Sun bear (*Helarctos malayanus)* preferred trees in the area of the Danau Girang Field Centre, lower Kinabatangan, Sabah, Borneo.

Thomas Komin & Valerie Irene Poinson

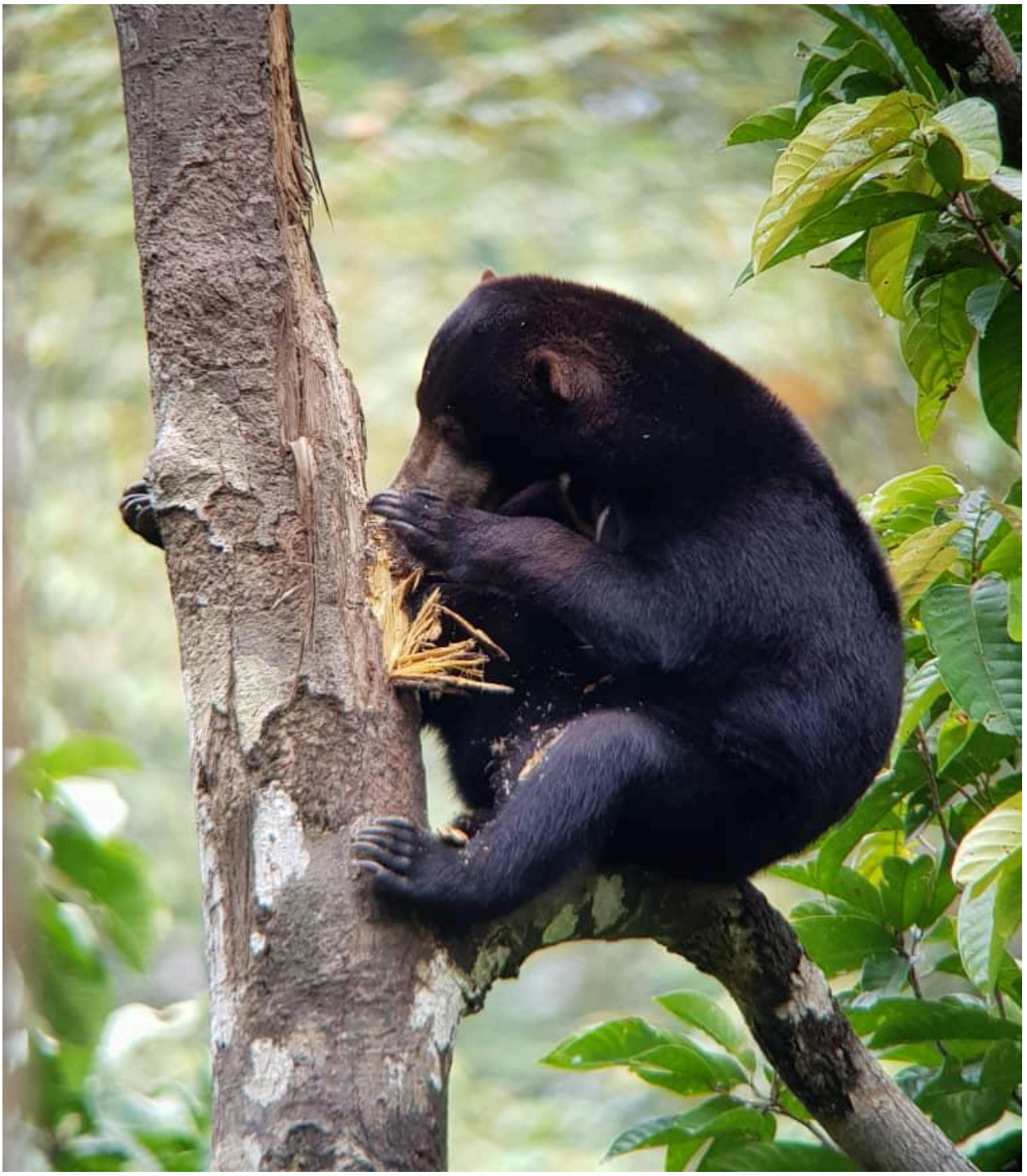

Photo by Miriam Kunde

Introduction

The Kinabatangan alluvial floodplain is the low-lying ground of the longest river in Sabah located on the east coast. The Kinabatangan forest is composed of a combination of riparian, seasonally flooded, swamp and dry dipterocarp forest (Danau Girang Field Centre, 2018) that has completely been altered in the past due to logging activities in the 1950s, development of agriculture in the 1970s (Kinabatangan - Corridor of, 2007) and conversion to oil palm plantation till now. Although the remaining forest is a highly fragmented secondary forest, it is still a central hotspot for 129 species of mammals, 314 species of birds, 101 species of reptiles and 33 species of amphibians (Danau Girang Field Centre. 2018).

