpus* species occur in Sebangau, which is unlikely to be the case. Likewise, given the diversity of the fig genus *Ficus* (for which, e.g., Anderson 1963 reports 24 species in coastal peat swamp forests of Sarawak and Brunei), our count of nine morpho-species in Sebangau is likely to be incomplete. Moreover, particularly for the less well-known invertebrate taxa that (to our knowledge) have received no previous research attention in this habitat, it is possible - or even probable - that some of our morpho-species designations will represent species new to science.

Many species found in Sebangau are used by the local community. These include many timber species (e.g. *Shorea* spp. and *Gonystylus bancanus*), although logging of all but the smallest poles in the NLPSF has ceased since 2004, owing to increased protection; *Dyera polyphylla* trees used for rubber tapping; *Alseodaphne coriacea* tree bark used for mosquito coil production, with usual harvesting methods involving felling and killing trees; plus use by both people and orangutans (Morrogh-Bernard *et al.* 2017) of *Dracaena cantleyi* leaves for self-medication of joint pains, a behaviour thought to be unique to the Sebangau orangutan population. Many animal species are hunted or trapped for food (e.g. soft-shell turtles, bearded pigs, sambar deer and flying foxes, Struebig *et al.* 2007), although wildlife hunting appears to have declined in recent years owing to increased protection and possibly reduced populations. Others have been reported to be harvested occasionally for ornamental purposes (e.g. great argus for feathers and clouded leopard for fur), or the pet trade (e.g. box turtles, blue-crowned hanging parrots, green leafbirds). In contrast, the edible-nest swiftlet normally roosts in caves and so is not typically found in PSF. However, local people have brought these birds into nearby villages, where they are bred in large numbers in custom-made swiftlet houses so that their nests can be collected for international export to make bird's-nest soup. The species can now be found feeding in large numbers

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above areas of PSF adjacent to villages, such as the NLPSF, where it may potentially be competing for food with the native glossy swiftlet and other bird species.

The biases inherent in our lists mean that they should be regarded as absolute minimum counts of total species numbers in the area. First, the lists incorporate spatial bias because greater and, for some species groups, exclusive survey effort was expended in the mixed swamp forest habitat sub-type around the main NLPSF base camp. Low pole, tall interior and other habitat sub-types are under-represented and the whole NLPSF area covers just 500 km^2 of the total 4,793 km^2 of forest in the Sebangau catchment. Secondly, capture or detection bias resulted from the survey methods adopted. In particular, canopy dwelling, cryptic, nocturnal, aquatic, high-flying, seasonal migratory and very rare species will be under-represented, as will species that are not attracted to or detectable using the techniques that we employed (e.g., ants and butterflies that are not attracted to the baits used in our traps, or bats that fly higher than or can avoid harp traps). Thirdly, ease of identifying and distinguishing species varies between groups, with the result that the lists for some groups (e.g., trees, invertebrates) contain more records for which identification to species level was not possible than lists for other groups (e.g., mammals, birds).

An additional bias hidden within the species lists presented here arises from the huge difference in understanding that exists between different species and species groups. For example, following many years of intensive research, we now know a large amount about orangutan population dynamics and behavioural ecology in Sebangau (Husson *et al.* 2002, Morrogh-Bernard *et al.* 2003, Harrison *et al.* 2007, Harrison 2009, Harrison *et al.* 2009b, Husson *et al.* 2009, Morrogh-Bernard 2009, Morrogh-Bernard *et al.* 2009, Harrison *et al.* 2010c, Morrogh-Bernard *et al.* 2011, Cheyne *et al.* 2013a, Morrogh-Bernard *et al.* 2014a, Morrogh-Bernard *et al.* 2014b, Husson *et al.* 2015); but the same cannot be said about the lesser woolly horseshoe bat or the spider *Pristidia longistila*, about which we know virtually nothing specific for the Sebangau PSF other than that these species are present. Moreover, whole taxonomic groups are entirely unrepresented in our dataset, including many that are likely to be incredibly species rich; e.g., beetles and fungi. Therefore, while it remains important to increase our understanding of the flagship species for which Sebangau is rightly famed, we encourage researchers also to investigate the many lesser-studied groups, to advance our overall understanding of PSF ecology and the effects of human activities on this ecosystem.

Conservation implications

These lists highlight the species richness, and particularly the numbers of threatened and nationally protected species, found in the Sebangau forest. This underlines the conservation importance of Sebangau, as well as other PSF areas in southern Kalimantan (e.g., Tuanan, Mawas, Katingan), especially given the high similarity to Sebangau in species composition for birds (Posa & Marques 2012) and trees (Harrison *et al.* 2010b) of Tuanan and Mawas, and for flora and fauna of Katingan (Harrison *et al.* 2010a, 2011b). Disruption of this diverse PSF community is likely to lead to knock-on negative effects on ecosystem service provision and resilience (Yule 2010, Harrison 2013), and thus on local human communities.

Sebangau was protected as a National Park in 2004, and all other deep peatlands in Central Kalimantan now have protection in some form owing to their importance as carbon stores and buffers to forest fires in their natural state. Nevertheless, all are threatened in some way, by peat drainage, fire, conversion for agriculture, timber logging, wildlife hunting and climate change (Miettinen & Liew 2010). Forest conversion, degradation and/or fragmentation will inevitably lead to reductions in both the abundance of individual species and species richness. Therefore, conservation of this ecosystem must - and, indeed, is - considered a high priority within Indonesia and internationally. This requires restoration of natural ecosystem functions within PSF including hydrology, carbon sequestration and storage, which are negatively affected by these disturbances (Yule 2010, Harrison 2013) and are difficult to restore once disrupted (Page *et al.* 2009a).

In light of this, we recommend the following conservation management actions, both specifically in Sebangau and more widely in PSF areas:

1. Active forest protection and restoration to avert further ecosystem damage and, where possible, to reverse existing damage, including enforcement of existing laws and regulations, forest patrols, firefighting, blocking of ex-logging canals and replanting of burned/deforested areas.

2. Development of sustainable livelihood and forest use initiatives that provide incentives for local people to support and actively participate in forest conservation.

3. Raising awareness among local and international communities, authorities and conservation managers about PSF biodiversity, the threats it faces, the implications of (individual) actions and the conservation measures needed.

 DOI: 10.19189/MaP.2018.OMB.352

4. Further research on the population abundance, distribution and ecology of flora and fauna species, and on how these aspects are affected by human activities, particularly for under-studied taxa and taxa that are likely to be especially useful as indicators of ecological disturbance for PSF (Gardner 2010, Harrison *et al.* 2012). This should be supplemented by in-depth sociological studies among local stakeholders in order to better understand their motivations, threat drivers and opportunities for mitigation, particularly in the context of the direct conservation interventions outlined above.

Finally, we note that this study and production of the species lists provided here has been possible only because of the many years of research and large numbers of researchers who have worked in the NLPSF, and that current implementation of the above conservation recommendations in the NLPSF could not be expected to have occurred in the absence of this research. Therefore, as in other tropical environments (e.g., Pusey *et al.* 2007, Wrangham & Ross 2008), this study also highlights the importance and wider benefits that can be derived from long-term PSF research projects and close collaborations between local and international organisations.

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AUTHOR CONTRIBUTIONS

This work represents a compilation of records collected by many different researchers over 25 years. SJH, SHL, SMC, LJD, HCM-B, SEP, BRC and MEH conceived the study and this article, and (together with IPK and KAJ) coordinated research; all authors contributed species records and/or assisted in reviewing records and threat/protected/endemic status; SJH and MEH managed the compiled species dataset; and BRC created Figure 1. MEH wrote the initial draft, which was forwarded for iterative review by all authors.

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Appendix: Lists of species recorded in the NLPSF, Sebangau

Table A1. List of plant (Plantae) species recorded in the NLPSF, Sebangau. BNF local names indicate those typically used by BNF (Borneo Nature Foundation) botanists and researchers, which commonly match local Dayak names from villages in the Sebangau area. IUCN Red List classifications are provided (CR = critically endangered; DD = data deficient; EN = endangered; LC = least concern; NT = near threatened; VU = vulnerable), and 'Protected?' refers to protection status in Indonesia. Parentheses for Latin names indicate synonyms, with those recommended by the Taxonomic Name Resolution Service prioritised; for local names, optional/ occasionally used parts of the name or spelling variations. Slashes for Latin names indicate cases in which identification between two classifications is uncertain; for local names they indicate alternatives. Forms: C = climber; E = epiphyte; Fe = fern; Fi = fig; L = liana; O = orchid; P = parasitic; Se = sedge; Sh = shrub; T = tree.

