MENTILIN *Cephalopachus bancanus bancanus* (HORSFIELD, 1821) HABITAT IN BANGKA REGENCY, INDONESIA

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ABSTRACT

The Mentilin *Cephalopachus bancanus bancanus* is a small nocturnal arboreal primate, also known as the Horsfield's Tarsier. It is a flagship species of Bangka Island, listed as Endangered (EN) by the IUCN Red List of Threatened Species. This research was undertaken with the aim to investigate Mentilin habitat in Bangka Regency. The research was conducted in Zed, Kemuja, Paya Benua and Petaling villages in Bangka Regency, Bangka-Belitung Islands Province, Indonesia from December 2015 to February 2016. The methods used to collect vegetation data were strip transect-line plots and strip transects. Across all habitats, we found 33 plant species from 22 families with 488 individuals. In general, the dominant vegetation in the study area was *Hevea brasiliensis* or jungle rubber. Rubber trees, poles, saplings and seedling layers were the main vegetation in all habitats. *Clidemia hirta* dominated ground cover layer in Zed, Kemuja and Paya Benua. In Petaling, *Brachiaria mutica* dominated. The study concluded that Mentilin in Bangka Regency were well adapted to habitat dominated by jungle rubber *H. brasiliensis.* Saplings were used by Mentilin for sleeping and foraging. Mentilin also used four sapling species as sleeping trees; these were *Schima wallichii, Trema orientalis, Ficus annulata and F. aurata*. This study demonstrates that areas dominated by jungle rubber provide important habitat for Mentilin. Consequently, some degree of protection of jungle rubber should be an important element in efforts to assure the conservation of this species in Bangka Regency, possibly along the lines of the IUCN Protected Area Category VI: Protected area with sustainable use of natural resources.

Keywords: Bangka Island, conservation, deforestation, jungle rubber, Tarsiidae, unprotected habitat

INTRODUCTION

Bangka Island is one of the main islands in Bangka-Belitung Islands Province which has an area of 11,330 km^2. Bangka Island consists primarily of secondary forest (WALHI, 2014) and lowland plains and shallow valleys, punctuated by hilly tracts. The highest elevation is 699 m above sea level (asl). The climate of Bangka Island is hot and wet, with an average annual rainfall of approximately 3,000 mm (Gorlinski, 2018).

Deforestation in Bangka Island began in the early 1700s with the advent of tin mining (Heidhues, 1991; Indahnesia, 2012; Kahin, 2015). Habitat loss increased with the introduction of pepper *Piper nigrum* L. in the mid-1800s (Idi, 2012) and rubber *Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg. in the 1920s (van Noordwijk et al., 2008). From 1995 however, oil palm *Elaeis guineensis* Jacq. plantations have started to appear in Bangka Island, becoming a new competitor to the pepper and rubber plantations (Kurniawan, 2005). Deforestation in Bangka Island appears to have worsened in the last two decades, when there has been a significant increase in tin mining and oil palm plantations (Ratno Budi, pers. comm., 2018). According to Supriatna et al. (2017), Bangka-Belitung Islands had the highest deforestation rate in Indonesia during the period 2000-2012.

Of the 6,575.1 km^2 forest cover in the Bangka-Belitung Islands (based on the Decree of Indonesian Forestry Minister No. 357/Menhut-II/2004 about Forest Area of Bangka-Belitung Islands Province), only 28% is relatively undisturbed, while the remaining 72% is degraded (WALHI, 2014). The 32.47 km^2 conservation forest, 298.07 km^2 protected forest and 1,252.24 km^2 production forest in Bangka-Belitung Islands have experienced deforestation and conversion into tin mines and oil palm plantations (Ratno Budi, pers. comm., 2018). The projections show that if current trends continue, the remaining areas of the better forest cover on the islands are at risk of degradation (WALHI, 2014).

