

**A note on the agonistic behaviour of proboscis monkeys at Labuk Bay, Sandakan, Sabah****Introduction**

Social animals display various behaviours to maintain social structure and spacing of group members. In agonistic behaviour, one animal becomes aggressive or attacks another animal, which returns the aggression or submits (Miller & Harley, 2005). Besides actual aggression, agonistic behaviour includes threat display, retreat, placating aggressors and conciliation. Agonistic behaviour is seen in many animal species because resources including food, shelter, mates and space are often limited. In many species, the males vent much of their aggression in the form of threat displays warning other males of an intention to defend an area or territory. Agonistic behaviour is important in the maintenance of territories and dominance hierarchies. In proboscis monkeys, high-intensity agonistic displays of slapping, chasing, biting are rare (Yeager, 1992). Low intensity agonistic displays of vocalization, leaping and branch shaking, and penile erection with open-mouth displays, are more frequent. Early morning displays by the adult males are some behavioural activities to ensure temporal avoidance between groups.

The capability of the Labuk Bay Proboscis Monkey Sanctuary (LBPMS) in successfully conserving and promoting ecotourism on proboscis monkeys in an isolated mangrove forest prompted this study. The initial effort of total conversion of mangroves to oil palm estate was halted due to the existence of wild proboscis monkey populations. It was reported that the proboscis monkeys in the remaining patches of mangrove forest displayed aggressive behaviour due to the lost of foraging area in their natural habitat. Furthermore, the populations in LBPMS are wild and difficult to relocate to nearby mangrove forest reserves. These problems have forced the management of LBPMS to conserve the remaining mangrove forest fragment as habitat and foraging area for the proboscis monkeys, and to provide pancakes as supplementary feeds.

**Study site**

In this study, the behaviour of proboscis monkey populations in Zones A and B of LBPMS (N 5°56' 14.9"; E 117°47' 44.5") was monitored. Located ~48 km west of Sandakan in Sabah, the mangrove forest proboscis monkey sanctuary (263 ha) is surrounded by tracts of oil palm plantations except the northern part, which borders

the Sulu Sea (Fig. 1). Kampung Samawang, the nearest village, is located ~3 km southwest of LBPMS and the topography is relatively flat (0.5–2.0 m asl).

**Methods**

Based on the scan sampling method of Altmann (1974), direct observations on the agonistic behaviour of proboscis monkey populations at LBPMS were made from October 2008 to July 2009. Sightings were made with binoculars and recorded using Canon video camera. To determine whether the focal groups of proboscis monkeys were territorial, analysis was conducted using the territoriality formula  $D = d/\sqrt{(4A/\pi)}$  where  $D$  = index of defensibility,  $d$  = daily path length (km) and  $A$  = home range area (km<sup>2</sup>) (Mitani & Rodman, (1979). When using this formula to determine the territorial behaviour of an animal group, if the value of  $D \geq 1$ , the group is expected to be territorial. Values  $< 1$  reflect non-territorial behaviour. The frequency of agonistic behaviour and the amount of pancakes consumed per individual monkey (kg/month) was correlated.

**Results and discussion**

From 2004 to 2009, the proboscis monkey populations in LBPMS increased from 89 to 148 individuals, indicating that the proboscis monkeys are able to survive in isolated mangroves of the sanctuary. The territorial behaviour of all focal groups indicated their ability to defend occupied areas. The groups confine and defend the mangrove forests surrounding the feeding platforms.

In this study, the agonistic behaviour of proboscis monkeys is 2.85% ( $n = 1,021$ ) of their total activity time based on ~35,900 observations made mostly at the feeding platforms when the animals are feeding on pancakes. The average amount of pancakes consumed per day per focal group is shown in Table 1. In Zone A, the amount consumed per day per focal group ranged from 2.29–3.55 kg with an individual consuming 210–230 g. In Zone B, the group and individual daily consumption was 1.11–3.13 kg and 130–300 g, respectively.