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
GYMNOSPERMS						
GNETALES						
Gnetaceae	*Gnetum*	sp. 1	L	Bajakah luaa		
		sp. 2	L			
PINALES						
Araucariaceae	*Agathis*	*borneensis*	T	Gatis	EN	Yes
Podocarpaceae	*Dacrydium*	*pectinateum*	T	Alau	EN	
PTERIDOPHYTES						
POLYPODIALES						
Blechnaceae	*Stenochlaena*	*palustris*	Fe	Kalakei		
Nephrolepidaceae	*Nephrolepis*	sp. 1	Fe	Paku jampa		
ANGIOSPERMS						
ALISMATALES						
Araceae	*Raphidophora*	sp. 1	L			
	Unknown	sp. 1	Sh	Kujang himba		
		sp. 2	Sh	Kujang himba		
		sp. 3	Sh			
APIALES						
Araliaceae	*Schefflera*	sp. 1	T			
		sp. 2	L	Sapahurung		
		sp. 3	L	Bajakah tabulus		
Pittosporaceae	*Pittosporum*	sp. 1	T	Prupuk tulang / napu / datar		

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
AQUIFOLIALES						
Aquifoliaceae	*Ilex*	*cymosa*	T	Kambasira (daun kecil)		
		hypoglauca	T	Kambasira (daun besar) / Sumpung		
		wallichi	T	Keranji / Kambasira		
Stemonuraceae	*Stemonurus*	*cf. scorpiodes*	T	Keput bajuku / Tabaras yang tidak punya akar		
		umbellata	T			
ARECALES						
Arecaceae (*Palmae*)	*Calamus*	sp. 1	C	Uey liling		
		sp. 2 *cf. trachycoleus*	C	Uey irit		
		sp. 3 *cf. caesius*	C	Uey sigi		
	Korthalsia	sp. 1	C	Uey paka		
	Metroxylon	sp. 1	Sh	Hambiey		
	Pinanga	sp. 1	Sh	Pinang jouy		
	Salacca	sp. 1	Sh	Lokip		
	Unknown	sp. 1	Sh	Lokip		
		sp. 2	C	Uey seluang		
ASPARAGALES						
Asparagaceae	*Dracaena*	*cantleyi*	Sh			
Orchidaceae	*Eria*	sp. 1	E	Anggrek bawang		
	Unknown	sp. 1	O			
CARYOPHYLLALES						
Nepenthaceae	*Nepenthes*	*ampullaria*	C	Ketupat hinut	LC	
		gracilis	C	Ketupat hinut	LC	
		rafflesiana	C	Ketupat hinut	LC	
CELASTRALES						
Celastraceae	*Lophopetalum*	sp. 1	T	Mahuwi		
COMMELINALES						
Commelinaceae	*Commelina*	sp. 1	L	Tewu kaak		
Hanguanaceae	*Hanguana*	*malayana*	Sh	Bakong himba	LC	

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
CUCURBITALES						
Anisophylleaceae	*Combretocarpus*	*rotundatus*	T	Tumih	VU	
ERICALES						
Ebenaceae	*Diospyros*	*areolata (bantamensis)*	T	Malam-malam / U(A)ring pahe		
		cf. evena	T	Gulung haduk		
		confertiflora	T	Arang		
		lanceifolia	T	Arang		
		siamang	T	Ehang		
		sp. 1	T	Kayu arang apui		
		sp. 7	T	Arang		
Lecythidaceae	*Barringtonia*	*longisepala*	T	Putat		
Pentaphylacaceae	*Ternstroemia*	*hosei*	T			
		magnifica	T	Tabunter		
Primulaceae	*Ardisia*	*cf. sanguinolenta*	T	Kalanduyung himba		
		sp. 2	T	Kamba Sulan		
	cf. Rapanea	*borneensis*	T	Rawoi / Species mertibu		
Sapotaceae	*Isonandra*	*lanceolata*	T	Nyatoh palanduk (daun kecil)		
		sp. 1	T	Nyatoh palanduk (daun besar)		
	Madhuca	*cf. pierri*	T	Nyatoh undus		
		motleyana	T	Katiau		
	Palaquium	*cf. xanthochymum*	T	Nyatoh burung 1		
		cochlearifolium	T	Tampnag gagas / Nyatoh gagas / Nyatoh terong		
		leiocarpum	T	Hangkang		
		pseudorostratum	T	Nyatoh bawoi / babi		
		Ridleyii	T	Nyatoh burung dua		
		sp. 2	T	Nyatoh burung tiga		
		spp. 3–4	T	Nyatoh burung		
	Planchonella	*cf. maingayi*	T	Sangkuak		
Tetrameristaceae	*Tetramerista*	*glabra*	T	Ponak		

 DOI: 10.19189/MaP.2018.OMB.352

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FABALES						
Fabaceae (*Leguminosae*)	*Adenanthera*	*pavonina*	T	Tapanggang		
	Archidendron	*borneensis*	T	Kacang nyaring		
	Dalbergia	sp. 1	L			
	Dialium	*Patens*	T	Kala pimping napu		
	Koompassia	*malaccensis*	T	Bangaris / Kempas	LC	Yes
	Leucomphalos	*callicarpus*	L	Akar kamunda		
	Ormosia	sp. 1	T			
	Unknown	sp. 1	L			
Polygalaceae	*Xanthophyllum*	*cf. ellipticum*	T	Pohon kemuning		
		sp. 1	T	Ketapi-ketapi		
		sp. 2	T			
GENTIANALES						
Apocynaceae	*Alyxia*	sp. 1	L	Kelanis		
	Absolmsia (Astrostemma)	*spartioides*	E	Anggrek rangau		
	Dischidia	*cf. latifolia*	E			
		sp. 1	E			
		sp. 2	E	Bajakah tapuser		
	Dyera	*polyphylla (lowii)*	T	Jelutong / Pantong		
	Hoya	sp. 1	E			
	Parameria	sp. 1	L			
	Willughbeia	sp. 1	L	Bajakah dango		
Gentianaceae	*Fagraea*	*accuminatisma*	T			
		racemosa	T	Tabat Barito		
		sp. 1	L	Kalamuhe		
Rubiaceae	*Psydrax (Canthium)*	*dicoccos (dydimum)*	T	Kopi-kopi		
	Gardenia	*tubifera*	T	Saluang belum		
	Ixora	*havilandii*	T	Keranji		
	Lucinea	sp. 1	L	Bajakah tabari		
	Timonius	sp. 1	Sh			
	Uncaria	sp. 1	L	Kalalawit bahandang		
	Unknown	spp. 1–3	L			

 DOI: 10.19189/MaP.2018.OMB.352

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
ICACINALES						
Icacinaceae	*Platea*	*excelsa*	T	Kambalitan		
		sp. 2	T	Lampesu		
LAMIALES						
Gesneriaceae	*Aeschynanthus*	sp. 1	L			
	Unknown	sp. 1	L			
Lamiaceae (Labiatae)	*Clerodendron*	sp. 1	T	Sopang		
Oleaceae	*Chionanthus*	sp. 1	T			
LAURALES						
Lauraceae	*Actinodaphne*	sp. 1	T			
	Alseodaphne	*coriacea*	T	Gemur		
	Cinnamomum	sp. 1 *cf. sintoc*	T	Sintok		
	Cryptocarya	sp. 1	T	Medang		
	Litsea	*cf. elliptica*	T	Medang (Species medang)		
		cf. grandis var. *rufofusca* *(cf. rufo-fusca)*	T	Tampang		
		sp. 1 *cf. resinosa*	T	Medang		
		sp. 2	T	Tampang		
	Nothaphoebe	sp. 1	T	Medang		
	Phoebe	*cf. grandis*	T	Tabitik		
LILIALES						
Smilacaceae	*Smilax*	sp. 1	L	Bajakah tolosong		
MAGNOLIALES						
Annonaceae	*Artabotrys*	*cf. roseus*	L	Kalalawit Hitam		
		suaveolins	L	Bajakah balayan		
	Drepananthus *(Cyathocalyx)*	*biovulatus*	T	Kerandau		
	Fissistigma	sp. 1	L			

 DOI: 10.19189/MaP.2018.OMB.352

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
Annonaceae {continued}	*Mezzetia*	*parviflora (leptopoda)*	T	Karipak / Pisang-pisang besar		
		umbellate	T	Kambalitan (hitam) / Pisang-pisang kecil		
	Maasia (Polyalthia)	*glauca*	T	Kayu bulan		
		hypoleuca	T	Alulup		
	Xylopia	*cf. malayana*	T	Tagula / Jangkang hijau		
		coriifolia	T	Jangkang merah		
		fusca	T	Rahanjang / Jangkang (kuning)		
Magnoliaceae	*Magnolia*	*bintulensis*	T	Hanyer bajai / Medang limo / Asam-asam	DD	
Myristicaceae	*Gymnacranthera*	*farquhariania*	T	Mendarahan (Mahadarah) daun kecil		
	Horsfieldia	*crassifolia*	T	Mendarahan (Mahadarah) daun besar	NT	
	Knema	*intermedia*	T	Bahandang	NT	
	Myristica	*lowiana*	T	Mahadarah hitam	NT	
MALPIGHIALES						
Calophyllaceae	*Calophyllum*	*cf. lanigerum*	T	Mahadingan		
		cf. hosei	T	Kapurnaga kalakei		
		hosei	T	Jinjit / Bintangor / Mentangor		
		sclerophyllum	T	Kapurnaga (jangkar)		
		soulattri	T	Takal	LC	
		sp. 2	T	Mahadingan		
		spp. 3–5	T	Kapurnaga kalakei		
Calophyllaceae	*Mesua*	sp. 1	T	Enyak beruk / Tabaras akar tinggi / Pasir-pasir		
Chrysobalanaceae	*Licania*	*splendens*	T	Bintan	LC	
Clusiaceae (*Guttiferae*)	*Garcinia*	*bancana*	T	Manggis (hutan)		
		sp. 1	T	Aci		
		sp. 2	T			
		sp. 3	T	Gantalang		
		sp. 4 *parvifolia*	T	Gandis		