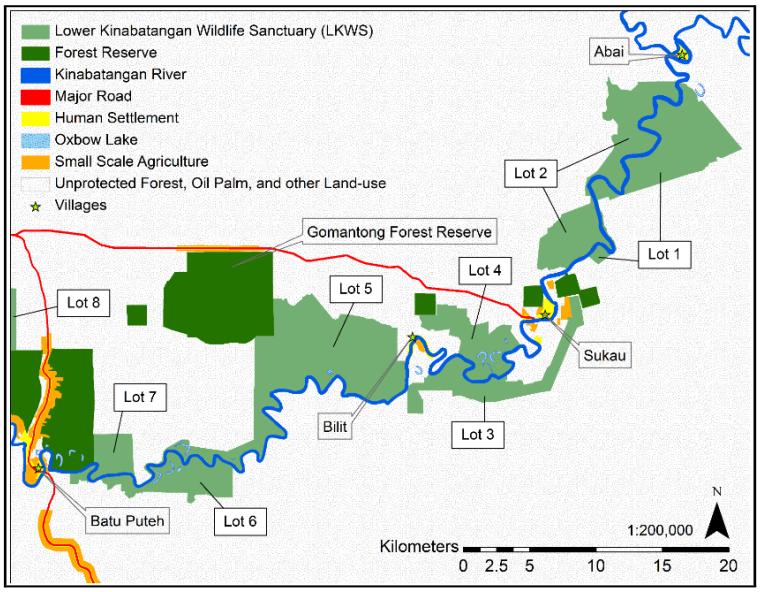

Figure 1 Map of Lower Kinabatangan Wildlife Sanctuary
source(Estes et al., 2012)

Therefore, in 2005 Lower Kinabatangan was gazetted as a Wildlife Sanctuary. One of the important projects that have been established at the Kinabatangan floodplain is the corridor of life which aims to protect its unique wildlife amid forest conversion by engaging stakeholders and partners. To help reduce the loss of Asian biodiversity due to habitat loss and fragmentation in the Kinabatangan floodplain, the collaborative and training facility Danau Girang Field Centre was established in Lot 6 and managed by Sabah Wildlife Department and Cardiff University. There are many studies on core species in Kinabatangan that have been done by researchers in this field centre to help understand the impact of forest conversion and fragmentation on animal behaviour and distribution. Examples are the pangolin (*Manis javanica*), the malayan civet (*Viverra tangalunga*), the otter (*Lutra sumatrana*) and the sun bear (*Helarctos malayanus*).

The sun bear is an iconic and endangered apex predator in Sabah, Borneo. They live in the primary and secondary rainforest, having home ranges of about fifteen km2 (Te Wong et al., 2003). They are the most arboreal of all bear species and use the trees for marking, sleeping and as a food source. Sun bears are usually diurnal, but in populated areas, they are mostly nocturnal to avoid and humans (Wong, S. T. *et al.,* 2004). Beetles (*Coleoptera*) and termites (*Isoptera*) are their main source of protein (Te Wong & Servheen, 2002). Sun bears are generalists, feeding on 115 fruit species with *Ficus* as the main fallback. *Moraceae*, *Burseraceae* and *Myrtaceae* contribute over 50% to sun bear diet during mast fruiting (Frederiksson & Wich, 2006). Sun bears play an important role in the tropical rainforest ecosystem as they are important for seed dispersal (Mcconkey & Galetti, 1998) and help keep termite and ant populations under control.

Most of the studies on sun bears have been done on their activity patterns, bedding sites, home ranges and their movement patterns, but there is still a lack of information on sun bear tree selection in the forest that influences these previous factors. Hence this study aims to identify the preferred sun bear tree species in the secondary forest and if sun bear activity is tree species related. The results from this study can help improve sun bear trapping efficiency which will, in turn, result in more information on this iconic species. Additionally, if sun bears indeed prefer a certain specie(s) of tree, regulations could be made to preserve these trees. These factors will help in the sun bear habitat conservation planning strategy in the area of DGFC. Finally, this generalist species can be used as an indicator species for the entire tropical rainforest ecosystem.