Tarsiers are small nocturnal arboreal primates characterized by large round eyes along with long hind legs adapted for vertical leaping (Crompton & Andau, 1986). Tarsiers are found in a wide variety of primary and secondary forests and scrub habitats, and often occur in agricultural areas (Shekelle et al., 2013). They are the only entirely carnivorous primate, preying on insects (e.g., beetles, ants, grasshoppers, locusts, cicadas, cockroaches, moths, butterflies and crickets) and vertebrates (e.g., birds, smaller fruit bats, spider, frogs, lizards, mice and snakes) (Shekelle et al., 2013). Tarsiidae comprises three genera: Western Tarsier *Cephalopachus,* Philippine Tarsier *Carlito* and Eastern Tarsier *Tarsius* (Groves & Shekelle, 2010). *Cephalopachus* comprises one species (i.e., *C. bancanus*) and four subspecies: Horsfield's Tarsier *C. b. bancanus* (Horsfield), Bornean Tarsier *C. b. borneanus* (Elliot), Natuna Islands Tarsier *C. b. natunensis* (Chasen) and Belitung Tarsier *C. b. saltator* (Elliot) (Yustian, 2007; Shekelle & Yustian, 2008a; Roos et al., 2014). The local name of *C. b. bancanus* in Bangka Island is Mentilin.

The IUCN Red List of Threatened Species has determined the conservation status of *C. bancanus* as Vulnerable (VU) (Shekelle & Yustian, 2008a; Roos et al., 2014). However, the subspecies conservation status varies: *C. b. borneanus* is a VU subspecies (Shekelle & Yustian, 2008b; Roos et al., 2014), *C. b. bancanus* and *C. b. saltator* are Endangered (EN) (Shekelle & Yustian, 2008c; 2008d; Roos et al., 2014), and *C. b. natunensis* is Critically Endangered (CR) (Shekelle & Yustian, 2008e; Roos et al., 2014). *Cephalopachus bancanus* (as *Tarsius bancanus*) is classified as a protected species by the Indonesian Government under the Regulation of Indonesian Environment and Forestry Minister No. P.92/MENLHK/SETJEN/KUM.1/8/2018 about Revision of the Regulation of Indonesian Environment and Forestry Minister No. P.20/MENLHK/SETJEN/KUM.1/6/2018 about Protected Plants and Animal Species. Along with other primates, it is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The conservation status of *C. bancanus* is based on the impact on their habitat from forest conversion for illegal/unconventional tin mining, large-scale oil palm plantations, settlements, illegal logging, forest fires and flooding (Shekelle & Yustian, 2008a; Yustian et al., 2009). Illegal hunting and wildlife trade are further causes of population decline for *C. bancanus* (Shekelle & Yustian, 2008a; Yustian et al., 2009).

Research on *C. bancanus* has been conducted in Sarawak (*C. b. bancanus:* Niemitz, 1979; 1984) and Sabah (*C. b. borneanus:* Crompton & Andau,1986; 1987), on Belitung Island (*C. b. saltator:* Yustian, 2007; Yustian et al., 2009), and at Muara Enim, South Sumatra (*C. b. bancanus:* Sesa et al., 2014). We were unable to find published research about the habitat and population of *C. bancanus* in Bangka Island (*C. b. bancanus*) and in Serasan and Subi, Natuna Islands (*C. b. natunensis*).

In view of the rapid land use changes and loss of habitats observed in Bangka Regency, this study was conducted to better understand Mentilin occurrence within the remaining habitat types in order to make urgent long-term conservation recommendations for the species.

METHODS

Locations and time of research

We conducted the research from December 2015 to February 2016 in the villages of Zed (2°03'38.99"S, 105°57'19.29"E), Kemuja (2°05'01.80"S, 105°58'17.46"E), Paya Benua (2°06'30.67"S, 105°56'26.90"E) and Petaling (2°08'45.92"S, 105°56'29.16"E), Bangka Regency, Bangka-Belitung Islands Province, Indonesia (Fig. 1). Collectively, the villages cover 224.56 km^2 or 22,456 ha at an altitude of 22-46 m asl, slope of 0-7.7%, temperature of 23.5-30°C and humidity of 70.8-99%. We included these villages in the current research based on interviews with Bangka people about Mentilin encounters. Preliminary surveys were conducted from April 2014 to July 2014 to confirm the presence of Mentilin in the villages.