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
Clusiaceae (*Guttiferae*) {continued}	*Garcinia* {continued}	sp. 5	T	Manggis jambu		
		sp. 6 *cf. cuspidata*	T	Gandis		
		sp. 7	T	Gandis		
		sp. 8 *cf. celebica (hombroniana)*	T			
		sp. 9	T	Gandis		
		sp. 10	T	Manggis empat garis		
		sp. 11	T	Mahalilis		
Euphorbiaceae	*Blumeodendron*	*tokbrai (elateriospermum)*	T	Kenari		
	cf. Borneodendron	sp. 1	T	Songkai bujongan		
	Cephalomappa	sp. 1	T	Kerandau		
	Glochidion	*cf. glomerulatum*	T	Buah bintang		
	Macaranga	*caladiifolia*	T	Mahang semut / bitik		
		sp. 2	T	Mahang batu		
	Neoscortechinia	*kingii*	T	Pupuh palanduk / Nangka-nangka		
	Pimelodendron	*griffithianum*	T			
	Unknown	sp. 2	L			
		sp. 3	T	Maha ramin		
		sp. 4	T	Teras bamban		
Hypericaceae	*Cratoxylon*	*arborescens*	T	Geronggang mambulau		
		glaucum	T	Geronggang merah / Geronggang padang		
Linaceae	*Ctenolophon*	*parvifolius*	T	Kayu Cahang		
Ochnaceae	*Euthemis*	*leucarpa*	Sh			
		sp. 1	Sh			
	Unknown	sp. 1	T			
Phyllanthaceae	*Antidesma*	*coriaceum*	T	Tampohot / Dawat		
		montanum (phanerophleum)	T	Matanundang		
	Baccaurea	*bracteata*	T	Rambai hutan		
		tetrandra (stipulata)	T	Kayu tulang		

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
Rhizophoraceae	*Carallia*	*brachiata*	T	Gandis		
	Gynotroches	sp. 1	T	Kelumun		
MALVALES						
Dipterocarpaceae	*cf. Anisoptera*	sp. 1	T	Keruing Sabun		
	Cotylelobium	*cf. lanceolatum*	T	Rasak galeget / Rasak daun kecil	VU (*C. lanceolatum*)	
		melanoxylon	T		EN	
	Dipterocarpus	*borneensis*	T	Keruing		
		confertus	T	Simpur		
		rappa	T	Bangkirai Rawa		
	Shorea	*balangeran*	T	Kahui / Balangeran	CR	
		crassa	T			
		teysmanniana	T	Meranti semut	EN	
		uliginosa	T	Meranti batu	VU	
	Unknown	sp. 1	T	Rasak		
	Vatica	*mangachapoi*	T	Rasak napu	EN	
Malvaceae	*Microcos (Grewia)*	sp. 1	T	Barania himba		
		sp. 2	T	Barania himba buah besar		
	Sterculia	*rhoidifolia*	T	Loting		
		sp. 1	T	Galaga		
		sp. 2	T	Muara bungkang		
Thymelaeaceae	*Gonystylus*	*bancanus*	T	Ramin	VU	
	Unknown	sp. 1	T			
MYRTALES						
Combretaceae	*Combretum*	sp. 1	L	Bajakah tampelas		
Crypteroniaceae	*Dactylocladus*	*stenostachys*	T	Mertibu		
Melastomataceae	*Melastoma*	*malabathricum*	Sh	Karamunting biasa		
		sp. 1	Sh	Karamunting Danum		
	Memecylon	sp. 1	T	Jambu-jambu		
		sp. 2	T	Milas		
		sp. 3	T	Tabati himba		
	Pternandra	*cf. coerulescens / galeata*	T	Kemuning yg bergaris tiga		

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
Myrtaceae	*Baeckea*	*frutescens*	T	Kayu pilus		
	Syzygium (Eugenia)	*zeylanicum (spicata)*	T	Kayu lalas		
	Syzygium	*cf. valevenosum*	T	Kayu lalas daun besar		
		claviflorum (clavatum)	T			
		havilandii	T	Tatumbu / Jambu-jambu 1		
		sp. 1 *cf. garcinifolia*	T	Jambu burung		
		sp. 2	T	Kemuning putih		
		sp. 3 *cf. nigricans*	T	Jambu burung kecil		
		sp. 4	T	Jambu burung kecil		
		sp. 5 *cf. E.spicata*	T	Kayu lalas daun kecil		
		sp. 6 *cf. campanulatum*	T	Tampohot batang		
		sp. 7	T	Milas 1		
		sp. 8	T	Jambu burung		
		sp. 9 *cf. lineatum*	T			
		sp. 10	T	Jambu burung		
		sp. 11	T	Jambu burung kecil		
		sp. 12	T			
		sp. 13	T	Tampohot himba		
		sp. 14	T	Milas 2		
		sp. 15	T	Hampuak galaget		
	Tristaniopsis	*obovata*	T	Blawan		
		sp. 1 *cf. bakhuizena*	T	Blawan buhis		
		sp. 2	T	Blawan merah		
		sp. 3 *cf. merguensis*	T	Blawan putih		
		sp. 4	T	Blawan punai		
		whiteana	T	Blawan		
OXALIDALES						
Elaeocarpaceae	*Elaeocarpus*	*acmocarpus*	T	Patanak galaget		
		cf. griffithi	T	Rarumpuit		
		marginatus	T	Kejinjing		
		mastersii	T	Mangkinang		
		sp. 1	T	Pasir payau		
		sp. 4	T	Ampaning nyatu		

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
PANDANALES						
Pandanaceae	*Freycinetia*	sp. 1	C	Akar gerising		
		sp. 2	C	Katipei Pari		
	Pandanus	sp. 1	Sh	Sambalaun / Pandan		
		sp. 2	Sh	Rasau		
	Pandanus / Freycinetia	sp. 1	Sh	Gerising / Pandan		
PIPERALES						
Piperaceae	*Piper*	sp. 1	C	Sirih himba		
POALES						
Cyperaceae	*Mapania (Thoracostachyum)*	*bancanum*	Se	Rumput		
Flagellariaceae	*Flagellaria*	sp. 1	C	Uey namei		
RANUNCULALES						
Menispermaceae	*Fibraurea*	*tinctoria*	L	Kalamuhe		
ROSALES						
Fagaceae	*Castanopsis*	*foxworthyii / jaherii*	T	Takurak		
	Lithocarpus	*conocarpus*	T	Pampaning bayang		
		rassa	T	Pampaning sangat besar		
		sp. 1 *cf. dasystachys*	T	Pampaning bitik		
		sp. 3	T	Pampaning bayang buah besar		
		sp. 4	T	Pampaning suling		
		sp. 5	T	Pampaning rantai		
		spp. 7–9	T	Pampaning		
Juglandaceae	*Engelhardtia*	*serrata*	T	Nyamu		
Moraceae	*Ficus*	*cf. spathulifolia*	Fi	Lunuk punai		
		cf. crassiramea stupenda (cf. stupenda)	Fi	Lunuk tinggang		
		sp. 2	Fi	Lunuk bunyer		
		sp. 5	Fi	Lunuk buhis		
		sp. 6	Fi	Lunuk sambon		

 DOI: 10.19189/MaP.2018.OMB.352

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
Moraceae {continued}	*Ficus* {continued}	sp. 7	Fi	Lunuk tabuan		
		sp. 8	Fi	Lunuk		
		spp. 9–10	Fi	Sesendok		
	Parartocarpus	*venenosus*	T	Lilin-lilin / Tapakan		
Rhamnaceae	*Ziziphus*	*angustifolia*	L	Kawit antan / Karinat / Liana duri		
SANTALALES						
Loranthaceae	*Dendrophthoe*	*incurvata*	P			
	Lepidaria	sp. 1	P	Mentawa		
SAPINDALES						
Anacardiaceae	*Bouea*	*oppositifolia*	T	Tamehas		
	Buchanania	*cf. arborescens*	T	Kenyem burung		
	Campnosperma	*coriaceum*	T	Ta(e)rontang		
		squamatum	T	(Teras) nyating		
Burseraceae	*Canarium*	sp. 1	T	Geronggang putih		
	Santiria	*cf. griffithi*	T	Teras Bamban	LC (*S. griffithi*)	
		cf. griffithi	T	Kasiak	LC (*S. griffithi*)	
		cf. laevigata	T	Irat	LC (*S. laevigata*)	
		spp. 1–2	T	Gerrongang putih		
Meliaceae	*Aglaia*	*rubiginosa*	T	Kajalaki / Para-para	NT	
		sp. 1	T	Bangkuang napu		
	Chisocheton	sp. 1	T	Mariuh		
		sp. 2	T	Latak manuk		
	Sandoricum	*beccanarium*	T	Papong / Ketapi hutan		
Rutaceae	*Tetractomia*	*tetrandra*	T	Rambangun		
Sapindaceae	*cf. Cubilia*	*cubili*	T	Kahasuhuy	LC (*C. cubili*)	
	Nephelium	*lappaceum*	T	Rambutan hutan / Manamun	LC	
		maingayi	T	Kelumun buhis / Rambutan gundul		
		sp. 1	T	Kaaja		
	Xerospermum	*laevigatum / noronhianum*	T	Kelumun biasa / bakei		
Simaroubaceae	*Quassia*	*borneensis*	T	Kayu takang		

