A Preliminary Study of Habitat Selection by Malayan Tapir, *Tapirus indicus*, in Krau Wildlife Reserve, Malaysia

Nor Zalipah Mohamed[1], Carl Traeholt[2]

1 Institute of Biodiversity, Department Of Wildlife And National Parks, Bukit Rengit, Lanchang, Pahang, Malaysia.
Corresponding author, present address: Department Of Biology, Faculty of Science and Technology, University Malaysia Terengganu, Kuala Terengganu, E-mail: zalipah@umt.edu.my

2 Copenhagen Zoo, Research and Conservation Division, SE Asia Programme, Kuala Lumpur, Malaysia,
E-mail: ctraeholt@pd.jaring.my

Introduction

The Malay tapir, *Tapirus indicus*, is the only member of the *Tapiridae* family to exist in Asia with the World's remaining three species found in the Americas. The Malay tapir is believed to have split up from its three American family members approximately 20-23 million years ago (Colbert, 1998, 2005). Whilst the species roamed large parts of Asia, recent finds suggest that the Malay tapir existed on Borneo from the late Pleistocene (~ 45,000 years ago) through the Holocene until as recently as perhaps a few hundred years ago (Cranbrook 2010; Cranbrook & Piper, 2009). It is not known what lead to their disappearance on Borneo, but there has been a suggestion that it is linked to the change of habitat, where Malay tapirs may have preferred the rich savannah landscapes that dominated Sundaland (Cranbrook 2010; Cranbrook & Piper, 2009). With the rising water level Borneo became isolated from continental Asia and forced tapirs and other large ungulates to forage in tropical rainforests that may not have been the optimal habitat for them. The Malay tapir is considered a hindgut fermenter and have a low defecation frequency, which might be linked to their comparatively low food intake. Their gastrointestinal capacity is very similar to that of horses (Clauss *et al*, 2010) suggesting that they are physiologically adapted to diets more similar to that of horses rather than as browsers in a tropical rainforest. Being hindgut fermenters, however, allows them to consume sugar-rich fruits and possibly act as seed dispersers in tropical rainforest habitats (Corlett, 1998).

Since 2002, the Malay tapir conservation project (MTCP) have undertaken extensive population and activity pattern studies on the Malay tapirs and found that the individual Malay tapirs roam over a relatively small area of 10-15 km^2 (Abdul Ghani, 2009; Traeholt, 2005; Traeholt & Sanusi, 2009) where they forage on up to 115 species of plants (Williams & Petrides, 1980). Although these results suggest that Malay tapirs consume a wide variety of herbaceous plants, Williams & Petrides (1980) and Abdul Ghani (2009) recorded that there are certain species that make up more than 60% of the diet. This could indicate that Malay tapirs prefer certain types of habitat rich with the preferred species. As such the preferred habitats contain the resources and conditions in an area that produce occupancy including survival and reproduction (Hall *et al*., 1997).

This study aimed at describing the micro-habitat of selected areas with known occupancy of Malay tapirs to emphasize on habitat usage and its relation to the feeding selection of *Tapirus indicus* at Krau Wildlife Reserve, Pahang.

Materials and Methods

Study Area

Krau Wildlife Reserve covers approximately 63.000 ha of largely undisturbed tropical rainforests. About 50% of this consists of lowland dipterocarp forest wtih the rest varying from hill forest at Bukit Tapah (~800 m) in the south to montane forest at Gunung Benom (~2000 m) in the north. Krau is home to other large mammals such as gaur, *Bos gaurus*, sambar deer, *Cervus unicolour*, wild pig, *Sus scrofa* and Malaysia's two largest terrestrial predators tiger, *Panthera tigris corbetti* and leopard, *Panthera pardus*. Elephants are known to occasionally venture into Krau from the adjacent forest reserve although no resident elephant population is found in Krau anymore.

An ongoing radio-telemetric study of the Malayan tapir has produced hundreds of waypoints where tapirs have been recorded. The first sixty GPS waypoints of the dataset of two Malay tapir individuals, A and B, were chosen to test for possible habitat preference in Krau Wildlife Reserve, Malaysia. Samplings of habitat

characteristic were conducted from October 2006 to June 2007. A total of 28 habitat variables were selected based on Kemper & Bell (1985), Patterson (1990) and Zainab (2001). At each waypoint, data were recorded from an area of 3m radius. All trees with DBH less then 5cm were collected for species identification as potential food plants.

Data were analyzed using Principal Component Analysis (PCA). From the total variables, only 23 were selected as some variables showed little variation with a constant value.

Results and Discussion

The records of 28 habitat variables reveal a high number of trees below 5cm at DBH, lots of shrubs below 50 cm in height, wines and gingers (Tab. 1). A total of 776 individual trees of DBH < 5 cm were identified in this study. Based on Williams (1978), the total number of species consumed by tapir in Taman Negara National Park was 115 species, with 5 species included in the most preferred category. The highest number of species consumed by tapir belongs to the family *Euphorbiacea* (5 species) (Tab. 2). Nizam *et al*. (2006) reported that the *Euphorbiacea* family contained the highest number of species recorded in Krau Wildlife Reserve.

