KOPEL Bhd

Environment Monitoring Report 2020

2020

KOPEL Bhd

Environment Monitoring Report 2020

Background & Introduction

KOPEL Bhd is a community organisation incorporated as a co-operative under the Malaysia Co-operative's Commission Act 1994. KOPEL Bhd is located in the community of Batu Puteh in the heart of the Kinabatangan Floodplain. The community of Batu Puteh consists of four villages, with the village of Batu Puteh at its centre. The entire community is surrounded by the Pin-Supu Forest Reserve, one of the largest protected forest reserves along the Lower Kinabatangan River.

KOPEL's main purpose is to support the generation of income and employment in the local community from the surrounding forests in an ecologically sustainable manner. This entails operating activities that generates income in a manner that supports the conservation of the forest ecosystem, the aquatic ecosystem, the biodiversity of this area, and the wildlife that makes its home in these habitats.

The community of Batu Puteh has been working with the Sabah Forestry Department since 1997 to establish sustainable community-based tourism and forestry activities within the Pin-Supu Forest Reserve. In 1998 the community got involved with fighting forest fires within the reserve. This led to the first community-led forest restoration activities in the wetland forests of the Lower Kinabatangan in 1999.

Major advancements in the forest restoration techniques were made in the following years with support and grants from Ricoh Corporation (Japan), the International School Brunei, Alexander Abraham Foundation and America Forests. LEAP, WWF, Raleigh International, Intrepid Travel, Outlook Expeditions, Camps International, World Challenge, Rakuno Gakuen University, Bring the Elephant Home, Borneo Explorer Club, and the Danau Girang Field Centre are just some of the many NGOs and companies that have supported KOPEL's restoration initiatives over the years.

In the year 2004 the conservation efforts turned to tackle the Invasive waterweed *Salvinia molesta* after this weed completely covered the Tungog Lake in 2003. Through the ingenuity and hard work of the local community, KOPEL cleared the Tungog Lake of the weed Salvinia in March 2007. The work from there-on was funded by the community-based tourism (CBT) programs run by KOPEL bhd. More recently, in the year 2018, KOPEL signed an MOU with Sabah Agriculture Department to release and monitor a biological control program to combat the invasive water weed *Salvinia molesta* on the Tungog Lake.

In the year 2009 the Sabah Forestry Department signed an agreement (MOU) with KOPEL Bhd to co-manage the Pin-Supu Forest Reserve (PSFR), there-in recognising and strengthening the community's long-running efforts to protect and restore the forest and habitats of this reserve. The agreement is designed to ensure that the overall management of this reserve is in-line with the comprehensive 10-year Forest Management Plan. Key partnership activities include; forest and habitat restoration, enhancing monitoring functions, and increasing revenue collection to the State Government via entrance fees.

In the year 2010 KOPEL embarked on protecting the caves in the northwest part of the Pin-Supu Forest Reserve vis a vis an agreement with the Sabah Wildlife Department. In 2012, through support from University Rakuno Gakuen (Japan), KOPEL Bhd began a long-term environmental monitoring program involving water quality monitoring, wildlife monitoring, and forest restoration monitoring.

In this reporting period 2020, conservation activities and monitoring efforts were scaled down due to the COVID19 pandemic, and the collapse of income from tourism. Even so, the core monitoring activities were maintained by KOPEL, and KOPEL is extremely grateful for the support provided by the Sabah Forestry Department, Cardiff University, the Green Steps Group, and Yayasan Hasanah in 2020.

This report is designed to provide an overview and summary of the monitoring outcomes in 2020. This is a key part of KOPEL's commitment towards continued monitoring, transparency, and feedback into the Sustainable Forest Management of Pin Supu Forest Reserve in partnership with the Sabah Forestry Department and other supporting agencies.

1. Forest Restoration & Restoration Monitoring

Forest Restoration efforts in 2020 were ongoing, albeit heavily impacted by the COVID19 pandemic and the subsequent Movement Control Restrictions beginning in mid-March. In the early part of the year tree planting activities with tourists and volunteers continued as per normal, however by mid-February KOPEL was already feeling the impacts of COVID19 through the cancelation of large student groups from mid-February onwards.

A total of **5,649** trees were planted in 2020, combining tourism & voluntourism activities (**1,314** trees) and other externally funded trees planted by the KOPEL restoration team (**4,335** trees). Tree planting generally was down by 30% on preceding year 2019, this was mostly attributed to the COVID19 lockdowns and the cancellation of all tourism activities from March 18 till year end. **Figure 1** (below) shows the overall planting totals for each site planted and a breakdown of species planted on each location. Summary of planting as follows:

Tree planting through ecotourism activities in 2020 (Jan-March) planted a total of **1,314 trees**. A total of 10 species of tree were planted with the bulk of the trees being Bangkal (*Nauclea sp* =563), Kelumpang (*Sterculia sp*. = 207 trees) and Mangkapon (*Colona serratifolia* = 200).