Data collection

Description of Mentilin habitat

Mentilin habitat description data were obtained using a strip transect-line plots method (Kusmana,

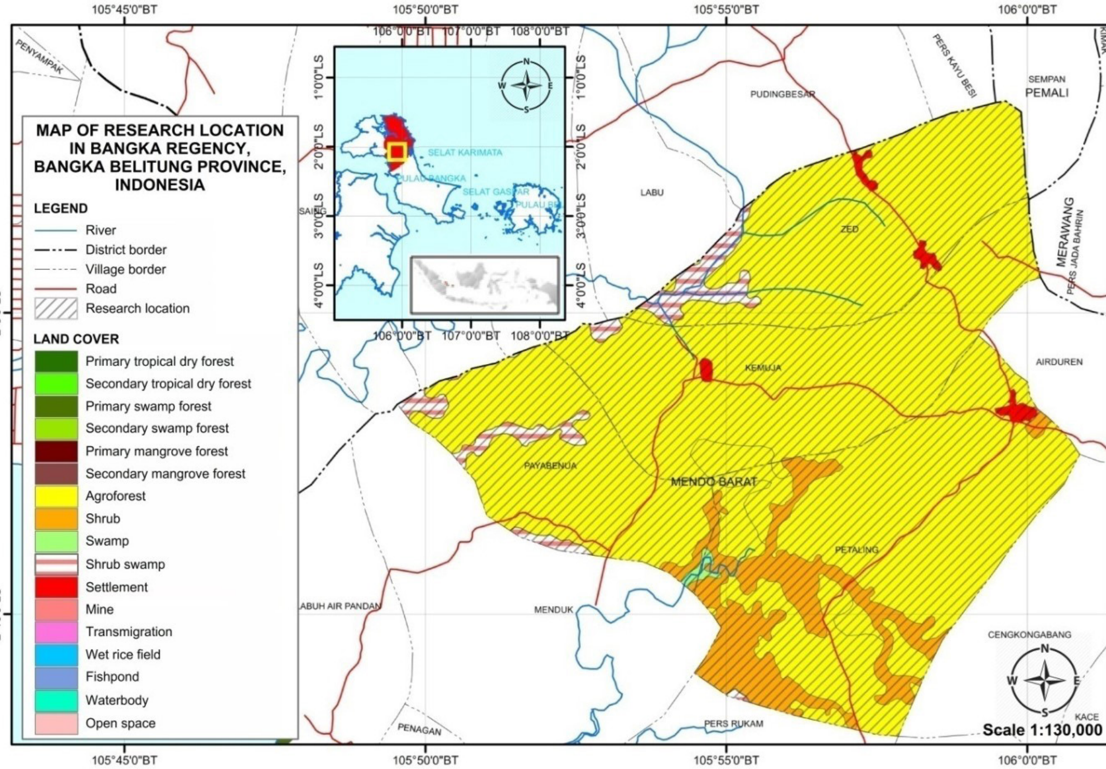


Fig. 1. Map of research location.

1997). Three line plots were placed on a strip transect in each habitat. We collected vegetation data during Mentilin sleeping times, from 09:00 to 15:00 h. The vegetation identified in each line plot included two categories, i.e., ground vegetation (shrubs, herbs and grasses) and tree vegetation. The tree vegetation consisted of four girth levels, i.e., trees (stems ≥20 cm DBH (diameter at breast height), poles (stems ≥10 cm and <20 cm DBH), saplings (>1.5 m tall and stems <10 cm DBH) and seedlings (≤1.5 m tall) (Iskandar, 2007). The strip transect-line plots in each habitat (Fig. 2) were placed on the same line as the line transects to measure Mentilin distribution and population published in Syafutra et al. (2017).

Identification of Mentilin sleeping trees

Mentilin sleeping trees were determined only as those specific trees where we found Mentilin sleeping. We identified Mentilin sleeping trees along the strip transect between 09:00 to 15:00 h.