***GROUP*/ORDER/Family**	**Genus**	**Species**	**Form**	**BNF local name**	**IUCN**	**Protected?**
UNKNOWN						
Unknown	Unknown	sp. 6	L	Kelemuhe / Liana kuning sp. 2		
		sp. 7	L			
		sp. 8	L	Liana Semut		
		sp. 9	L			
			T	Kala pimping galaget		
			T	Rumbang		
			Sh	Lemba		
			E	Anggrek tanduk rusa		
			E	Pahakung		
			L	Liana Sonya		
			L	Liana rambutan		
	Xanthophyllum?	sp.	T	Takang sp. 2		
VITALES						
Vitaceae	*Ampelocissus*	*rubiginosa*	L	Bajakah panamar pari		
		sp. 1	L	Bajakah oyang / Liana anggur		
	Unknown	sp. 1	L	Bajakah panamar pari		
ZINGIBERALES						
Zingiberaceae	*Alpinia*	sp. 1	Sh	Suli batu		
	Unknown	sp. 1	Sh	Suli kambang		
	Zingiber	sp. 1	Sh	Suli tulang		

 DOI: 10.19189/MaP.2018.OMB.352

Table A2. List of ant (Formicidae) species recorded in the NLPSF, Sebangau. No species identified to species level are listed in the IUCN Red List or Indonesian protected species list. Slashes indicate cases in which identification between two species is uncertain, and parentheses indicate subgenera. Abbreviations: "nr." = near (indicating relatedness to the taxon referred to).

Sub-family	**Genus**	**Species**
Dolichoderinae	*Ochetellus*	sp. 1
	Philidris	sp. 1
	Tapinoma	*melanocephalum*
		spp. 1–2
	Technomyrmex	*kraepelini*
		lisae
		rotundiceps
		sp. 1
Ectatomminae	*Gnamptogenys*	*gabata*
Formicinae	*Camponotus*	sp. 1
		spp. 3–6
	Dinomyrmex	*gigas*
	Euprenolepis	*procera*
	Nylanderia	spp. 1–3
	Oecophylla	*smaragdina*
	Polyrhachis (Hedomyrma)	sp. 1
	Polyrhachis (Myrma)	sp. 1
	Polyrhachis (Myrmhopla) sexspinosa-group	sp. 1
	Polyrhachis (Polyrhachis)	*ypsilon*
	Formicinae	sp. 1
Myrmicinae	*Acanthomyrmex*	*ferox*
	Cardiocondyla	spp. 1–2
	Cardiocondyla wroughtonii-group	spp. 1–2
	Carebara	*cf. affinis*
		cf. pygmaea
		sp. 1
	Crematogaster (Physocrema)	*inflata*
		cf. onusta
		sewardi
	Crematogaster	spp. 1-7
	Mayriella	sp. 1
	Meranoplus	*malaysianus*
	Monomorium	*cf. floricola*
		sp. 1
	Pheidole	*aglae*
		aristoteles
		hortensis / clypeocornis
		jacobsoni
		plagiaria
		quadrensis
		quadricuspis
		rugifera
	Rhopalomastix	sp. 1
	Solenopsis	sp. 1
	Strumigenys	spp. 1–2

 DOI: 10.19189/MaP.2018.OMB.352

Sub-family	**Genus**	**Species**
Myrmicinae {continued}	*Tetramorium*	*pacificum*
		scabrosum-group sp. 1
		sp. 1
		cf. "Triglyphothrix" sp. 1
		tonganum-group sp. 1 *(nr. laparum)*
		tortuosum-group sp. 1
	Vollenhovia	sp. 1
Ponerinae	*Leptogenys*	sp. 1
	Odontomachus	*rixosus*
	Pachycondyla	*cf. tridentata*
Pseudomyrmecinae	*Tetraponera*	*attenuata*
		extenuata / modesta
		nitida

 DOI: 10.19189/MaP.2018.OMB.352

Table A3. List of butterfly (Lepidoptera) species recorded in the NLPSF, Sebangau, together with IUCN Red List classifications (LC = least concern). No species are included on the Indonesian protected species list.

Family	**Sub-family**	**Genus**	**Species**	**IUCN**
Nymphalidae	Charaxinae	*Agatasa*	*calydonia*	
		Charaxes	*bernardus*	
			borneensis	
			solon	
		Polyura	*hebe*	
			schreiber	
		Prothoe	*franck*	
	Cyrestinae	*Chersonesia*	*peraka*	
	Danainae	*Euploea*	*mulciber*	
			radamanthus	
		Ideopsis	*vulgaris*	LC
	Heliconiinae	*Vindula*	*dejone*	
	Limenitidinae	*Athyma*	*asura*	
			pravara pravara	
		Dophla	*evelina*	
		Moduza	*procris*	
		Pandita	*sinope*	
	Morphinae	*Amathusia*	*phidippus*	
		Faunis	*stomphax*	
		Thaumantis	*klugius*	
			noureddin	LC
		Zeuxidia	*aurelius*	
			doubledayi horsfieldi	
	Nymphalinae	*Euthalia*	*kanda kanda*	
		Hypolymnas	*bolina*	
		Lexias	*bangkana*	
			canescens	
			cyanipardus	
			pardalis	
			sp. 1	
		Tanaecia	*clathrata clathrata*	
			godartii vacillaria	
			munda	
			sp. 1	
	Satyrinae	*Coelites*	*euptychioides euptychioides*	
		Melanitis	*leda*	
		Mycalesis	*anapita*	
		Xanthotaenia	*busiris*	
Papilionidae		*Graphium*	*agamemnon*	
			antiphates	
			delessertii	
			doson	
			evemon	
			sarpedon	
		Papilio	*demoleus*	
			iswara	
Riodinidae		*Paralaxita*	*damajanti*	LC
			orphna	LC
			telesia	

 DOI: 10.19189/MaP.2018.OMB.352

Family	**Sub-family**	**Genus**	**Species**	**IUCN**
Pieridae	Coliadinae	*Eurema*	*nicevillei*	
	Pierinae	*Saletara*	*panda*	
Hesperidae	Coeliadinae	*Burara*	*etelka*	
			gomata	
			harisa	
		Hasora	*badra*	
Lycaenidae	Lycaeninae	*Acytolepis*	*puspa*	
			ripte	
		Arhopala	sp. 1	
		Caleta	*elna*	
		Catapaecilma	*evansi*	
		Nacaduba	*solta*	
		Zeltus	*amasa*	
	Theclinae	*Amblypodia*	*narada*	
		Eooxylides	*tharis*	
		Hypolycaena	*amablis*	
			amasa	

 DOI: 10.19189/MaP.2018.OMB.352

Table A4. List of spider (Araneae) species recorded in the NLPSF, Sebangau. No species identified to species level are listed in the IUCN Red List or Indonesian protected species list.

Family	Genus	Species
Aranaeidae	*Argiope*	spp. 1–11
		versicolor
	Cyclosa	*bifida*
		insulana
		sp. 1
	Cyrtophora	*beccarii*
		unicolor
	Neoscona	spp. 1–15
	Parawaxia	*dehaani*
	Aranaeidae	spp. 1–14
Clubionidae	*Malamatidia*	*bohorkensis*
	Nusatidia	*borneensis*
	Pristidia	*longistila*
	Clubionidae	spp. 1–5
Corrinidae	*Medmassa*	spp. 1–2
		insignis
	Utivarachna	sp.1
	Corrinidae	spp. 1–6
Ctenidae	*Ctenus*	*sarawakensis*
	Ctenidae	spp. 1–2
Hersiliidae	*Hersilia*	*deelemanae*
		spp. 1–3
Mimetidae	*Mimetus*	spp. 1–6
Nephilidae	*Nephila*	sp. 1
Oonopidae	Oonopidae	spp. 1–56
Oxyopidae	*Hamataliwa*	spp. 1–8
Pholcidae	*Belisana*	sp. 1
	Calapnita	*deelemanae*
	Pholcidae	spp. 1–8
Pisauridae	*Nilus*	*albocinctus*
	Pisauridae	spp. 1–4
Salticidae	*Donoessus*	*striatus*
	Parabithippus	*petrae*
	Portia	*labiata*

Family	Genus	Species
Salticidae {continued}		sp. 1
	Spartaeus	*spinimanus*
	Telamonia	*dimidiata*
	Salticidae	spp. 1–25
Sparassidae	*Heteropoda*	sp. 1
		tetrica
		venatoria
Sparassidae	*Pandercetes*	sp. 1
	Sparassidae	spp. 1–4
Tetragnathidae	*Leucauge*	*argentina*
		celebesiana
		spp. 1–7
	Mesida	sp. 1
	Opadometa	spp. 1–2
	Tylorida	*ventralis*
	Tetragnathidae	spp. 1–12
Theridiidae	*Ariamnes*	sp. 1
	Brunepisinus	*selirong*
	Chrysso	spp. 1–12
	Janula	*batman*
		spp. 1–6
	Phoroncidia	sp. 1
	Rhomphaea	spp. 1–10
	Theridion	*zebrinum*
	Theridiidae	spp. 1–6
Thomisidae	*Thomisus*	sp. 1
	Thomisidae	spp. 1–3
Uloboridae	*Philoponella*	*raffrayi*
	Uloborus	*plumipes*
		sp. 1
	Uloboridae	sp. 1
Zodariidae	*Asceua*	sp. 1
Unknown	Unknown	spp. 1–27

 DOI: 10.19189/MaP.2018.OMB.352

Table A5. List of dragon/damselfly (Odonata) species recorded in the NLPSF, Sebangau, together with IUCN Red List classifications (DD = data deficient; LC = least concern; NT = near threatened) and Borneo endemic species assignments. None of these species are included in the Indonesian protected species list. Slashes indicate alternative English names.