Tree planting through externally funded operations in 2020 planted a total of **4,335 trees**. These trees were funded by Cardiff University Regrow Borneo, and Green Steps Group. A total of 9 species of tree were planted through these programs, with the bulk of the trees being Bangkal (*Nauclea sp* =3,037 trees), Kelumpang (*Sterculia sp*. = 547 trees) and Binuang (*Octomeles sp.* = 270 trees), Terosob (*Dracontomelon sp. = 239 trees*) and Mangkapon (*Colona sp. = 130 trees*). (refer figure 1 below)

Figure 1: Tree species Planted at each Planting site

	Local Name	Species	Kaboi Lake	Kaboi Stumping	Ladang K Riparian Regrow / GSG	Ladang K Riparian Eco Volunteers	Total
1	Bongkol	*Nauclea sp.*	2238	236	799	127	3600
2	Kelumpang	*Sterculia sp.*		136	547	71	754
3	Binuang	*Octomeles sumatrana*	100	63	170	68	401
4	Mangkapon	*Colona serratifolia*		46	130	154	330
5	Terosob	*Dracontomelon sp.*	196		43	32	271
6	Nyatoh	*Palaquium sp.*		65	35	14	114
7	Salungpoid	*Mallotus muticus*	63	18		33	114
8	Payung1	*Terminalia copelandii*		96			96
9	Durian	*Durio sp.*		2	9	5	16
10	Tagap	*Artocarpus sp.*			5	8	13
	Grand Total		2597	602	1738	712	5649

Three (3) key areas were planting in 2020, as follows:

Figure 2: Location Map - Kaboi Stumping Site

Block Kaboi Stumping

Kaboi Stumping restoration site, is a riparian site in Pin-Supu Forest Reserve. In 2020, a total of 602 trees were planted in both small and large gaps within degraded forest at this site. Species planted were mostly of Bongkol (*Nauclea sp.* 236 trees), and Kelumpang (*Sterculia sp*. 136 trees) with a mix of 3 other species (*Colona sp., Palaquium sp., Octomeles sp., Terminalia sp., Mallotus muticus and Durio sp. combined = 230 trees).* Trees at the

Kaboi Stumping sites were planted by tourists and eco-volunteers (voluntourists). The trees were subsequently tagged and maintained two times throughout 2020 by KOPEL staff. See figure 3 & 4 (below).

Figure 3: Kaboi Stumping Site – Example of Site Preparation and tree planting by tourist program (from Japan)

Figure 4: Kaboi Stumping Site – Tree maintenance activities 2020

Figure 5: Kaboi Stumping Site – Tree maintenance activities 2020, recording tree survivorship after November 2020 floods

Riparian Corridor: Ladang Kinabatangan Restoration Site

The restoration site known as Ladang Kinabatangan is a riparian site providing a narrow but vital riparian corridor for wildlife on the south side of the Kinabatangan River - adjacent to Pin-Supu Forest Reserve. The site is a gazetted Riparian Reserve that was encroached upon by the adjacent plantation company.

In 2020, a total of **2,450** trees were planted on this site in 2020, covering the remaining gaps close to the riverbank on this site. Planting totals include the **1,738** trees planted as replacement of trees destroyed by the neighbouring plantation company (Ladang Kinabatangan) an area totalling 1 hectare. (Action was taken against the company by Sabah Land and Survey Department and Sabah Forestry Department). A total of 9 species were planted on this riverine habitat site in 2020, the majority coming from Bangkal (*Nauclea sp.* = 1,126 trees), Kelumpang (*Sterculia sp*. 618 trees), Mangkapon (*Colona sp.* = 284), Binuang (*Octomeles sp*. = 238 trees), and Terosob (*Dracontomelon sp*. = 75 trees).

Figure 6: Location Map - Ladang Kinabatangan Restoration Sites – Tree Planting & maintenance activities 2020

Figure 7: Ladang Kinabatangan Restoration Site – Jan 2020 Neighbouring Estate destroys restoration project after 4 years of planting

Figure 8: Ladang Kinabatangan Restoration Site – KOPEL Team replanting Ladang 1ha site June 25 2020

Figure 9: Ladang Kinabatangan Restoration Site – Planted Trees at 6 months age 1ha site January 25 2021

Figure 10: Location Map – **Kaboi Lake** Restoration Sites – Tree Planting & maintenance activities 2020

Kaboi Lake Restoration Site (Seasonally Flooded Alluvial Swamp Forest)

Kaboi Lake Restoration Site is a seasonally flooded alluvial forest, in Pin-Supu Forest Reserve adjacent to the Kaboi Lake. The site is 1km walk from the Kinabatangan River. There is no road access to this site. The site is also accessible by boat, but only during high water (flooding) events via the Kaboi River Tributary (Creek). Work on this site was funded in 2020 by the Cardiff University Regrow Borneo Initiative and is the first of five sites focusing on long-term monitoring to support KOPEL to monitor carbon sequestration and restoration ecology across a variety of floodplain forest types.

Site preparation for tree planting involved clearing of woody vines, climbing bamboos and grass clearing in the open areas that have zero tree cover. All existing trees on this site were retained and liberated from the extraordinary mass of climbing vines. A second round of preparation maintenance was carried out prior to planting. In early September 2020, a total of **2,597** trees were planted at the Kaboi Lake site. Four (4) flood resistant species were chosen to plant on this site, namely Bangkal (*Nauclea sp.* = 2,238 trees), Terosob (*Dracontomelon sp*. = 196 trees), Binuang (Octomeles sp. = 238 trees), and Salongapid (*Mallotus muticus* = 63 trees).