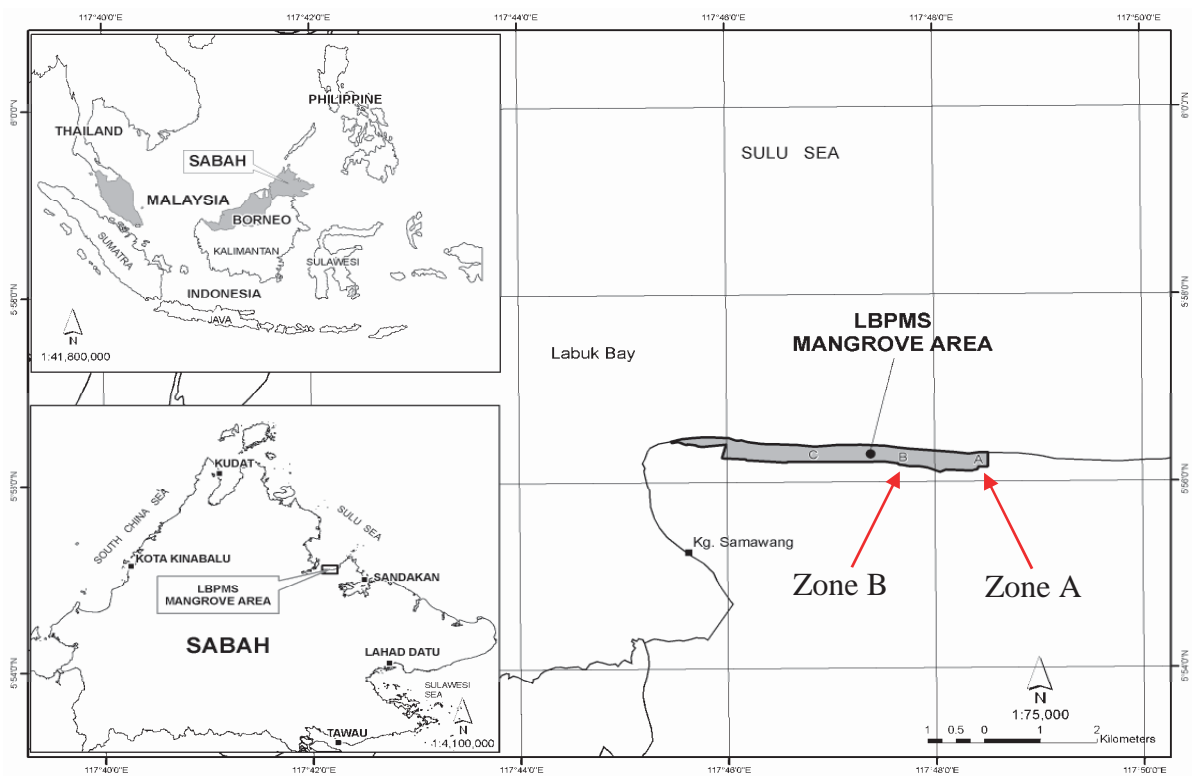
The overlapping movement of proboscis monkeys in LBPMS suggests the existence of territorial behaviour among groups of proboscis monkeys as indicated by the high index of defensibility value ( $D$ ). In this study, the  $D$  values of all focal groups were more than  $> 3$ , with KK ( $D = 4.56$ ) and Owen ( $D = 4.61$ ) being the most territorial for the one male units (OMU) and all male units (AMU), respectively (Table 2).

In this study, the amount of pancakes consumed per individual based on seven focal groups was negatively correlated to frequency of agonistic behaviour with  $P = 0.29$  and  $r = -0.43$  (Fig. 2). This indicated that the frequency of agonistic behaviour of proboscis monkeys at LBPMS decreased with increasing amounts of pancakes consumed per individual.