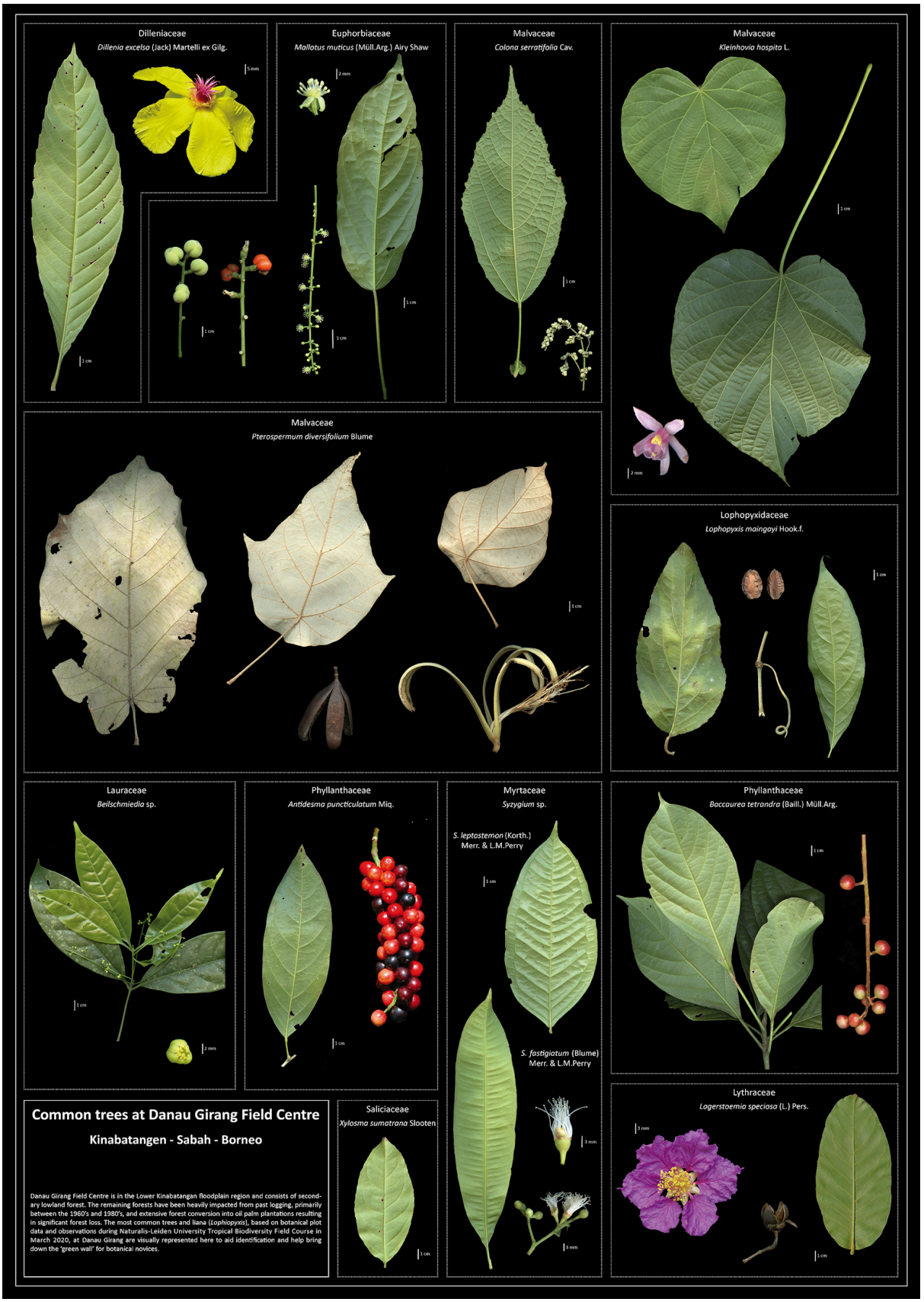

Figure 2: A poster including the most common plant species in the area of the Danau Girang Field centre, according to the plot data, with their respective characters. Courtesy of Dr. James Byne.