Figure 11: Kaboi Lake Restoration Sites – Site Preparation for tree planting (de-vining & grass clearing) July 2020

Figure 12: Kaboi Lake Restoration Sites – Tree Planting September 2020

Figure 13: Kaboi Lake Restoration Sites – Flooding at restoration site November 2020

Shortly after the November tree maintenance the Kaboi Lake experienced severe flooding over 1m in depth on this site. The flood lasted approximately 3 weeks between November 09 to November 30, although was most severe between the 14th-24th November. Post flood monitoring observed severe mortality across this site. Although post monitoring audit (stock-check) was not carried out, it was estimated from visual observation that more 90% of the trees were destroyed in this single flood event. Of the remaining trees, many were further damaged by wildlife, based on post flood monitoring observations.

Recommendations:

The current restoration outcomes for 2020 reflect similar outcomes from previous years. Based on more than 20 years of restoration efforts by KOPEL Bhd, there is still a great need for more diverse array of science to support the forest restoration efforts. KOPEL is seeking partners in both academia and industry to work in this area to support research efforts especially restoration ecology and various aspects of science that support the forest restoration efforts. KOPEL aims to upscale the forest restoration efforts over the next year and focus attention on carbon stocking alongside biodiversity conservation.

2. Wildlife Monitoring

Wildlife Monitoring within Pin-Supu Forest Reserve is carried out by the community cooperative KOPEL Bhd using camera trap methodology. The monitoring of wildlife via camera traps has been ongoing since 2012, and has compiled a large bank of data on the wildlife within Pin Supu Forest Reserve. In 2020 a total of 8 camera traps were deployed semi-permanently within Pin Supu Forest Reserve, some for multiple short duration monitoring periods, and some for single longer duration monitoring periods.

The wildlife monitoring is designed primarily to determine wildlife species diversity within the Pin Supu Forest Reserve. Species diversity per se is fundamental to establish the significance of this forest management unit for protection. The list of species is likewise used to highlight the presence of vulnerable, threatened, or endangered species within the forest management unit. Species diversity is also an important component of the forest reserve's HCVF assessment because diversity is a determinant of conservation value.

In addition to the basic inventory of wildlife within the reserve, the wildlife data is being analysed to determine trends or changes in the presence of target species, to help ensure their conservation.

In the Pin Supu Forest Reserve case, this is made possible because of the long-term monitoring program run by KOPEL. Long-term monitoring of wildlife is vital to determine the use of the reserve as habitat - over time (this is otherwise known as "temporal use"). Short-term (snap-shot) studies, are less able to separate short-term changes from the impacts caused by factors such as climatic events (e.g. droughts), which can last for 1-2 years, and dramatically impact the food availability for wildlife during this time, and hence wildlife numbers. It is expected that only through the implementation of a consistent and long-term study (e.g., for a period of more than 5 years), will sufficient data be made available for the analysis of long-term trends.

The ongoing monitoring by KOPEL, has already determined the presence of several critically endangered, vulnerable, and threatened species of wildlife within this forest management unit (see Figure 16, below). Based on the preliminary analysis of data, **it is extremely important,** for the management of the Pin Supu Forest Reserve, that any activities within the reserve proceed based on a "precautionary approach", and that all activities should only be carried out with the strictest sensitivity towards wildlife. This will require an ongoing strong policy around minimising negative impacts to critical habitats within the reserve.

Further to this, the current monitoring scenario **indicates against** the development of mass tourism within the critical habitats of Pin-Supu Forest Reserve. This is imperative, given that the broader forest landscape, and wildlife habitat of the Lower Kinabatangan already faces bottlenecks, fragmentation, and many other threats.