INFRAORDER / Family	**Genus**	**Species**	**English Name**	**IUCN**	**Endemic?**
ANISOPTERA					
Aeshnidae	*Heliaeschna*	*crassa*		LC	
		idae		LC	
	Tetracanthagyna	*plagiata*		LC	
	Oligoaeschna	sp.			
Corduliidae	*Metaphya*	*micans*			Yes
Gomphidae	*Ictinogomphus*	*acutus*		NT	
Libellulidae	*Brachygonia*	*oculata*		LC	
		ophelia		DD	
		puella			
	Chalybeothemis	*fluviatilis*		LC	
	Nannophyopsis	*chalcosoma*			
		pygmaea	Scarlet dwarf	LC	
	Neurothemis	*fluctuans*	Red grasshawk / common parasol / grasshawk dragonfly	LC	
	Orthetrum	*chrysis*	Spine-tufted skimmer / crimson-tailed marsh hawk / brown-backed red marsh hawk	LC	
		sabina	Slender skimmer / green marsh hawk	LC	
	Pornothemis	*serrata*			
	Raphismia	*inermis*			
	Rhyothemis	*phyllis phyllis*	Yellow-striped flutterer / yellow-barred flutterer	LC	
	Risiophlebia	*dohrni*		LC	
	Tholymis	*tillarga*	Coral-tailed cloudwing	LC	
	Tramea	*phaeoneura*			Yes
	Tyriobapta	*laidlawi*			
	Zyxomma	*petiolatum*	Longtailed dusk darter / brown dusk hawk / dingy duskflyer	LC	
Macromiidae	*Epophthalmiaa*	*vittigera*		LC	
ZYGOPTERA					
Argiolestidae	*Podolestes*	*atomarius*			Yes
Chlorocyphidae	*Libellago*	*hyalina*		LC	
	Pachycypha	*aurea*			Yes
Coenagrionidae	*Agriocnemis*	*minima*		LC	
	Amphicnemis	*platystyla*		DD	Yes
		triplex			Yes
		sp. 2			Yes[1]
	Archibasis	*melanocyana*	Blue-nosed sprite		
		viola		LC	
	Ceriagrion	*cerinorubellum*	Orange-tailed marsh dart / bi-coloured damsel	LC	
	Mortonagrion	*forficulatum*			Yes
	Pseudagrion	*coomansi*		DD	
	Teinobasis	*cf. suavis*			Yes[2]

 DOI: 10.19189/MaP.2018.OMB.352

INFRAORDER / Family	Genus	Species	English Name	IUCN	Endemic?
Platycnemididae	*Coeliccia*	*paludensis*			Yes
	Elattoneura	*aurantiaca*			
		erythromma			Yes
		coomansi			

[1] Every named species of *Amphicnemis* known from Borneo is endemic to Borneo and it is highly unlikely that this species, even if undescribed, is any different. Therefore, this species is considered to be a Borneo endemic here.

[2] Although male specimens are required to confirm definitive identification as *T. suavis*, this species record is considered to indicate a Borneo endemic here because no similar species are known from other parts of the region.

 DOI: 10.19189/MaP.2018.OMB.352

Table A6. List of freshwater fish (Actinopterygii) species recorded in the NLPSF, Sebangau, together with IUCN Red List classifications (DD = data deficient; LC = least concern; VU = vulnerable) and Borneo endemic species assignments. None of these species are included in the Indonesian protected species list. Additional local and Indonesian species names are provided by Thornton (2017).

ORDER / Family	**Genus**	**Species**	**English name**	**IUCN**	**Endemic?**
BELONIFORMES					
Zenarchopteridae	*Hemirhamphodon*	*chrysopunctatus*			
		tengah			
CYPRINIFORMES					
Cobitidae	*Kottelatlimia*	*cf. pristes*			
Cyprinidae	*Cyclocheilichthys*	*janthochir*			Yes
	Desmopuntius	*foerschi*	Foersch's fire barb		Yes
		hexazona	Six-banded tiger barb		
		johorensis	Striped barb		
		rhomboocellatus	Snakeskin barb		Yes
	Eirmotus	sp. [1]	Eight-banded barb		
	Osteochilus	*melanopleura*	Greater bony lipped barb	LC	
		spilurus		LC	
	Rasbora	*cephalotaenia*	Porthole rasbora		
		dorciocelatta	Eyespot rasbora		
		kalbarensis	Kalbar rasbora		Yes
		kalochroma	Clown rasbora		
	Striuntius	*lineatus*	Lined barb		
	Trigonopoma	*gracile*	Blackstripe rasbora		
PERCIFORMES					
Anabantidae	*Anabas*	*testudineus*	Climbing perch	DD	
Channidae	*Channa*	*bankanensis*	Bangka snakehead		
		gachua	Forest snakehead	LC	
		melanoptera	Black finned snakehead		
		micropeltes	Giant snakehead	LC	
		pleurophthalmus	Oscellated snakehead		
		striata	Snakehead murrel	LC	
Helostomatidae	*Helostoma*	*temminckii*	Kissing gourami	LC	
Nandidae	*Nandus*	*nebulosus*	Bornean leaffish	LC	
Osphronemidae	*Belontia*	*hasselti*	Malay combtail		
	Betta	*anabatoides*	Giant betta		Yes
		foerschi			Yes
		hendra [2]			Yes
	Luciocephalus	*aura*	Peppermint pikehead		
		pulcher	Giant pikehead		
	Sphaerichthys	*acrostoma*	Giant chocolate gourami		Yes
		osphromenoides	Chocolate gourami		
	Trichopodus	*pectoralis*	Snakeskin gourami	LC	
Pristolepidae	*Pristolepis*	*grootii*	Indonesian leaffish		

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	Genus	Species	English name	IUCN	Endemic?
SILURIFORMES					
Bagridae	*Leiocassis*	*micropogon*	Bumblebee catfish		
		sp.			
	Mystus	*nigriceps*	Twospot catfish		
		olyroides			Yes
		sp.			
Chacidae	*Chaca*	*bankanensis*	Angler catfish	LC	
Clariidae	*Clarias*	*meladerma*	Blackskin catfish	LC	
		nieuhofii	Slender walking catfish	LC	
		teijsmanni	Airbreathing catfish		
	Encheloclarias	*tapeinopterus*		VU	
Schilbeidae	*Pseudeutropius*	*moolenburghae*	Sun catfish		
Siluridae	*Kryptopterus*	sp.	Striped glass catfish		
	Ompok	*leiacanthus*		DD	
	Silurichthys	*ligneolus*	Brown leaf catfish		Yes
		phaiosoma	Hasselt's leaf catfish		
	Wallago	*leeri*	Striped wallago catfish		
SYNBRANCHIFORMES					
Mastacembelidae	*Macrognathus*	*aculeatus*	Lesser spiny eel		
		maculatus	Frecklefin eel	LC	
Synbranchidae	*Monopterus*	*albus*	Asian swamp eel	LC	

[1] Potentially new species based on inspection in the field and of photographs. Specimen required for confirmation.

[2] New species described from the Palangka Raya/Sebangau area in Central Kalimantan (Schindler & Linke 2013).

 DOI: 10.19189/MaP.2018.OMB.352

Table A7. List of amphibian (Amphibia; Anura) species recorded in the NLPSF, Sebangau, together with IUCN Red List classifications (LC = least concern; NT = near threatened; VU = vulnerable). No species identified to species level are listed in the Indonesian protected species list and none are Borneo endemics. Parentheses indicate synonyms.

Family	**Genus**	**Species**	**Common name**	**IUCN**
Bufonidae	*Ingerophrynus*	*quadriporcatus*	Swamp toad	LC
	Pseudobufo	*subasper*	Aquatic swamp toad	LC
Dicroglossidae	*Limnonectes*	*paramacrodon*	Lesser swamp frog	NT
	Occidozyga	*laevis*	Yellow-bellied puddle frog	LC
Microhylidae	*Kalophrynus*	*punctatus*	Dotted sticky frog	VU
Ranidae	*Pulchrana (Hylarana)*	*baramica*	Brown marsh frog	LC
	Chalcorana (Hylarana)	*raniceps*	White-lipped tree frog	LC
Rhacophoridae	*Polypedates*	*colletti*	Collett's tree frog	LC
		leucomystax	Four-lined tree frog	LC
		macrotis	Dark-eared tree frog	LC
	cf. Racophorus	sp. 1	Tree frog spp.	

 DOI: 10.19189/MaP.2018.OMB.352

Table A8. List of reptile (Reptilia) species recorded in the NLPSF, Sebangau, together with IUCN Red List classifications (DD = data deficient; EN = endangered; LC = least concern; NT = near threatened; VU = vulnerable), Indonesian protected species listings (i.e. 'Protected?' refers to protection status in Indonesia) and Borneo endemic species assignments. Parentheses indicate synonyms and slashes indicate cases in which identification between two classifications is uncertain.