For tapir A, 391 individual trees from 47 families were recorded in the study areas. This amounted to a total of 166 species of which 13 species were recorded to be consumed by Malay tapirs, two of which were in the most preferred category listed by Williams (1978). For tapir A 36 individual trees belonging to the 13 recorded food species where found that constitutes 9.2% of the total number of trees being potential tapir food. In the area utilised by tapir B, 385 trees from 47 families and 165 species were recorded. Of this, 18 individual trees belonging to 10 food species were recorded, of which four species belonged to in the most preferred category. This constitutes 4.67% of the total number of trees that could be tapir food.

Only climbers showed a significant difference between the two tapir habitats ($t = -2.05$, $P = 0.045$, $df = 58$). Eigen value of the first two principal components accounted for 23.6% of variation in the 23 data dimensions (Tab. 1). Individually, tapir A showed the highest affinity towards habitat with many climbers while tapir B showed the highest affinity for habitat with lots of ginger (Tab. 1).

Although Malay tapirs are generally classified as browsers, Williams (1978) recorded eight species of herbs and one species of moss in the tapir diet, but no ginger species. Williams & Petrides (1980) also recorded six species of climbers consumed by tapir.

Based on the preliminary data in this study canopy height and the abundance of climbers may be factors determining habitat preference and utilization of tapir in Krau Wildlife Reserve. However, with results from only two individuals it is not possible to make any specific conclusion as to what factors determine Malay tapirs' habitat choices. Tall canopy habitat may provide better shade cover and cooler micro-climate preferred by tapirs but in this case the bias towards tall canopy is most likely a result of the study taking place in an undisturbed lowland *dipterocarp* rainforest that is dominated by tall canopy habitat. The same reason may apply to the abundance of climber species that are not normally present in disturbed habitat. To get a clearer picture of tapir's habitat usage and preference a comparison with habitat characteristic of random sites, including areas were tapirs do not live, should be conducted and combined with browsing signs. Such data may help to determine differences in consumption volume and frequency of preferred species and, subsequently, provide more details on what drives tapirs' habitat selection.

Acknowledgement

This study was supported and funded by Department of Wildlife and National Parks, Malaysia, and Copenhagen Zoo, Denmark.

References

Abdul Ghani, Siti K. (2009). Home range size, density estimation and behaviour of Malayan tapirs *(Tapirus indicus)* at Krau wildlife reserve. MSc thesis, University of Science, Malaysia. 226 pp.

Clauss, M., Lang-Deuerling, S., Muller, D. W. H., Kienzle, E., Steuer, P. and J. Hummel (2010). Retention of fluid and particles in captive tapirs (Tapirus sp.). *Comparative Biochemistry and Physiology A* **157(1):** 95-101.

Corlett, R.T. (1998). Frugivory and seed dispersal by vertebrates in the Oriental (Indomalayan) Region. *Biological Reviews* **73(4):** 413-448.

Colbert, M.W., and R.M. Schoch (1998). The Tapiroidea and other moropomorphs. In: Evolution of Tertiary Mammals of North America. C. Janis & L. Jacobs, eds. Cambridge University Press:. 569-582.

Colbert, M.W. (2005). The facial skeleton of the Early Oligocene *Colodon* (Perissodactyla, Tapiroidea). *Palaeontologia Electronica* **8(12A):** 27p.

Cranbrook, E. (2010). Late quaternary turnover of mammals in Borneo: the zooarchaeological record. *Biodiversity and conservation* **19(2):** 373-391.

Table 1. The results of each habitat variable recorded for each individual tapir (mean + SD, white columns). Value of Eigen vectors for the first two principal components (N = 60). PC1 and PC2 and value of Eigen vectors for the first principal component (PC1) for each tapir individual (grey columns).