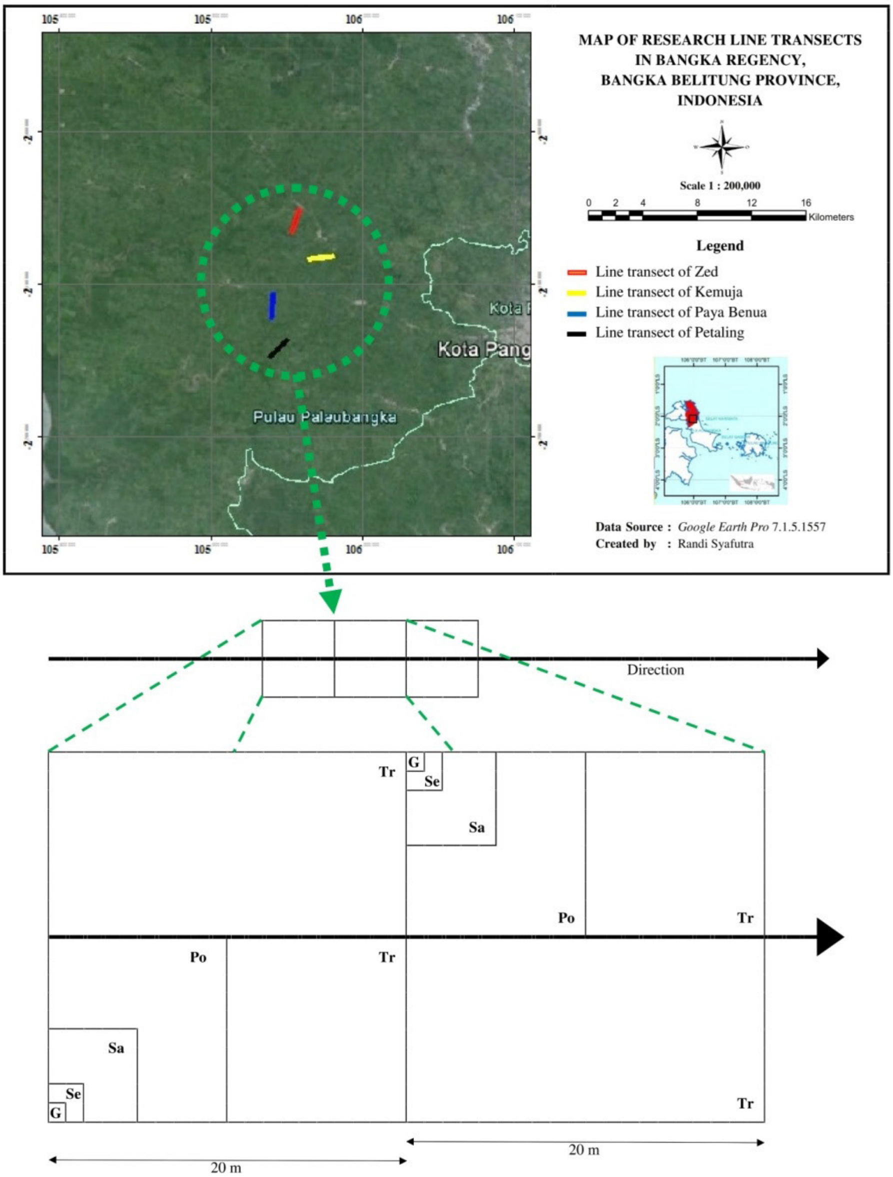
Data analysis

Vegetation data (i.e., relative density, relative frequency and relative dominance) were used to calculate the importance value index (IVI) (Curtis & McIntosh, 1950). After obtaining the IVI, diversity and evenness of vegetation species respectively were analysed by using the indices of Shannon-Wiener (H') (Shannon & Wiener, 1963) and Pielou (E) (Pielou, 1966a; 1966b; 1975). Magurran (1988) stipulated that H'≤1 indicates low species diversity, 1<H'≤3 indicates moderate species diversity, and H'>3 indicates high species diversity. In addition, E≤0.3 indicates low species evenness, 0.3<E≤0.6 indicates moderate species evenness, and E>0.6 indicates high species evenness.

RESULTS

Description of Mentilin habitat

Across all habitats, we identified 33 species of 22 families with 488 individuals. When categorised based on vegetation girth, the tree vegetation (i.e., trees, poles, saplings and seedlings) comprised 21 species from 16 families with 327 individuals, while the ground cover vegetation (i.e., shrubs, herbs and grasses) comprised 12 species from 9 families with 161 individuals. Based on the IVI (Table 1), *H. brasiliensis* dominated tree, pole, sapling and seedling layers in all habitats, except Zed where both of *Trema orientalis* (L.) Blume and



Information:

Tr	:	Tree (plot 20 m x 20 m)	Se	:	Seedling (plot 2 m x 2 m)
Po	:	Pole (plot 10 m x 10 m)	G	:	Ground vegetation (plot 1 m x 1 m)
Sa	:	Sapling (plot 5 m x 5 m)			

Fig. 2. Design of strip transect-line plots method.