ORDER / Family	**Genus**	**Species**	**English name**	**IUCN**	**Protected?**	**Endemic?**
SQUAMATA						
Agamidae	*Bronchocela*	*cristatella*	Green-crested lizard			
	Draco	*quinquefasciatus*	Flying lizard			
Colubridae	*Calamaria*	sp.	Reed snake sp.			
	Gonyosoma	*oxycephalum*	Red-tailed racer	LC		
	Ahaetulla	*fasciolata*	Speckle-headed whip snake	LC		
		prasina	Green vine snake	LC		
	Boiga	*jaspidea*	Jasper cat snake	LC		
	Chrysopelea	*paradisi*	Paradise tree snake	LC		
	Dendrelaphis	*caudolineatus*	Striped bronze-back			
		formosus	Elegant bronze-back	LC		
		pictus	Painted bronze-back			
	Homalopsis	*buccata*	Puff-faced water snake	LC		
	Oligodon	*octolineatus*	Striped kukri snake	LC		
	Psammodynastes	*pictus*	Painted mock viper			
	Rhabdophis	*chrysargos*	Speckle-bellied keelback	LC		
	Macropisthodon	*flaviceps*	Orange-lipped keelback	LC		
	Xenochrophis	*trianguligerus*	Red-sided keelback water snake	LC		
	Stegonotus	*borneensis*	Bornean black snake	LC		Yes
	Xenelaphis	*hexagonotus*	Malayan brown snake	LC		
Crotalinae	*Trimeresurus*	*sumatranus*	Sumatran pit viper	LC		
	Tropidolaemus	*wagleri*	Wagler's (keeled green) pit viper	LC		
Cylindrophiidae	*Cylindrophis*	*ruffus*	Red-tailed pipe snake	LC		
Elapidae	*Bungarus*	*flaviceps*	Red-headed krait	LC		
	Calliophis	*bivirgata*	Blue coral snake	LC		
	Naja	*sumatrana*	Equatorial spitting cobra	LC		
	Ophiophagus	*hannah*	King Cobra	VU		
Homalopsidae	*Enhydris*	*enhydris*	Rainbow water snake	LC		
	Phytolopsis (Enhydris)	*punctate*	Blackwater mud snake	DD		

ORDER / Family	Genus	Species	English name	IUCN	Protected?	Endemic?
Gekkonidae	*Cyrtodactylus*	*pubisulcus*	Inger's bow-fingered gecko			Yes
	Gekko	*smithii*	Forest gecko	LC		
	Hemidactylus	*frenatus*	House gecko	LC		
Pythonidae	*Python*	*reticulatus*	Reticulated python			
Scincidae	*Dasia*	*vitatta (vittatum)*	Banded tree skink			
	Dasia / Lamprolepis group	sp.	Skink sp. 1			
	Lygosoma	sp. (*sens. lat.*)	Skink sp. 2			
	Eutropis	*cf. multifasciata*	*cf.* common sun skink			
	Sphenomorphus	sp.	Skink sp. 4			
Varanidae	*Varanus*	*salvator*	Monitor lizard	LC		
Xenopeltidae	*Xenopeltis*	*unicolor*	Iridescent earth snake	LC		
CROCODILIA						
Crocodylidae	*Crocodylus*	*porosus (raninus)* [1]	Estuarine / Bornean crocodile	LC (*C. porosus*)	Yes (*C. porosus*)	Yes (*C. raninus*)
	Tomistoma	*schlegelii*	Malayan/false gharial	VU	Yes	
TESTUDINES						
Bataguridae	*Orlitia*	*borneensis*	Bornean river turtle	EN	Yes	Yes
Geoemydidae	*Cuora*	*amboinensis*	South Asian box turtle	VU		
	Cyclemys	*dentata*	Asian Leaf Turtle	NT		
Trionychidae	*Amyda*	*cartilaginea*	South Asian softshell turtle	VU		

[1] *C. raninus* is often considered to be a separate species endemic to Borneo (Ross 1990, 1992; Martin 2008) but some authors remain uncertain (Cox *et al.* 1993) and a unique Borneo species is not recognised by the IUCN, which only lists *C. porosus* (Crocodile Specialist Group 1996).

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Table A9. List of bird (Aves) species recorded in the NLPSF, Sebangau, together with IUCN Red List classifications (CR = critically endangered; DD = data deficient; EN = endangered; LC = least concern; NT = near threatened; VU = vulnerable), Indonesian protected species listings ('Protected?' refers to protection status in Indonesia) and Borneo endemic species assignments. Parentheses for Latin names indicate synonyms and slashes indicate cases where identification between two options is uncertain. For English names, parentheses indicate optional parts of the name and slashes indicate alternative names.

ORDER / Family	**Genus**	**Species**	**Common name**	**IUCN**	**Protected?**	**Endemic?**
GALLIFORMES						
Phasianidae	*Melanoperdix*	*nigra*	Black partridge	VU		
	Lophura	*erythrophthalma*	Crestless fireback	VU		
	Argusianus	*argus*	Great argus [1]	NT	Yes	
ANSERIFORMES						
Anatidae	*Dendrocygna*	*javanica*	Lesser whistling duck	LC		
CICONIIFORMES						
Ciconiidae	*Ciconia*	*stormi*	Storm's stork	EN	Yes	
	Leptoptilos	*javanicus*	Lesser adjutant (stork)	VU	Yes	
Threskiorbithidae	*Pseudibis*	*davisoni*	White-shouldered ibis [2]	CR	Yes	
Ardeidae	*Ixobrychus*	*cinnamomeus*	Cinnamon bittern	LC		
	Butorides	*striatus*	Little / striated heron	LC		
	Ardeola	*speciosa*	Javan pond-heron	LC		
	Ardea	*sumatrana*	Great-billed heron	LC	Yes	
		purpurea	Purple heron	LC		
	Egretta	*garzetta*	Little egret	LC		
PELICANIFORMES						
Anhingidae	*Anhinga*	*melanogaster*	Oriental darter	NT		

[1] Confirmed sighting in NLPSF from mid-1990s, but no records since. Probably locally extinct, at least in NLPSF.

[2] One sighting in NLPSF from burned area in tall-interior forest in 1999, but no records since. Possible vagrant or locally extinct, at least in NLPSF.

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	Genus	Species	Common name	IUCN	Protected?	Endemic?
FALCONIFORMES						
Falconidae	*Microhierax*	*fringillarius*	Black-thighed falconet	LC	Yes	
Accipitridae	*Aviceda*	*jerdoni*	Jerdon's baza	LC	Yes	
	Haliastur	*indus*	Brahminy kite	LC	Yes	
	Haliaeetus	*leucogaster*	White-bellied sea-eagle	LC	Yes	
	Spilornis	*cheela*	Crested serpent eagle	LC	Yes	
	Accipiter	*trivirgatus*	Crested goshawk	LC	Yes	
	Nisaetus (Spizaetus)	*cirrhatus (limnaeetus)*	Changeable hawk-eagle	LC	Yes	
		nanus	Wallace's hawk-eagle	VU	Yes	
GRUIFORMES						
Rallidae	*Amaurornis*	*phoenicurus*	White-breasted waterhen	LC		
CHARADIFORMES						
Scolopacidae	*Actitis*	*hypoleucos*	Common sandpiper	LC		
	Tringa	*glareola*	Wood sandpiper	LC		
Laridae	*Gelochelidon (Sterna)*	*nilotica*	Gull-billed tern	LC	Yes	
	Sterna / Thalasseus	sp.	Crested tern sp.	-		
COLUMBIFORMES						
Columbidae	*Streptopelia*	*chinensis*	Spotted dove	LC		
	Chalcophaps	*indica*	Emerald dove	LC		
	Ptilinopus	*jambu*	Jambu fruit-dove	NT		
	Treron	*fulvicollis*	Cinnamon-headed green-pigeon	NT		
		vernans	Pink-necked green-pigeon	LC		
		curvirostra	Thick-billed green-pigeon	LC		
	Ducula	*aenea*	Green imperial-pigeon	LC		
		badia	Mountain imperial-pigeon	LC		
PSITTACIFORMES						
Psittacidae	*Loriculus*	*galgulus*	Blue-crowned hanging-parrot	LC	Yes	
	Psittacula	*longicauda*	Long-tailed parakeet	NT	Yes	