Material

- GPS
- DGFC Botanical Plot map
- DGFC Botanical Plot plant species list

Methods

Pin Supu forest Reserve, Lot 5 and DGFC Botanical plots are secondary forests that were selected as the study site. Botanical Plots 1, 2, 3, and 4 were selected as reference plots because they could be accessed easily and the habitat is similar to the Pin Supu and Lot 5 study sites. Figure 1.0 shows the location of these tree study sites.

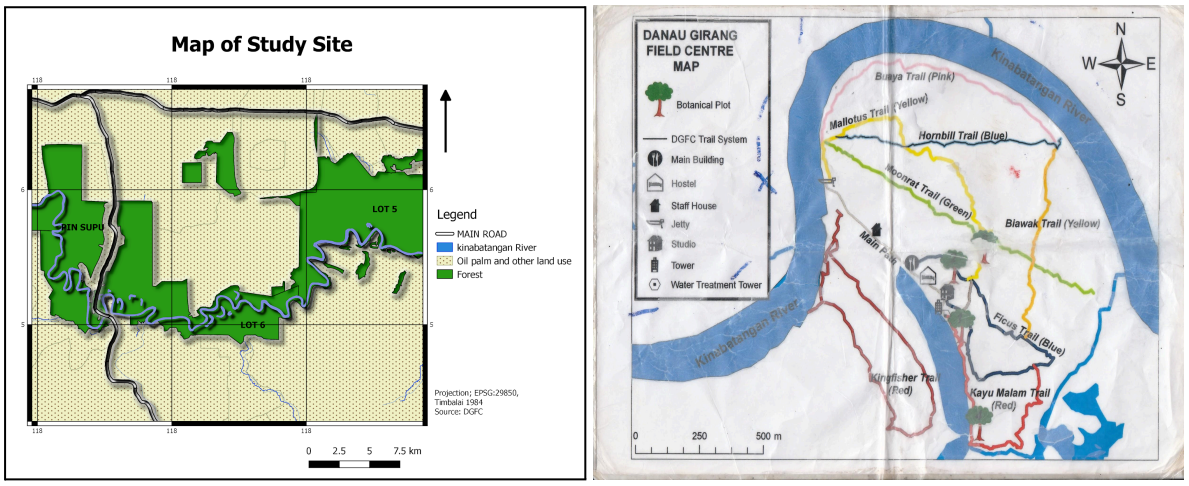

Figure 3: Map of the Pin Supu forest reserve, Lot 5 and DGFC around the Kinabatangan river and Botanical Plots 1, 2, 3, and 4.

A boat was used to go to Pin Supu forest reserve and Lot 5. Trees that were previously marked by a sun bear were visited and the tree species were identified with the help of Dr James Byne. The age of these marks has been estimated (Steinmetz & Garshelis, 2010). All the tree species with sun bear marks or any termites, hornbill, or stingless bee nests were noted and marked with a GPS signal. The corresponding trees have been identified to species level if possible by sampling leaves and, if possible, flowers. The relative abundance of these trees has also been measured in the botanical plots 1-4 in the area of the Danau Girang Field Centre to compare the areas.

Figure 4: Tree with sun bear claw marks

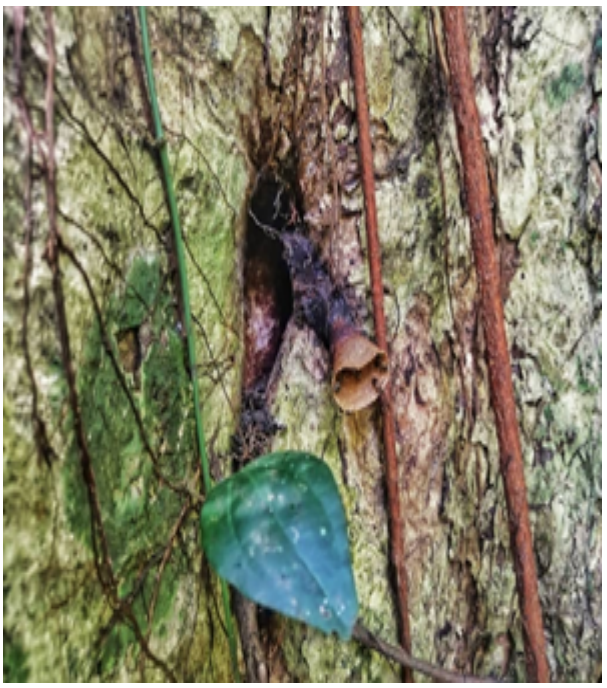

Figure 5: Stingless bees on the tree trunk

Figure 6: Empty hornbill nest.