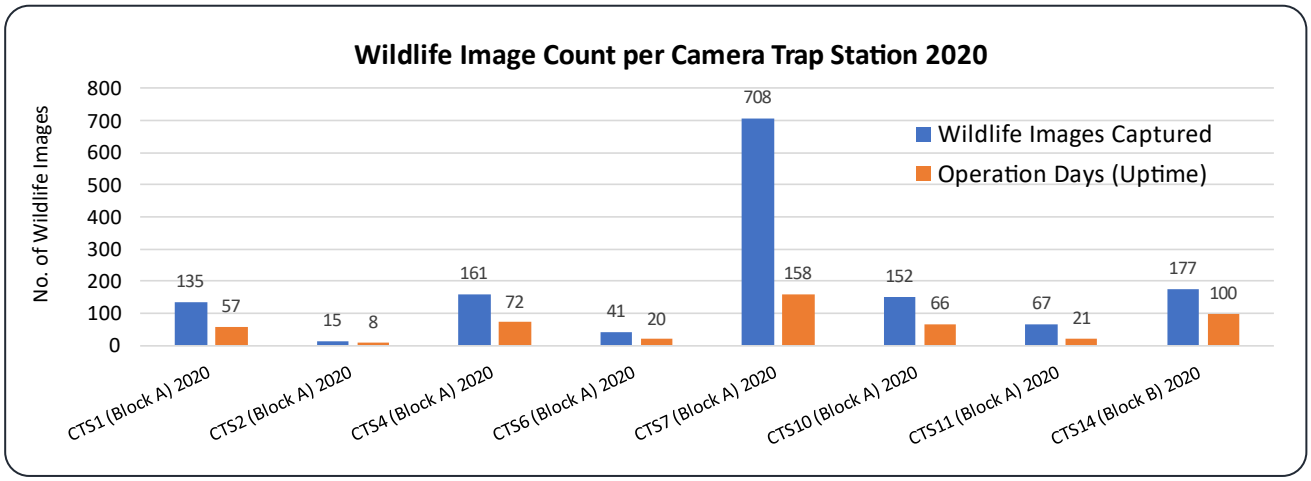

Figure 14: Number of Wildlife Pictures and Operation Days at 8 Camera Trap Stations 2020

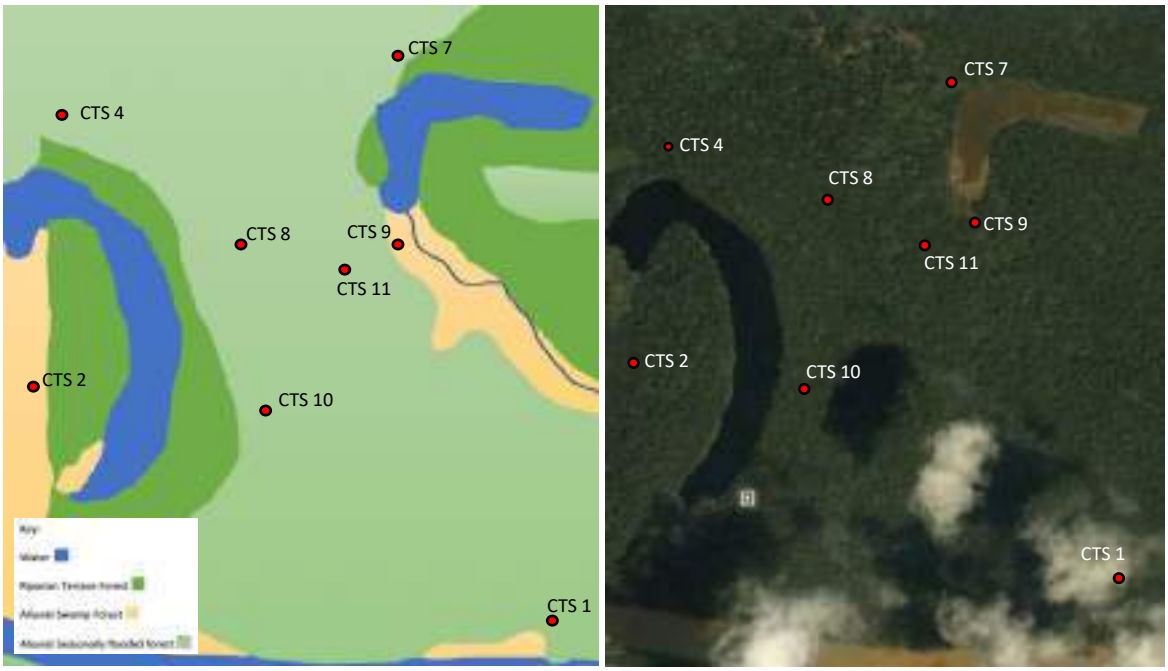

Figure 15: Camera Trap Stations (2020)

Forest management planning has already taken into consideration the sensitivity of the PSFR through the establishment of HCVF values, the establishment of species conservation targets, and the institutionalisation of monitoring mechanisms. Moving forward the monitoring methodology itself (primarily using camera traps) will need to be refined, improved based on current camera technology, and expanded to meet the ongoing monitoring requirements of the forest managers of PSFR.

Camera Trap Monitoring in 2020

This report is a short summary of the analysis and findings for the monitoring year 2020. This report also concludes, with a list of implications for management, designed to provide feed-back into the annual revisions of the PSFR Forest Management Plan.

In 2020, seven out of the eight camera trap stations (CTS) were located in the southern part of the Pin Supu Forest Reserve - Block A. These seven CTS were set-up all in Riverine Dipterocarp Forest or Seasonally Flooded Alluvial Swamp Forest. Other notable features of this area are the Tungog Lake and the Kaboi Lakes (see CTS locations Figure 15, above).

One of the six CTS was located on the ridge of Supu Hill (CTS14). This is in Limestone Forest. The data gathered is analysed for (a) Relative Abundance Index (RAI) to record the species abundance, and (b) the Shannon and Simpson index to compare species diversity.

Analysis of Data 2020

I. Of all the known and previously recorded species only the clouded leopard *Neofelis nebulosi*, was not captured in 2020. Even so, many other notable species were captured however, including the Critically Endangered Orang utan *Pongo pygmaeus* and the endangered Proboscis monkey *Nasalis larvatus*. (see Figure 16, 24, 25, below)

II. Camera Traps 1, 2, 4 have the highest diversity (Simpsons and Shannon's indexes) and are situated in Meander belt Forest (a form of Riverine Dipterocarp forest). The low diversity in some other stations is possibly due to the prevalence of Bearded Pigs and Long Tail Macaques, which from a statistical perspective have a significant impact on the diversity value, despite the high variety of species captured at these other sites (namely CTS7 & CTS10).