Table 1. The highest IVI in each mentilin habitat.

Location of habitat	Level of vegetation girth	Family	Species		RDE (%)	RFQ (%)	RDO (%)	IVI (%)
			Binomial name	Local name				
Zed	Tree	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	71.43	60.00	36.52	167.95
	Pole	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	65.63	33.33	18.28	117.24
	Sapling	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	35.48	18.75	-	54.23
	Seedling	Cannabaceae	*Trema orientalis* (L.) Blume	Meng-kirai	30.77	21.43	-	51.20
		Theaceae	*Schima wallichii* Choisy	Seruk	30.77	21.43	-	51.20
	Ground cover	Melastomata-ceae	*Clidemia hirta* (L.) D. Don	Kedebik pasir	30.30	17.65	-	47.95
Kemuja	Tree	Poaceae	*Gigantochloa at-ter* (Hassk.) Kurz	Bambu ater	44.44	28.57	96.91	169,92
	Pole	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	81.25	66.67	40.21	188.13
	Sapling	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	36.00	15.38	-	51.38
	Seedling	Theaceae	*Schima wallichii* Choisy	Seruk	20.00	15.38	-	35.38
	Ground cover	Melastomata-ceae	*Clidemia hirta* (L.) D. Don	Kedebik pasir	42.50	18.75	-	61.25
Paya Benua	Tree	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	78.57	50.00	25.96	154.53
	Pole	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	100	100	100	300
	Sapling	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	40.63	18.75	-	59.38
	Seedling	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	26.67	25.00	-	51.67
		Theaceae	*Schima wallichii* Choisy	Seruk	26.67	25.00	-	51.67

	Ground cover	Melastomataceae	*Clidemia hirta* (L.) D. Don	Kedebik pasir	32.56	17.65	-	50.21
Petaling	Tree	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	100	100	100	300
	Pole	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	100	100	100	300
	Sapling	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	36.00	17.65	-	53.65
	Seedling	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.	Karet	30.77	20.00	-	50.77
	Ground cover	Poaceae	*Brachiaria mutica* (Forssk.) Stapf	Rumput malela	46.67	27.27	-	73.94

RDE: relative density, RFQ: relative frequency, RDO: relative dominance, and IVI: importance value index.

Schima wallichii Choisy dominated the seedling layer; Kemuja where the Giant Atter Bamboo *Gigantochloa atter* (Hassk.) Kurz and *S. wallichii* dominated tree and seedling layers, respectively; and Paya Benua where both of *H. brasiliensis* and *S. wallichii* dominated the seedling layer. *Clidemia hirta* (L.) D. Don dominated the ground cover layer in Zed, Kemuja and Paya Benua, except Petaling where *Brachiaria mutica* (Forssk.) Stapf dominated. In addition, Shannon-Wiener's diversity (H') and Pielou's evenness (E) indexes (Table 2) showed that all habitats generally have moderate species diversity and high species evenness.

Based on the IVI, H' and E results, Mentilin in Bangka Regency occurred most frequently in habitats where jungle rubber *H. brasiliensis* was the dominant vegetation. This conclusion was strengthened by interviews with villagers around research locations who affirmed that Mentilin in Bangka Regency were generally observed in areas of jungle rubber *H. brasiliensis* aged over 10 years combined with forest of the Giant Atter Bamboo *G. atter* or with abandoned and unproductive pepper *P. nigrum* plantations (Table 3 and Fig. 3).

Identification of Mentilin sleeping trees

Mentilin were observed using four species of plants as sleeping sites, seruk *S. wallichii,* mengkirai *T. orientalis*, bua bulu *Ficus annulata* Blume and bua tupai *F. aurata* (Miq.) Miq. *Schima wallichii* and *T. orientalis* were used as sleeping trees in all habitats, while *F. annulata* and *F. aurata* were only used as sleeping trees in two habitats, i.e., Paya Benua and Petaling (Table 4).