Figure 7: Black termite nest

Results

Table 1 Frequency of tree species with sun bear claws marks.

Study site	Tree species	No. of trees with claw marks	Notes
Pin Supu Forest reserve	*Pterospermum macrocarpum*	9	Tree 6 has a stingless beehive, but it seems like it has not been damaged
Lot 5	*Pterospermum macrocarpum*	2	1 of the trees has a minor termite mud tube
	Colona sp	6	3 of the trees have a minor termite mud tube

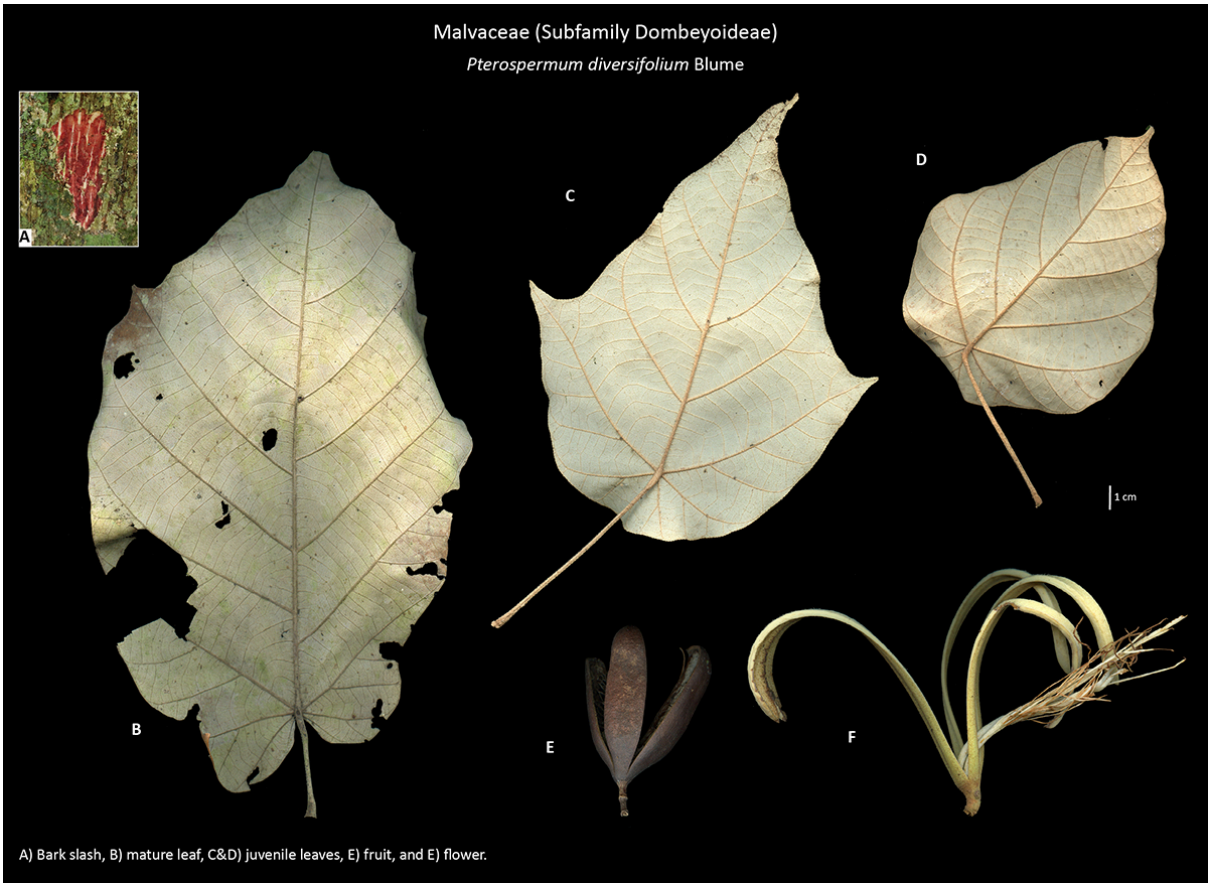

Figure 8: *Pterospermum diversifolium,* an example of a common tree in the area of DGFC. Most sun bear marks were on trees of the *Pterospermum* genus.