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	Genus	Species	Common name	IUCN	Protected?	Endemic?
CUCULIFORMES						
Cuculidae	*Cacomantis*	*sonneratii*	Banded bay cuckoo	LC		
		merulinus	Plaintive cuckoo	LC		
	Chrysococcyx	*xanthorhynchus*	Violet cuckoo	LC		
	Surniculus	*lugubris*	Drongo cuckoo	LC		
	Carpococcyx	*radiatus (radiceus)*	Bornean ground cuckoo	NT		Yes
	Phaenicophaeus (Rhopodytes)	*sumatranus*	Chestnut-bellied malkoha	NT		
	Rhinortha (Phaenicophaeus)	*Chlorophaea (chlorophaeus)*	Raffle's malkoha	LC		
	Zanclostomus (Phaenicophaeus)	*curvirostris*	Chestnut-breasted malkoha	LC		
	Centropus	*sinensis*	Greater coucal	LC		
		bengalensis	Lesser coucal	LC		
STRIGIFORMES						
Tytonidae	*Phodilus*	*badius*	Oriental bay owl	LC		
Strigidae	*Bubo*	*sumatranus*	Barred eagle-owl	LC		
	Ketupa	*ketupu*	Buffy fish-owl	LC		
	Strix	*leptogrammica*	Brown wood-owl	LC		
	Ninox	*scutulata*	Brown hawk-owl / boobook	LC		
CAPRIMULGIFORMES						
Podargidae	*Batrachostomus*	*stellatus*	Gould's frogmouth	NT		
		cornutus	Sunda frogmouth	LC		
Caprimulgidae	*Eurostopodus*	*temminckii*	Malaysian eared nightjar	LC		
	Caprimulgus	*affinis*	Savanna nightjar	LC		
		concretus	Bonaparte's / Sunda nightjar	VU	Yes	

ORDER / Family	Genus	Species	Common name	IUCN	Protected?	Endemic?
APODIFORMES						
Apodidae	*Collocalia*	*esculenta*	Glossy swiftlet	LC		
	Aerodramus	*fuciphaga*	Edible-nest swiftlet	LC		
	Rhaphidura	*leucopygialis*	Silver-rumped spine/needletail	LC		
	Apus	*affinis*	Little/house swift	LC		
		pacificus	Fork-tailed swift	LC		
	Hemiprocne	*longipennis*	Grey-rumped tree swift	LC		
TROGONIFORMES						
Trogonidae	*Harpactes*	*kasumba*	Red-naped trogon	NT	Yes	
		diardii	Diard's trogon	NT	Yes	
		duvaucelii	Scarlet-rumped trogon	NT	Yes	
CORACIIFORMES						
Coraciidae	*Eurystomus*	*orientalis*	(Asian) dollarbird	LC		
Alcedinidae	*Pelargopsi*	*capensis*	Stork-billed kingfisher	LC		
	Todirhamphu	*chloris*	Collared kingfisher	LC		
	Ceyx	*rufidorsa / erithaca* [3]	Rufous-backed kingfisher / oriental dwarf kingfisher	LC		
	Alced	*meninting*	Blue-eared kingfisher	LC		
Meropidae	*Merop*	*viridis*	Blue-throated bee-eater	LC		
Bucerotidae	*Anorrhinus*	*galeritus*	Bushy-crested hornbill	LC	Yes	
	Anthracoceros	*albirostris*	Oriental pied Hornbill	LC	Yes	
		malayanus	(Asian) black hornbill	NT	Yes	

[3] *Ceyx rufidorsa / erithaca* clade taxonomy is complex. Recent genetic studies (Lim *et al.* 2010) indicate that only *C. rufidorsa* occurs in Borneo, but that hybridisation with *C. erithaca* occurred during periods of low sea level. Sebangau appears to have examples that fit the pure *C. rufidorsa* and of the possible *C. erithaca* hybrid (with patches of dark blue on the outer wings and head). The IOC recognise only *C. erithaca*, with a *motleyi* sub-species occurring on Borneo (IOU 2018). Phillipps & Phillipps (2009) recognise *C. rufidorsa* as resident on Borneo (with *C. rufidorsa rufidorsa* in Kalimantan) and *C. erithaca* as a potential vagrant.

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	Genus	Species	Common name	IUCN	Protected?	Endemic?
Bucerotidae {continued}	*Buceros*	*rhinoceros*	Rhinoceros hornbill [4]	NT	Yes	
	Rhinoplax	*vigil*	Helmeted hornbill [5]	CR	Yes	
	Rhabdotorrhinus (Aceros / Rhyticeros)	*corrugatus*	Wrinkled hornbill	NT	Yes	
PICIFORMES						
Ramphastidae (Megalaimidae)	*Megalaima (Psilopogon)*	*rafflesii*	Red-crowned barbet	NT		
		australis	Blue-eared barbet	LC		
	Calorhamphus	*fuliginosus*	Brown barbet	LC		
Picidae	*Sasia*	*abnormis*	Rufous piculet	LC		
	Dendrocopos	*moluccensis*	Sunda pygmy / brown-capped woodpecker	LC		
		canicapillus	Grey capped (pygmy) woodpecker	LC		
	Dryocopus	*javensis*	White-bellied woodpecker	LC		
	Celeus (Micropternus)	*brachyurus*	Rufous woodpecker	LC		Yes (*C b. badiosus*)
	Picus	*puniceus*	Crimson-winged woodpecker	LC		
		miniaceus	Banded woodpecker	LC		
	Dinopium	*rafflesii*	Olive-backed woodpecker	NT		
	Blythipicus	*rubiginosus*	Maroon woodpecker	LC		
	Reinwardtipicus	*validus*	Orange-backed woodpecker	LC		
	Meiglyptes	*tristis*	Buff-rumped woodpecker	LC		
		tukki	Buff-necked woodpecker	NT		
	Mulleripicus	*pulverulentus*	Great slaty woodpecker	VU	Yes	
	Hemicircus	*concretus*	Grey and buff woodpecker	LC		

[4] Confirmed sightings in NLPSF from the mid-1990s and possibly in 2002/03, but no records since in NLPSF. Probably locally extinct in NLPSF/northern Sebangau, but may still be present in the south-east, where there are greater densities of figs, and abundant in Katingan (M.L. Dragiewicz, personal communication).

[5] Confirmed sightings in NLPSF from the mid-1990s but no records since. Probably locally extinct, at least in NLPSF.

ORDER / Family	Genus	Species	Common name	IUCN	Protected?	Endemic?
PASSERIFORMES						
Eurylaimidae	*Calyptomena*	*viridis*	(Asian) green broadbill	NT		
	Cymbirhynchus	*macrorhynchos*	Black-and-red broadbill	LC		
	Eurylaimus	*javanicus*	Banded broadbill	LC		
		ochromalus	Black-and-yellow broadbill	NT		
Pittidae	*Pitta*	*moluccensis*	Blue -winged pitta	LC	Yes	
	Pitta (Erythropitta)	*granatina*	Garnet pitta	NT	Yes	
Acanthizidae	Gerygone	sulphurea	Golden-bellied gerygone	LC		
Pachycephalidae	*Pachycephala*	*cinerea (grisola)*	Mangrove whistler	LC		
Campephagidae	*Coracina*	*striata*	Bar-bellied cuckooshrike	LC		
		fimbriata	Lesser cuckooshrike	LC		
	Pericrocotus	*igneus*	Fiery minivet	NT		
		speciosus	Scarlet minivet	LC		
Oriolodae	*Oriolus*	*xanthonotus*	Dark-throated oriole	NT		
Incertae	*Hemipus*	*hirundinaceus*	Black-winged flycatcher-shrike	LC		
	Philentoma	*pyrhopterum*	Rufous-winged philentoma	LC		
Artamidae	*Artamus*	*leucorynchus*	White-breasted woodswallow	LC		
Aegithinidae	*Aegithina*	*tiphia*	Common iora	LC		
		viridissima	Green iora	NT		
Rhipiduridae	Rhipidura	javanica	Pied fantail	LC	Yes	
Monarchidae	*Hypothymis*	*azurea*	Black-naped monarch	LC		
	Terpsiphone	*paradisi*	Asian paradise flycatcher	LC		
Dicruridae	Dicrurus	paradiseus	Greater racket-tailed drongo	LC		
Corvidae	*Corvus*	*enca*	Slender-billed crow	LC		
	Platysmurus	*aterrimus*	(Bornean) black magpie	LC		Yes
Pityriasidae	*Pityriasis*	*gymnocephala*	Bornean bristlehead	NT		Yes
Laniidae	*Lanius*	*tigrinus*	Tiger shrike	LC		
		schach	Long-tailed shrike	LC		

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	Genus	Species	Common name	IUCN	Protected?	Endemic?
Nectariniidae	*Anthreptes*	*simplex*	Plain sunbird	LC		
		malacensis	Brown / plain-throated sunbird	LC		
	Leptocoma (Nectarinia)	*Brasiliana / sperata*	van Hasselt's / purple-throated sunbird	LC		
	Hypogramma	*hypogrammicum*	Purple-naped sunbird	LC		
	Arachnothera	*longirostra*	Little spiderhunter	LC		
		crassirostris	Thick-billed spiderhunter	LC		
		flavigaster	Spectacled spiderhunter	LC		
		chrysogenys	Yellow-eared spiderhunter	LC		
Dicaeidae	*Prionochilus*	*maculatus*	Yellow-breasted flowerpecker	LC		
		percussus	Crimson-breasted flowerpecker	LC		
		thoracicus	Scarlet-breasted flowerpecker	NT		
	Dicaeum	*thoracicus (cruentatum)*	Scarlet-backed flowerpecker	LC		
		trigonostigma	Orange-bellied flowerpecker	LC		
Chloropseidae	*Chloropsis*	*sonnerati*	Greater green leafbird	LC	Yes	
		cyanopogon	Lesser green leafbird	NT	Yes	
		cochinchinensis	Blue-winged leafbird	LC	Yes	
Sittidae	*Sitta*	*frontalis*	Velvet-fronted nuthatch	LC		
Estrildidae	*Lonchura*	*atricapilla*	Chestnut / black-headed munia	LC		
		fuscans	Dusky munia	LC		
Passeridae	*Passer*	*montanus*	Eurasian tree-sparrow	LC		
Motacillidae	*Motacilla*	*cinerea*	Grey wagtail	LC		
Sturnidae	*Gracula*	*religiosa*	(Common) hill-mynah	LC	Yes	
Muscicapidae	*Copsychus*	*saularis*	(Oriental) magpie-robin	LC		
	Kittacincla	*malabarica*	White-rumped shama	LC		
	Trichixos	*pyrrhopygus*	Rufous-tailed shama	NT		
	Rhinomyias	*umbratilis*	Grey-chested jungle-flycatcher	NT		