DISCUSSION

Description of Mentilin habitat

According to Beukema et al. (2007), jungle rubber can be regarded as an extensive rubber *H.brasiliensis* agroforest in which wild species are growing between rubber trees. Consequently, it structurally resembles secondary forest. Siregar et al. (2016) found jungle rubber to be dominated by *H. brasiliensis* complemented with other economic plants, such as *Eusideroxylon zwageri* Teijsm. & Binn., *Sloetia elongate* Koord., *S. wallichii, Artocarpus elasticus* Reinw. ex Blume, *Fagraea fragrans* Roxb. and *Parkia speciosa* Hassk.

This study did not record any Mentilin using the well-maintained rubber and oil palm plantations, which were more or less free of undergrowth and other natural vegetation. Yustian (2007) similarly reported that *C.b. saltator* in Belitung Island did not use well-maintained rubber and oil palm plantations, but they were recorded in abandoned pepper and rubber plantations, and in unmaintained oil palm plantations that were abundant with wild shrubs and saplings

We assume that insect availability was not a factor influencing Mentilin's preference for jungle rubber rather than well-maintained rubber and oil palm plantations as its habitat. This is based on the study of Siregar et al. (2016) who reported that the availability of insects (Hymenoptera, Diptera and Lepidoptera) in rubber and oil palm plantations was higher than that

Table 2. H' and E of vegetation of Mentilin habitat.

Location of habitat	Level of vegetation girth	Species number	Shannon-Wiener's diversity (H')		Pielou's evenness (E)	
			Value	Interpretation	Value	Interpretation
Zed	Tree	12	0.6860	Low	0.9896	High
	Pole	13	1.0902	Moderate	0.9924	High
	Sapling	18	1.8849	Moderate	0.9064	High
	Seedling	15	1.5669	Moderate	0.9736	High
	Ground cover	18	1.9495	Moderate	0.9375	High
Kemuja	Tree	15	1.2445	Moderate	0.7732	High
	Pole	12	0.6605	Moderate	0.9529	High
	Sapling	18	1.9232	Moderate	0.9249	High
	Seedling	18	2.0515	Moderate	0.9865	High
	Ground cover	18	1.8705	Moderate	0.8995	High
Paya Benua	Tree	12	0.6927	Moderate	0.9993	High
	Pole	11	-	Low	-	-
	Sapling	18	1.9540	Moderate	0.9397	High
	Seedling	17	1.7874	Moderate	0.9185	High
	Ground cover	17	1.8571	Moderate	0.9544	High
Petaling	Tree	11	-	Low	-	-
	Pole	11	-	Low	-	-
	Sapling	10	2.1398	Moderate	0.9293	High
	Seedling	16	1.7207	Moderate	0.9603	High
	Ground cover	15	1.4217	Moderate	0.8834	High

Table 3. Description of Mentilin habitat in each research location.

Research location	Habitat description
Zed	Jungle rubber *Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg. aged over 10 years.
Kemuja	Jungle rubber *Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg. aged over 10 years + forest of the Giant Atter Bamboo *Gigantochloa atter* (Hassk.) Kurz.
Paya Benua	Jungle rubber *Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg. aged over 10 years.
Petaling	Jungle rubber *Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg. aged over 10 years + abandoned and unproductive plantations of pepper *Piper nigrum* L.

Fig. 3. Mentilin habitats in the villages of (a) Zed, (b) Kemuja, (c) Paya Benua, and (d) Petaling.

in jungle rubber. One likely factor influencing Mentilin's preference for jungle rubber as its habitat was the presence of suitable substrate for its locomotion. In jungle rubber dominated habitats, Mentilin can use the abundant saplings necessary for its specialized mode of locomotion. In Belitung Island, *C.b. saltator* foraged and travelled on branches, trunks and saplings that measure 1-4 cm DBH and ranges 1-5 m height above ground level (agl) (Yustian, 2006; 2007).