Species	IUCN Conservation Status	Total Individuals
Long-tailed Macaque (*Macaca fascicularis*)	LC	664
Bearded Pig (*Sus barbatus*)	VU	312
Bat (unknown) (*Unknown*)	uk	61
Crested Fireback (*Lophura ignita*)	NT	60
Lesser Mouse Deer (*Tragulus javanicus*)	LC	58
Orang Utan (*Pongo pygmaeus*)	CR	43
Asian Elephant (*Elephas maximus*)	EN	39
Malay Civet (*Viverra tangalunga*)	LC	26
Malay Badger (*Mydaus javanensis*)	LC	23
Squirrel (*unknown*)	uk	22
Banded Palm Civet (*Hemigalus derbyanus*)	NT	22
Moon Rat (*Echinosorex gymnura*)	LC	21
Common Treeshrew (*Tupaia glis*)	LC	18
Storm's Stork (*Ciconia stormi*)	EN	16
Pig-tailed Macaque (*Macaca nemestrina*)	EN	16
Rat (u*nknown*) (Unknown)	uk	12
Common Palm Civet (*Paradoxurus hermaphroditus*)	LC	9
Short-Tailed Mongoose (*Herpestes brachyurus*)	NT	7
Sambar Deer (*Rusa unicolor*)	VU	6
Sun Bear (*Helarctos malayanus*)	VU	4
Pangolin (*Manis javanica*)	CR	3
Unknown (*Unknown*)	uk	2
Common Porcupine (*Hystrix brachyura*)	LC	2
Prevost Squirrel (*Callosciurus prevostii*)	LC	2
Great Argus (*Argusianus argus*)	VU	1
White Crowned Shama (*Copsychus stricklandii*)	LC	1
Four-striped Ground Squirrel (*Lariscus hosei*)	LC	1
Leopard Cat (*Prionailurus bengalensis*)	LC	1
Common Water Monitor (*Vavanus salvator*)	LC	1
Binturong (*Arctictis binturong*)	VU	1
Proboscis Monkey (*Nasalis larvatus*)	EN	1
Crested Serpent Eagle (*Spilornis cheela*)	LC	1
	TOTAL	**1456**
Taxonomic Class	**Species Total**	**Individual Total**
Mammal	**27**	**1377**
Bird	**5**	**79**
Reptile	**0**	**0**

Figure 16: Number of individual wildlife captured per species 2020 (Pin Supu Forest Reserve)

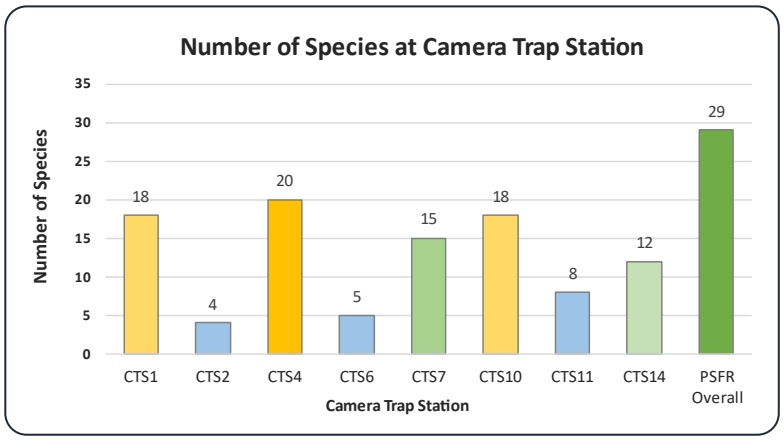

Figure 17: Total species captured per camera trap station

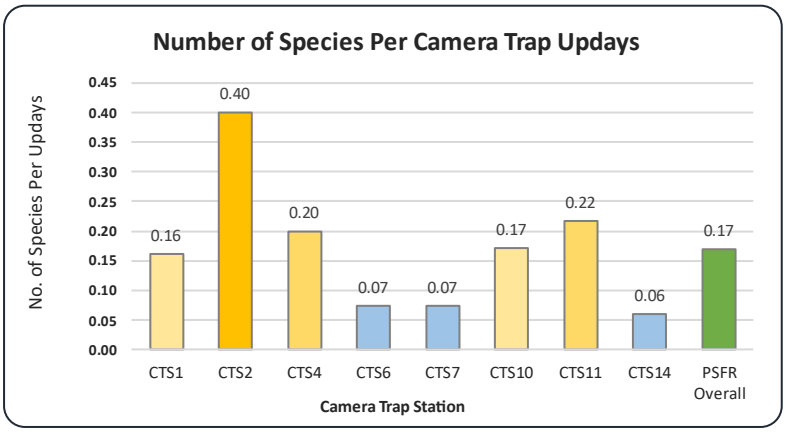

Figure 18: Total Species Per Camera Trap Operational Days (Updays)