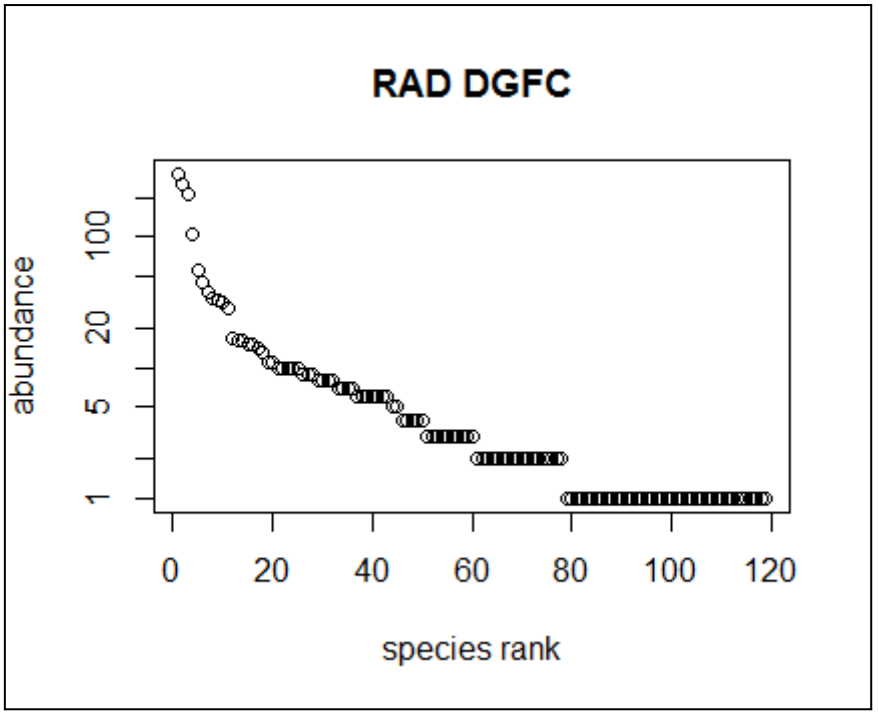

figure 9: Species rank vs abundance graph. This shows that there are a few species that have a relatively large abundance and a lot of species that have a very low relative abundance.

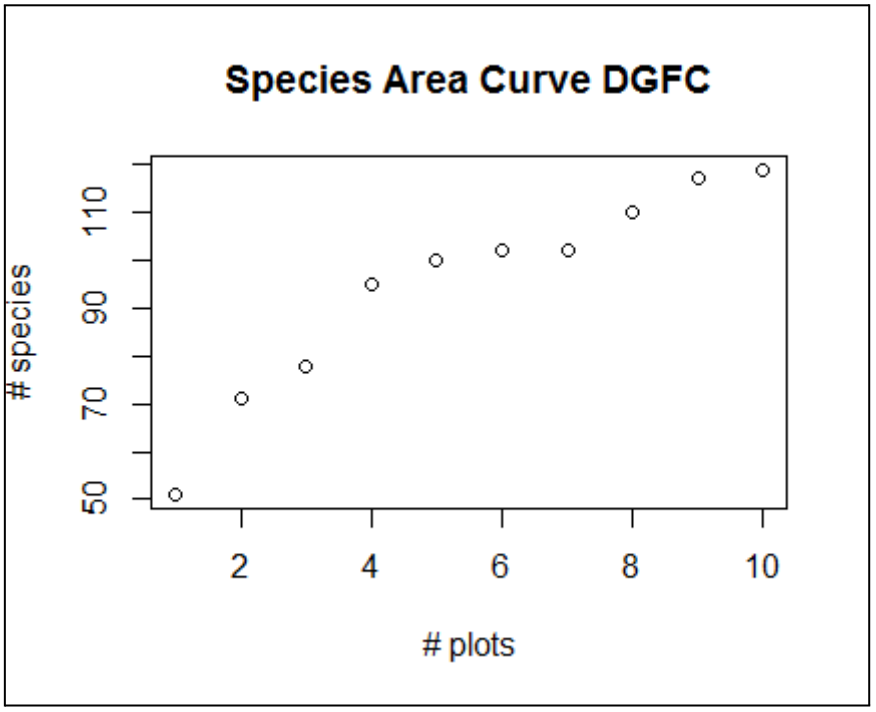

figure 10: A number of species vs number of plots graph. It shows that some plots have more species than others.