Identification of Mentilin sleeping trees

Although its habitat was generally the jungle rubber, we did not observe Mentilin using the rubber trees for sleeping. Mentilin preferred *S. wallichii, T. orientalis, F. annulata* and *F. aurata* saplings for sleeping and travelling when foraging. These saplings have denser crowns and were more suitable as Mentilin sleeping trees (RS, pers. obs., 2016); and are also native to Bangka Island (Yulian Fakhurrozi, pers. comm., 2018). MacKinnon & MacKinnon (1980), Nowak (1999), Meijaard et al. (2006) and Wirdateti & Dahruddin (2006) observed that tarsiers in secondary forest slept during the day in dense vegetation, especially in shady trees with DBH of 4-8 cm, on vertical branches at a height of 3-15 m agl, and rarely in hollow trees. In addition, Dagosto & Gebo (1998), Gursky (1998; 2007), Neri-Arboleda (2001), Wirdateti & Dahrudin (2006), Shekelle et al. (2013), Sandego et al. (2014) and Sesa et al. (2014) reported that tarsiers often use *Ficus* spp. as sleeping trees.

We identified several potential species that could be used as sleeping trees by Mentilin, i.e., *G. atter, Gynotroches axillaris* Blume, *Vitex pinnata* L., *Dillenia suffruticosa* (Griff.) Martelli, *Commersonia bartramia* (L.) Merr. and *F. fistulosa* Reinw. ex Blume; all of which are native to Bangka Island (Yulian Fakhurrozi, pers. comm., 2018). *Gigantochloa atter* was indicated as one of the potential sleeping trees for Mentilin based on Wirdateti & Dahrudin (2008), Amnur (2010), Qiptiyah & Setiawan (2012), Sesa et al. (2014) and de la Cruz & Casas Jr. (2015) who reported that tarsiers use dense bamboo groves with thick undergrowth as sleeping sites and to hide from predators such as

Table 4. Species of Mentilin sleeping trees.

Location of habitat	Level of vegetation girth	Family	Species		IVI (%)	Number of sleeping mentilin
			Binomial name	Local name		
Zed	Sapling	Theaceae	*Schima wallichii* Choisy	Seruk	41.33	1
	Sapling	Cannabaceae	*Trema orientalis* (L.) Blume	Mengkirai	34.88	1
Kemuja	Sapling	Theaceae	*Schima wallichii* Choisy	Seruk	35.38	1
	Sapling	Cannabaceae	*Trema orientalis* (L.) Blume	Mengkirai	39.08	1
Paya Benua	Sapling	Moraceae	*Ficus annulata* Blume	Bua bulu	21.88	1
	Sapling	Moraceae	*Ficus aurata* (Miq.) Miq.	Bua tupai	21.88	1
	Sapling	Cannabaceae	*Trema orientalis* (L.) Blume	Mengkirai	21.88	1
	Sapling	Theaceae	*Schima wallichii* Choisy	Seruk	21.88	1
Petaling	Sapling	Moraceae	*Ficus annulata* Blume	Bua bulu	23.76	1
	Sapling	Theaceae	*Schima wallichii* Choisy	Seruk	23.76	1
	Sapling	Moraceae	*Ficus aurata* (Miq.) Miq.	Bua tupai	19.76	2
	Sapling	Cannabaceae	*Trema orientalis* (L.) Blume	Mengkirai	19.76	1

snakes and owls. *Gynotroches axillaris, D. suffruticosa, C. bartramia* and *F. fistulosa* are potential sleeping trees for Mentilin because their crowns are dense as *S. wallichii, T. orientalis, F. annulata and F. aurata* (RS, pers. obs., 2016). *Ficus fistulosa* is also considered a potential sleeping tree because Mentilin is known to use *Ficus* spp.

Conservation efforts

The occurrence of Mentilin in jungle rubber habitats indicates the suitability of the habitat as additional habitat for Mentilin. Currently, jungle rubber dominates unprotected forest areas in Bangka Island (typically associated with local communities and private forest areas). However, due to the low commercial value of rubber, many jungle rubber areas are being converted to the more profitable unconventional tin mines and well-maintained palm oil plantations. This conversion is detrimental to conservation of Mentilin as jungle rubber is clearly an important additional habitat for the species. Hence, the maintenance of jungle rubber dominated agroforest areas will have a positive impact on the conservation of Mentilin. Thus, socio-economic assistance or research activities with financial benefits to the landowners may be an option to encourage the landowners to maintain the jungle rubber. However, Mentilin occurring in jungle rubber areas are vulnerable to capture for trade by the local people. Therefore, awareness programs are needed to highlight the conservation needs and the legal protection status (including penalties and punishments) of the species.

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