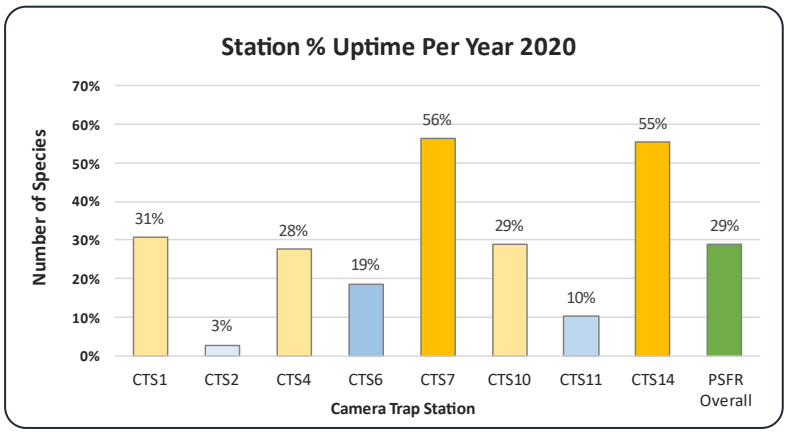

Figure 19: Camera Trap Station Updays Per Year

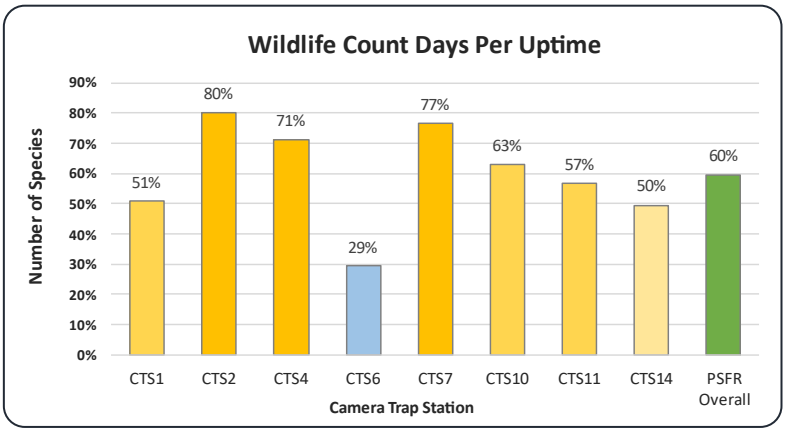

Figure 20: Camera Trap Station Wildlife Individuals Per Uptime

III. Long-tailed Macaques, *Macaca fascicularis* and Bearded Pigs *Sus barbatus* are the most abundant sightings in the RAI analysis (relative abundance). Seven of the eight stations captured notable numbers of images of this species, indicating that there is a prominent population in this area (BLOCK A). Further research into the impacts of this high population density may be needed in future.

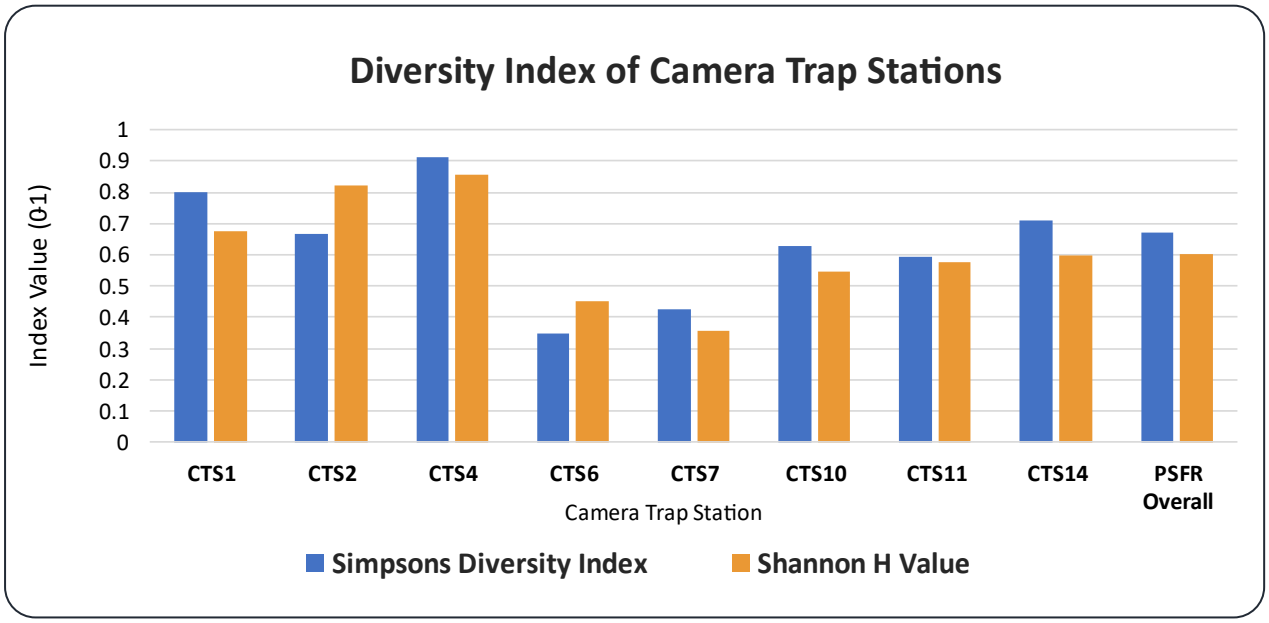

Figure 21: Diversity (Simpsons Index of Diversity or Shannon's diversity index) by camera trap station 2020