	Habitat Variable	Tapir A	Tapir B	PC1	PC2	Tapir A (N=30)	Tapir B (N=30)
1	Canopy cover (%)	89.93±6.49	89.00±6.96	0.081	-0.07	0.139	-0.046
2	Canopy height (m)	7.00±5.15	6.75±5.03	0.421	0.228	0.32	0.353
3	Height of tallest tree (m)	10.57±4.02	10.81±5.32	0.362	0.326	0.144	0.319
4	Number of tress DBH > 5 cm	0.56±0.77	0.76±0.89	-0.073	-0.197	-0.069	0.011
5	Number of tress DBH > 10 cm	0.36±0.55	0.16±0.37	0.026	-0.005	0.057	-0.02
6	Number of tress DBH > 15 cm	0.16±0.37	0.26±0.44	0.219	0.338	0.089	0.225
7	Number of tress DBH < 5 cm	13.00±6.70	12.56±5.28	0.304	-0.249	0.322	0.196
8	Number of fallen log diameter > 5 cm	0.03±0.18	0.13±0.34	-0.16	0.16	-0.16	-0.014
9	Number of fallen log diameter < 5 cm	0.03±0.18	0.03±0.18	0.011	-0.076	-0.062	-0.333
10	Number of shrub less than 50 cm height	204.90±107.51	187.10±135.66	0.287	-0.018	0.276	0.172
11	Number of shrub 50-100 cm height	38.13±19.39	39.06±15.39	0.278	-0.319	0.267	-0.043
12	Number of Climber	6.60±6.50	10.03±6.46	0.413	-0.186	0.437	0.154
13	Number of Herb	12.60±14.00	13.30±14.39	0.088	-0.326	0.294	-0.278
14	Number of Fern	3.06±4.90	6.23±8.22	0.139	-0.314	0.283	-0.292
15	Number of Rattan	7.56±3.92	4.20±9.60	0.181	-0.075	0.219	0.179
16	Number of Bertam	1. 40±2.02	1.33±1.45	-0.136	0.018	-0.18	-0.073
17	Number of Palm	6.40±4.41	6.56±4.30	-0.106	-0.274	-0.064	-0.248
18	Number of Pandan	0.26±0.76	0.20±0.78	0.135	0.142	-0.133	0.244
19	Number of Ginger	2.53±3.73	2.60±3.79	-0.064	-0.173	0.024	-0.399
20	Ground cover, Soil (%)	8.46±5.54	7.10±5.27	0.137	0.229	-0.063	0.168
21	Ground cover, Litter (%)	88.53±5.24	92.56±15.66	-0.185	0.065	0.021	-0.062
22	Ground cover, Rock (%)	3.00±0.91	0.16±16.43	0.126	-0.171	0.288	0.005
23	Litter depth (cm)	12.23±2.85	11.06±3.68	0.042	0.18	0.118	0.058
	Eigen-value			**2.995**	**2.4442**		
	Proportion			**0.13**	**0.106**		
	Cumulative			**0.13**	**0.236**		

Table 2. List of tree species consumed by tapir at Krau Wildlife Reserve.

Family	Species	Local Name (growth form)	Tapir A	Tapir B
Ebenaceae	*Diospyros buxifolia*	- (tree)	√	√
	Diospyros sumatrana	Behtne (tree)	√	
Euphorbiaceae	*Antidesma tomentosum*	- (-)	√	
	Aporusa symplocoides	Metkot (-)		*
	Baccaurea parviflora	Kemai (small tree)	*	
	Elateriospermum tapos	Perah (tree)	√	√
	Pimelodendron griffithianum	- (-)	√	√
Gnetaceae	*Gnetum gnemon*	- (tree)	√	√
Guttiferae	*Garcinia nigrolineata*	- (-)		*
Melastomataceae	*Memecylon dichotomum*	Klandis (shrub-tree)	√	√
Moraceae	*Ficus semicordata*	Ara (tree)	*	*
	Streblus elongatus	- (tree)	√	
Rubiaceae	*Timonius wallichianus*	- (tree)	√	
	Lasianthus griffithii	Tenboh (srub)		*
Sapotaceae	*Payena lucida*	- (-)	√	√

* most preferred species as recorded by Williams (1978)

Cranbrook, E.O. and Piper, P.J. (2009). Borneo Records of Malay Tapir, Tapirus indicus Desmarest: A Zooarchaeological and Historical Review. *International Journal of Osteoarchaeology* **19(4):** 491-507

Hall, H.L., Krausman, P.R. and Morrison, M.L. (1997). The habitat concept and a plea for standard terminology. *Wildlife Society Bulletin*. **25**: 173-182.

Nizam, M.S., Fakrul-Hatta, M. and Latiff, A. (2006). Diversity and tree species community in the Krau Wildlife Reserve, Pahang, Malaysia. *Malaysian Applied Biology*. **35(2)**: 81-85.

Kemper, C. and Bell, D.T. (1985). Small mammals and habitat structure in lowland rain forest of Peninsular Malaysia. *Journal of Tropical Ecology*. **1**: 5-22.

Patterson, B.D., Meserve, P.L. and Lang, B.K. (1990). Quantitative habitat associations of small mammals along an elevational transect in temperate rainforest of Chile. *Journal of Mammalogy*. **71 (4)**: 620-633.

Traeholt, C. (2005). Malay Tapir Conservation Project: Completion Report. Kuala Lumpur.

Traeholt, C. and Sanusi, M. (2009). Population Estimates of Malay Tapir, Tapirus indicus, by Camera Trapping in Krau Wildlife Reserve, Malaysia. *Tapir Conservation* **18(1):** 18-26.

Williams, K.D. and Petrides, G.A. (1980). Browse use, feeding behavior, and management of the Malayan tapir. *Journal of Wildlife Management* **44(2):** 489-494.

Williams, K.D. (1978). Aspects of the ecology and behavior of the Malayan Tapir (Tapirus indicus Desmarest) in the National Park of West Malaysia. MSc Thesis Dissertation, Michigan State University

Zainab, B. (2001). Kajian Transek Altitud Mamalia Kecil (non-volan) di Gunung Nuang, Hulu Langat, Selangor. Thesis Sarjana Sains, Universiti Kebangsaan Malaysia.