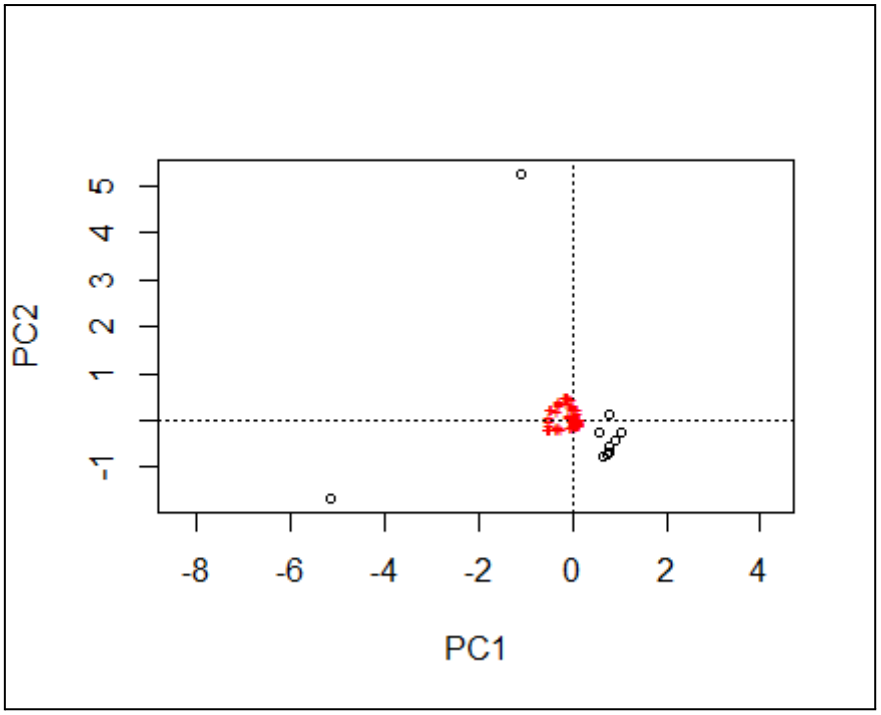

figure 11: A principal component analysis, showing the loadings of species per plot.

Discussion

The Kinabatangan River is a secondary forest. Thus, vegetation mostly consists of pioneering tree species such as *Colona sp.* and *Pterospermum macrocarpum*. Small riparian forest fragments such as lot 6, where the botanical plots are located, are usually used as a bridge to bigger forest fragments rather than as a feeding or resting area (Tenth Anniversary Report, 2018). Unlike Lot 6, large forests such as Lot 5 and Pin Supu forest reserve are more extensively used by sun bears (Tenth Anniversary Report, 2018). Based on Table 1, the most common tree species with sun bear claw marks are *Pterospermum macrocarpum* and *Colona sp.* There are no fruit or feeding activity signs on the marked trees. Sun bears usually prefer big and tall trees as a comfortable and safe bedding site (Wong, S. T. 2002). Most of the big trees in Lot 5 and Pin Supu forest reserve are *Colona sp.* and *Pterospermum macrocarpum*. Therefore, tree preference might be due to the lack of big trees in those areas.

On the other hand, in 2002 a study conducted on a pristine forest Danum Valley by Wong, S. T. shows that there is a huge variation of sun bear tree selection where *Lithocarpus sp.* and *Ficus sp.* hold the highest frequency. Meanwhile, *Lithocarpus sp.* ranked 11th and 7th on preferred sun bear tree on the primary and logged forest at Ulu Segama Forest Reserve respectively (Hussin, M. Z. 1994). However, none of these studies has any

recordings of *Pterospermum macrocarpum* and *Colona sp.* These studies show different results on preferred tree species in primary and secondary forest. Therefore, it shows that sun bear activity is highly affected by tree size and fruit viability.

For future research, it would be very interesting to do a study that investigates whether annual fruitings of *Pterospermum macrocarpum* is linked to sun bear activity since all sun bear marks on these species of tree seem to be of similar age. This would give an insight into whether sun bears use these trees as a food source or solely as a sleeping place in the secondary forest around DGFC. Furthermore, studies should be conducted that focus on botanical plots where there is not one dominant tree species and investigate if sun bear marks are more widely spread across species in those areas. This would give further arguments for their generalist role in the ecosystem and promote much needed additional research on this indicator species.