Conclusions & Management Implications

I. The results of camera trap wildlife monitoring in 2020 were consistent with previous years. The results for both Diversity Index and RAI analysis, concurs that the forest ecosystem within Pin Supu continues to be healthy with high diversity and abundant food sources for a wide range of wildlife species, including Vulnerable, Endangered and Critical species (IUCN).

II. The current methodology of camera trapping is still considered one of the most appropriate mechanism for monitoring wildlife populations within PSFR. This is because the method poses no threat to wildlife and very minimal impact on the wildlife directly and forest ecosystem more generally.

III. Based on analysis of measurable effectiveness indicators for the camera trapping methodology the following recommendations should be noted within revised FMP action plans:

   a. The camera trapping needs to be expanded and implemented more consistently over a wider range and broader diversity of forest ecosystems within the PSFR.
   b. Refined camera trapping methods or alternative methods should be developed to monitor the impacts of the main road (Sandakan Lahad Datu Highway) which divides and fragments the Kinabatangan Forest Corridor.
   c. The camera trapping needs to be upgraded, revised and improved to stay abreast of technology, and to avoid theft of the cameras (unfortunate incidents, which has occurred repeatedly within the PSFR). Minimizing detection of camera traps, a red filter over the infrared flash to reduce visible glow of infrared flashes or utilising cables and padlocks have been successful in other studies and may be potential methods to consider.
   d. In the past KOPEL has consistently moved camera traps after a few months. This practice needs to be changed, so that longer-term (permanent) stations are established to ensure the camera traps can continue functioning more consistently for a longer period at each station (location) to ensure adequate data is collected over the long-term to determine

temporal changes and trends. Consistent monitoring of the same locations for multiple years enables more detailed analysis (and greater accuracy when analysing trends and patterns).

e. Technique for avoiding floodwaters is critical and should be developed to protect camera traps from being flooded. Examples could also include the installation of hydrological monitoring stations, which can be used to both protect equipment from flooding and provide corelating data.

IV. Based on the analysis of camera trap data and consistent with the Shannon and Simpson (diversity) index values, a diverse list of high conservation value species has been recorded for PSFR, hence it is highly recommended to expand the conservation species targets for Pin-Supu Forest Reserve.

V. Based on consistent findings over the last 4 years, namely the long-term absence of large groups of Borneo Pygmy Elephants for much of the monitoring period. It is suggested that Borneo Pygmy Elephant be removed as one of the conservation targets for PSFR.

VI. Based on consistent findings over the last 4 years, namely the absence of large groups of Proboscis monkeys in camera trap data for much of the monitoring period. It is suggested that a different methodology be developed to monitor this primate within PSFR. Monitoring using river surveys or arboreal camera traps may be feasible options for future consideration.

VII. More broadly there is insufficient data to concur that restoration efforts or tourism activities are having a positive or negative impact on wildlife. It suggested that the monitoring be modified to include comparison sites and control sites to compare the current data sets. This will need to be implemented consistently over several years to establish temporal changes.

VIII. It is recommended that the data be share more broadly with students, select scientific experts, or select technical people within the conservation community, to provide a broader analysis of the data. This is likewise envisaged to encourage local capacity building through the sharing of technical expertise, and likewise encourage further collaboration in the wildlife management aspects of PSFR.

IX. It is recommended that some changes are made to the database structure and data logging process to ensure accurate analysis and reduce confounding effects. One such example is adding a standardised ‘sighting’ variable to reduce confounding effects of the same sighting of an individual being recorded multiple times in the database.

X. In summary ongoing monitoring work has been effective and continues to have consistent outcomes, no other major changes are suggested apart from what has already been outlined in this document. It is important that this work continues into the long-term hence ensuring reliable and consistent income into this program is paramount to its success. Income generation mechanisms are hoped to be expanded to benefit expanded monitoring activities in the future.