Although agonistic behaviour of the proboscis monkeys in LBPMS is a minor activity, the percentage of time allocated for aggression was higher than the wild populations such as those at Sukau in Kinabatangan. In Sukau, young leaves are available in abundance throughout the year and this may reduce the aggressive behaviour of the wild proboscis monkeys. In this study, most of the agonism was recorded during feeding time at the respective feeding platforms at LBPMS. The amount of pancake contributed to the aggressive behaviour of the monkeys, whereby an increase in pancake intake reduced aggression. The different groups frequently used the same area, slept on the same trees, foraged from the same mangrove plants, and travelled along the same ground and arboreal routes.

In LBPMS, the territorial behaviour of proboscis monkeys was related to aggression, suggesting that their ranging areas were overlapping and aggravated by the feeding programme. With only two focal groups, there was minimal range overlapping in Zone A. There was ample space for both groups to roam freely. On the other hand, range separation was not possible for the five focal groups in Zone B and their movement pattern was highly overlapping. All the focal groups in Zone B were highly territorial as reflected by their high  $D$  values of  $\geq 3$ .

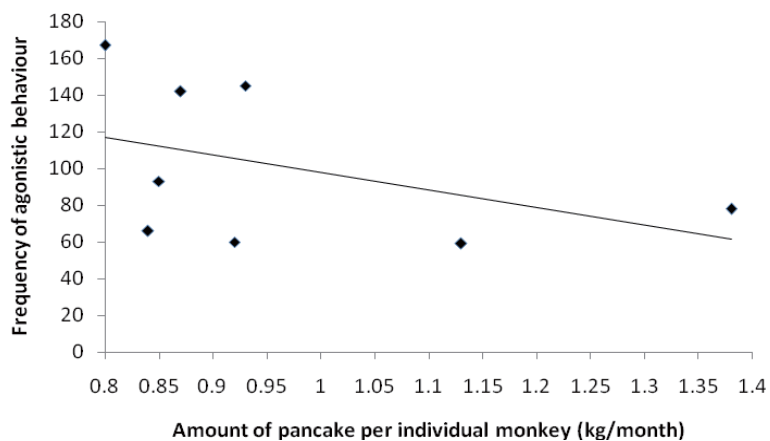
In conclusion, one should not generalise that proboscis monkeys are shy and non-territorial animals. Under stressful habitat settings such as the isolated mangroves of LBPMS, agonism in the form of aggressive behaviour may prevail among proboscis monkeys (Fig. 3).



**Fig. 1** Map of LBPMS showing the location of the study area (Zones A and B)

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**Fig. 2** The correlation pattern of the frequency of agonistic behaviour of proboscis monkeys vs. the amount of pancakes consumed per individual (kg/month)



**Fig. 3** Agonistic displays by an all male unit (AMU) in LBPMS

**Table 1** Average amount of pancakes consumed by focal groups

Zone	Group ID	kg/group/day Mean $\pm$ SD	kg/day/monkey Mean $\pm$ SD	Mann-Whitney U test, <i>p</i>	Kruskal Wallis test, <i>p</i>
A	John	3.55 $\pm$ 0.54	0.23 $\pm$ 0.08	< 0.05	
	Jonathan	2.29 $\pm$ 0.35	0.21 $\pm$ 0.03	< 0.05	
B	KK	3.13 $\pm$ 0.35	0.13 $\pm$ 0.03		< 0.01
	Ronaldo	2.10 $\pm$ 0.60	0.19 $\pm$ 0.06		< 0.01
	Rivaldo	1.37 $\pm$ 0.25	0.26 $\pm$ 0.11		< 0.01
	KC	1.11 $\pm$ 0.53	0.21 $\pm$ 0.07		< 0.01
	Owen	1.56 $\pm$ 0.36	0.30 $\pm$ 0.15		< 0.01

**Table 2** Index of defensibility (*D*) of various focal groups of proboscis monkeys

Zone	Group type	Group ID	<i>D</i>
A	OMU	John	3.91
A	OMU	Jonathan	4.12
B	OMU	KK	4.56
B	OMU	Ronaldo	4.38
B	OMU	Rivaldo	3.95
B	AMU	KC	3.67
B	AMU	Owen	4.61

OMU = one male unit, AMU = all male unit, ID = identity and *D* = index of defensibility

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