Acknowledgements

We would like to thank Miriam Kunde for taking us into the jungle around DGFC and for letting us participate in sun bear research.
We would also like to thank James Byne for all the help on identifying the plant species and for visualizing these results in the poster(s).
We would like to thank Hans ter Steege for the help with the statistical analysis of the botanical plot data.
Finally, we would like to thank all the research assistance of DGFC for guiding us in the jungle and helping us get leave samples.

Appendix

Row Labels	Count of species
Actinodaphne glomerata	6
Agelaea sp.	3
Aglaia cf. odoratissima	2
Aglaia odoratissima	1
Aglaia sp.	6
Allophylus cobbe	2
Ancanthocephalus chinensis	1
Antidesma puncticulatum	45
Antidesma sp.	4
Aporusa sp.	1
Archidendron ellipticum	1
Ardisia sp.	7
Artabotrys sp.	8
Artocarpus sp.	2
Atuna nonnodes	1
Baccaurea tetrandra	31
Beilschmiedia lucidula	1
Beilschmiedia sp.	56
Bridelia insulana	1
Bridelia stipularis	6
Calophyllum sp.	1
Cananga odorata	8
Canarium sp.	6
Carallia brachiata	1
Chionanthus sp.	1

Cinnamomum sp.	2
Cleistanthus megacarpus	1
Cleistanthus mynanthus	1
Cleistanthus obligonfolius	2
Colona serratifolia	209
Crateva sp.	6
Cratoxylum cochinchinensis	3
Cratoxylum sp.	1
Crudia reticulata	1
Crudia sp.	1
Cryptocarya ferrema	1
Cryptocarya griffithiana	2
Cryptocarya sp.	5
Cynometra sp.	10
Dalbergia sp.	2
Dehassia sp.	10
Dillenia excelsa	303
Diospyros elliptifolia	4
Diospyros racemosa	1
Diospyros sp.	17
Diospyros wallichii	10
Dipterocarpus validus	10
Dracontomelon dao	11
Drypetes sp.	2
Elaeis guineensis	1
Elaeocarpus stipularis	3
Entada rheedii	2

Erythoxylon cuneatum	2
Ficus fistulosa	16
Ficus racemosa	2
Ficus sp.	6
Flacourtia sp.	2
Garcinia parvifolia	16
Glochidion rubrum	1
Gnetum sp.	2
Gonocaryum macrophylla	3
Homalium caryophyllaceum	1
Horsfieldia sp.	2
Hydnocarpus sp.	9
Kleinhovia hospita	106
Knema sp.	5
Lagerstroemia speciosa	14
Leea sp.	1
Lepisanthes sp.	1
Litsea accedens	1
Litsea artocarpifolia	1
Litsea lancifolia	1
Litsea sp.	4
Lophopetalum sp.	2
Lophopyxis maingayi	34
Madhuca dubardii	3
Mallotus floribundus	1
Mallotus mollissimus	1
Mallotus muticus	249

Margaritaria indica	7
Memecylon laevigatum	6
Memecylon paniculata	2
Memecylon sp.	10
Microcos crassifolia	9
Mischorcarpus pentapetalus	1
Mischorcarpus sp.	8
Mitragyna speciosa	2
Myristica malaccensis	1
Myristica sp.	1
Nauclea orientalis	13
Nauclea subdita	15
Nothaphoeba sp.	1
Palaquium sp.	1
Planchonia valida	8
Polyalthia obliqua	4
Pternandra sp.	7
Pterospermum diversifolium	38
Pterospermum elongatum	33
Pterospermum macrocarpum	1
Rauvolfia sumatrana	3
Ryparosa acuminata	1
Sterculia macrophylla	1
Syzygium fastigiatum	7
Syzygium sp.	11
Tetracera sp.	3
Theobroma cacao	4

Uncaria sp.	1
unknown	116
Urophyllum griffithianum	2
Urophyllum sandahanicum	1
Urophyllum sp.	1
Vatica rassak	15
Vatica venulosa	1
Vatica vilonusa	1
Ventilago dichotoma	3
Vitex pinnata	9
Xanthophyllum ellipticum	3
Xanthophyllum florescens	3
Xylosma sp.	28
Xylosma sumatrana	1
(blank)	
Grand Total	**1692**

Appendix 1: Pivot table including every species and count of species within botanical plots 1-10. Unknown refers to trees that were unidentifiable due to the height of the tree.

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