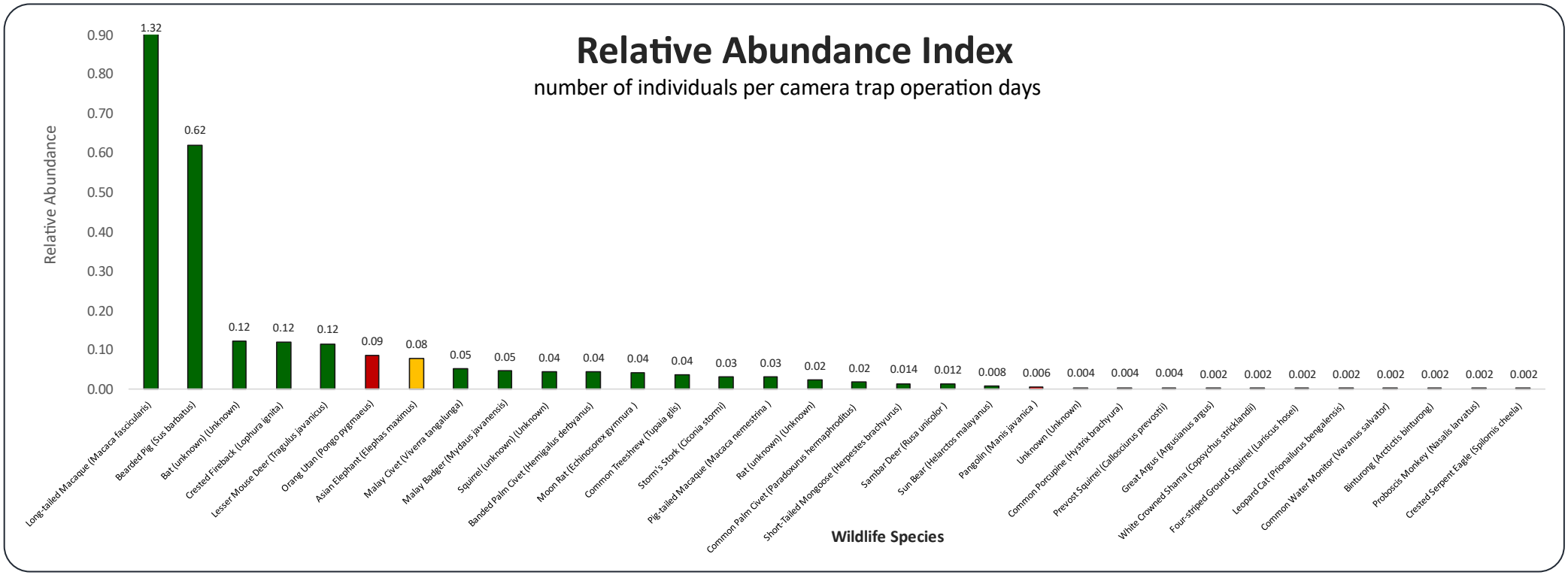

Figure 22: Relative Abundance Rate (RAI) (number of individuals per camera trap operation days)

Figure 23: Image captured of **Southern Pig-tail Macaque**, *Macaca nemestrina*, (Listed **Endangered** species (IUCN) primate active by day (CTS 7 15/7/2020)

Figure 24: Image captured of **Borneo pygmy elephant**, *Elephas maximus* borneensis Listed as an **Endangered** species (IUCN) endemic to Borneo (CTS 1 14/8/2020)

Figure 25: Image captured of **Orang Utan**, *Pongo pygmaeus* primate species, listed as **Critically Endangered** by the IUCN. (CTS 14 28/08/2020)

Figure 26: Image captured of **Borneo Bearded Pig**, *Sus barbatus*, endemic to Borneo, most common mammal in camera trap data by KOPEL Bhd, Listed **Vulnerable** IUCN (CTS 7 02/7/2020)

Figure 27: Image captured of **Great Argus**, *Argusianus argus s* an **Vulnerable** species (IUCN) endemic to Borneo (CTS 14 08/06/2020)

Figure 28: Image captured of **Storm's stork**, *Ciconia stormi* a forest swamp wading bird, classed as **Endangered** by the IUCN with estimated less than 500 individuals worldwide. (CTS 1 10/02/2020)

Figure 29: Image captured of **Sambar Deer**, *Rusa unicolor*, listed as **Vulnerable** (IUCN) (CTS 4 15/6/2020)

Figure 30: Image captured of **Binturong**, *Arctictis binturong* listed as **Vulnerable** species (IUCN) is a nocturnal predator feeds on small rodents, frogs & snakes (CTS 10 16/03/2020)

Figure 31: Image captured of **Crested fireback**, *Lophura ignita* a not uncommon forest pheasant in PSFR, classed as **Near Threatened** by the IUCN. (CTS 11 06/03/2020)

3. Water Quality Monitoring

Pin-Supu Forest Reserve water quality monitoring is conducted by community cooperative KOPEL Bhd. This work has been ongoing since 2012 and compiles water quality parameter data from a total of 5 sample points. These include a point of discharge from the Kg Mengaris, Tungog Lake, as well as at the confluence of the Kaboi River, the Takala River, and the Pin River – refer to Figure 45 (p.24 below) (Sample Location Map). The work is normally funded by KOPEL's ecotourism program, however in 2020 the program was funded (in the latter half of the year) by Yayasan Hasanah.

Data collected is compared with the National Water Quality Standards for Malaysia to determine the status of water quality in the sampled area – refer to Figure 44 below (National Water Quality Index).

Figure 32: KOPEL HSG2020 Water quality monitoring activities Jan-Feb 2021, Sungai Pin

Figure 33: KOPEL HSG2020 Water quality monitoring activities Jan-Feb 2021, PH, EC & DO Meter

Figure 34: KOPEL HSG2020 Water quality monitoring activities Jan-Feb, Sampling Kit, Tungog Lake

Figure 35: KOPEL HSG2020 Water quality monitoring activities Jan-Feb 2020, Sungai Pin