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	Genus	Species	Common name	IUCN	Protected?	Endemic?
Pycnonotidae	*Pycnonotus (Euptilotus)*	*eutilotus*	Puff-backed bulbul	NT		
	Pycnonotus (Brachypodius)	*atriceps*	Black-headed bulbul	LC		
	Pycnonotus	*goiavier*	Yellow-vented bulbul	LC		
		simplex	Cream-vented bulbul	LC		
		aurigaster	Sooty-headed bulbul	LC		
	Setornis	*criniger*	Hook-billed bulbul	VU	Yes	
	Alopoixus	*finschii*	Finsch's bulbul	NT		
Hirundinidae	*Hirundo*	*rustica*	Barn swallow	LC		
		tahitica	Pacific / house swallow	LC		
Timaliidae	*Stachyris*	*nigricollis*	Black-throated babbler	NT		
		erythroptera	Chestnut-winged babbler	LC		
		maculata	Chestnut-rumped babbler	NT		
	Macronous (Mixornis)	*bornensis*	Bold-striped tit-babbler	LC		
		ptilosus	Fluffy-backed tit-babbler	NT		
	Pellorneum	*capistratum*	Black-capped babbler	LC		
	Malacopteron	*cinereum*	Scaly-crowned babbler	LC		
		magnum	Rufous-crowned babbler	NT		
	Malacopteron (Ophrydornis)	*albogulare*	Grey-breasted babbler	NT		
	Trichastoma	*rostratum*	White-chested babbler	NT		
	Malacocincla (Trichastoma)	*malaccensis*	Short-tailed babbler	NT		
Phylloscopidae	*Phylloscopus*	*borealis*	Arctic warbler	LC		
Cisticolidae	*Orthotomus*	*ruficeps*	Ashy tailorbird	LC		
		sericeus	Rufous-tailed tailorbird	LC		
	Prinia	*flaviventris*	Yellow-bellied prinia	LC		

 DOI: 10.19189/MaP.2018.OMB.352

Table A10. List of mammal (Mammalia) species recorded in the NLPSF, Sebangau, together with IUCN Red List classifications (CR = critically endangered; DD = data deficient; EN = endangered; LC = least concern; NT = near threatened; VU = vulnerable), Indonesian protected species listings and Borneo endemic species assignments. Parentheses for Latin names indicate synonyms. For English names, parentheses indicate optional parts of the name and slashes indicate alternative names. Bat species records from Struebig *et al.* (2006).

ORDER / Family	**Genus**	**Species**	**English name**	**IUCN**	**Protected?**	**Endemic?**
ERINACEOMORPHA						
Erinaceidae	*Echinosorex*	*gymnura*	Moonrat	LC		
Soricidae	*Crocidura*	*fuliginosa*	South-east Asian white-toothed shrew	LC		
SCANDENTIA						
Ptilocercidae	*Ptilocercus*	*lowii*	Pentail treeshrew	LC		
Tupaiidae	*Tupaia*	*glis*	Common treeshrew	LC		
		minor [1]	Pygmy treeshrew	LC		
		splendidula [2]	Ruddy treeshrew	LC		
DERMOPTERA						
Cynocephalidae	*Galeopterus*	*variegatus*	Colugo / Sunda flying lemur	LC		
CHIROPTERA						
Pteropodidae	*Megaerops*	*wetmorei*	White-collared fruit bat	VU		
	Balionycteris	*maculata*	Spotted-winged fruit bat	LC		
	Cynopterus	*brachyotis*	Short-nosed fruit bat	LC		
	Pteropus	*vampyrus*	Large flying fox	NT		
Rhinolophidae	*Rhinolophus*	*trifoliatus*	Trefoil horseshoe bat	LC		
		sedulus	Lesser woolly horseshoe bat	NT		
Vespertilionidae	*Glischropus*	*tylopus*	Common thick-thumbed bat	LC		
	Kerivoula	*hardwickii*	Hardwicke's / Common woolly bat	LC		
		intermedia	Small woolly bat	NT		
		minuta	Least woolly bat	NT		
		pelucida	Clear-winged woolly bat	NT		
		papillosa	Papillose woolly bat	LC		
	Murina	*suilla*	Lesser / Brown tube-nosed bat	LC		
	Myotis	*muricola*	Nepalese whiskered myotis bat	LC		

[1] Listed as *T. gracilis* in Page *et al.* (1997), which we consider to be a mis-identification of *T. minor.*

[2] Listed as T. *picta* by Page *et al.* (1997) and Hamamoto *et al.* (2007), which we consider to be a mis-identification of *T. splendidula.*

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	Genus	Species	English name	IUCN	Protected?	Endemic?
PRIMATA						
Lorisidae	*Nycticebus*	*borneanus / menagensis*	Bornean slow loris	VU	Yes	
Tarsiidae	*Tarsius / Cephalopachus*	*bancanus borneanus*	Western / Horsfield's tarsier	VU	Yes	
Cercopithecidae	*Macaca*	*fascicularis*	Long-tailed/crab eating macaque	LC		
		nemestrina	Southern pig-tailed macaque	VU		
	Nasalis	*larvatus*	Proboscis monkey	EN	Yes	Yes
	Presbytis	*rubicunda*	Maroon / Red leaf monkey	LC	Yes	Yes
Hylobatidae	*Hylobates*	*albibarbis*	Bornean white-bearded gibbon	EN	Yes	Yes
Hominidae	*Pongo*	*pygmaeus wurmbii*	Bornean orangutan	CR	Yes	Yes
PHOLIDOTA						
Manidae	*Manis*	*javanica*	Sunda Pangolin	CR	Yes	
RODENTIA						
Sciuridae	*Aeromys*	*tephromelas*	Black flying squirrel	DD		
	Callosciurus	*notatus*	Plantain squirrel	LC		
	Exilisciurus	*exilis*	Plain / least pygmy squirrel	DD		Yes
	Nannosciurus	*melanotis*	Black-eared pygmy squirrel	LC		
	Petinomys	*genibarbis*	Whiskered flying squirrel	VU		
	Ratufa	*affinis*	Pale Giant squirrel	NT		
	Rhinosciurus	*laticaudatus*	Shrew-faced ground squirrel	NT		
	Sundasciurus	*hippurus*	Horse-tailed squirrel	NT		
		lowii	Low's squirrel	LC		
Muridae	*Maxomys*	*whiteheadi*	Whiteheads rat	VU		
	Maxomys / Lenothrix [3]	*surifer / canus* [3]	Red spiny rat / Grey tree rat	LC		
	Niviventer	*cremoriventer*	Dark-tailed tree rat	VU		
	Rattus	*exulans*	Polynesian rat	LC		
	Sundamys	*muelleri*	Müller's rat	LC		

[3] One of *Maxomys surifer* or *Lenothrix canus* considered to be present; requires confirmation.

 DOI: 10.19189/MaP.2018.OMB.352

ORDER / Family	**Genus**	**Species**	**English name**	**IUCN**	**Protected?**	**Endemic?**
CARNIVORA						
Ursidae	*Helarctos*	*malayanus*	(Malayan) sun-bear	VU	Yes	
Mustelidae	*Martes*	*flavigula*	Yellow-throated marten	LC		
	Mustela	*nudipes*	Malay weasel	LC		
	Aonyx	*cinerea*	Oriental / Asian small-clawed otter	VU		
Prionodintidae	*Prionodon*	*linsang*	Banded linsang	LC	Yes	
Viverridae	*Viverra*	*tangalunga*	Malay civet	LC		
	Paradoxurus	*Hermaphroditus (philippinensis)*	Common palm civet	LC		
	Arctictis	*binturong*	Binturong	VU	Yes	
	Arctogalidia	*trivirgata*	Small-toothed palm civet	LC		
	Cynogale	*bennettii*	Otter civet	EN	Yes	
Hespertidae	*Herpestes*	*brachyurus*	Short-tailed mongoose	NT		
		semitorquatus	Collared mongoose	NT		
Felidae	*Neofelis*	*diardi borneensis*	Bornean clouded leopard	EN	Yes	
	Pardofelis	*marmorata*	Marbled cat	NT	Yes	
	Prionailurus	*planiceps*	Flat-headed cat	EN	Yes	
		bengalensis	Leopard cat	LC	Yes	
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Suidae	*Sus*	*barbatus*	Bearded pig	VU		
Tragulidae	*Tragulus*	*kanchil*	Lesser mouse-deer	LC	Yes	
		napu	Greater mouse-deer	LC	Yes	
Cervidae	*Rusa*	*unicolor*	Sambar deer	VU	Yes	
	Muntiacus	*atherodes*	Bornean yellow muntjac	LC	Yes	Yes

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