A CAMERA TRAP ASSESSMENT OF TERRESTRIAL VERTEBRATES IN TAMAN NEGARA KELANTAN AND TERENGGANU, MALAYSIA

Asrulsani Jambari*, Sivananthan T. Elagupillay, Hazril Rafhan Abdul Halim, Muhd. Hakim Saharudin, Khairul Amirin Mohamed, Alim Mohd, Mohd Fauzi Seman, Sohaimi Samsuddin & Ihsan Syahid Mohd Azmi

Department of Wildlife and National Park (DWNP) Peninsular Malaysia, KM 10 Jalan Cheras, 56100 Kuala Lumpur, Malaysia

*Corresponding author's email: sani@wildlife.gov.my

ABSTRACT

Information and knowledge on species distribution are crucial for planning and evaluating conservation strategies. Camera trapping method was used at two study areas within Taman Negara Kelantan and Terengganu for a period of two months to determine the species composition and distribution of terrestrial vertebrates. A total of 6,879 and 1,957 images were recorded from 4,364 and 3,453 trap-nights in Kelantan and Terengganu respectively with 25 species were recorded. Sambar deer (*Rusa unicolor*) was most frequently photographed with 3,270 (39.16%) images followed by Asian elephant (*Elephas maximus*) with 1,400 (16.76%) images and avian with 777 (9.30%) images. Our analysis revealed that five species significantly showed an edge-biased pattern, four species significantly correlated with higher altitudinal elevations while three species are significantly biased to water distributions near to main water body. Findings indicated that distance to park edge, elevations and main water body can significantly influence the distribution of certain terrestrial species in the study area. These results provide knowledge and baseline information for long term terrestrial vertebrates monitoring in Taman Negara Kelantan and Terengganu.

Keywords: terrestrial vertebrates, camera trapping, park edges, altitudinal elevations, water resources

INTRODUCTION

Nowadays, the camera trapping method becomes increasingly popular. The improvement of technology and cost benefit (Rowcliffe & Carbone, 2008) makes this method widely used among researcher purposely to detect species presence (Tobler *et al*., 2008), to estimate the community structure and diversity (Ahumada *et al*., 2011), and to determine the activity pattern (Grassman *et al*., 2006).

Systematic camera trapping survey in a large-scale area to document terrestrial animal species such in Taman Negara (National Park) Kelantan and Terengganu is crucial (Mugerwa *et al*., 2012). The baseline information on assessment of activity pattern of wildlife based on species presence (Tobler *et al*., 2008), density (Maffei & Noss, 2008), richness (O'Brien *et al.,* 2011), and its diversity (Ahumada *et al*., 2011) are important for planning and formulating conservations strategies (Tobler *et al*., 2008), evaluation of conservation programmes and develop approaches of effective management (Nowel & Jackson, 1996; Stander, 1998; Karanth, 2003).

Accountable and reliable information on spatial and temporal are very useful especially in wildlife monitoring. Thus, the objective of this study is to evaluate the trap-based information of terrestrial vertebrates' distributions at the Taman Negara Kelantan and Terengganu in relation to park edge, altitudinal elevations and main water body. We predict that these factors may influence terrestrial vertebrates in the study area and hope to provide knowledge and baseline information for the long term terrestrial vertebrates monitoring in Taman Negara Kelantan and Terengganu.

METHODOLOGY

Study Area

This study was carried out in Taman Negara Kuala Koh, Kelantan (4°45'57.6"N 102°26'36.2"E) and Taman Negara Terengganu (5°00'36.7"N 102°42'07.5"E), located in the north-central peninsular where Kelantan, Pahang and Terengganu adjoin. Taman Negara Kelantan is the second largest protected area at 1,043 km² after Taman Negara Pahang (2,477 km²) and followed by Taman Negara Terengganu at 853 km² (Figure 1).
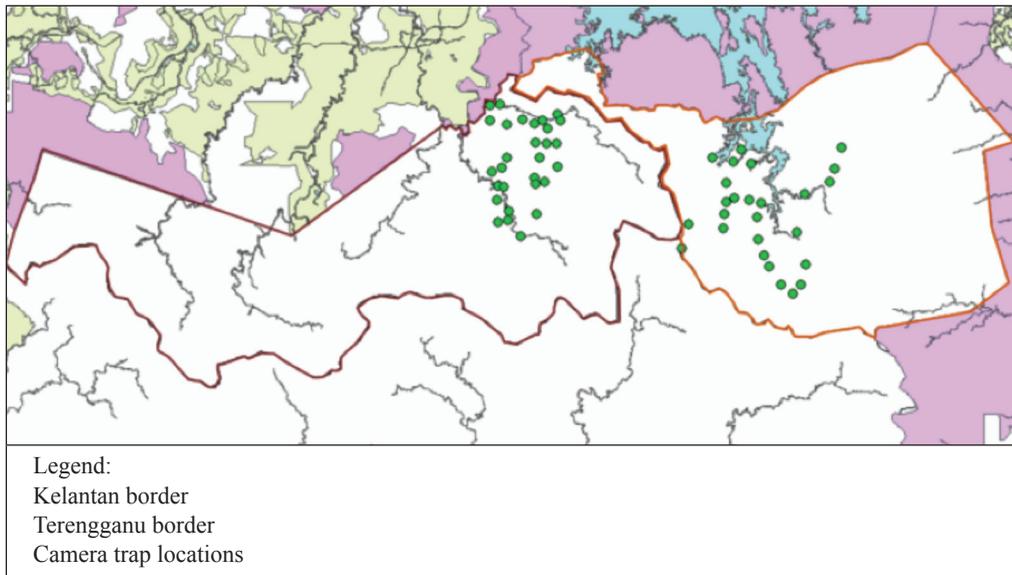
Legend:
Kelantan border
Terengganu border
Camera trap locations

Figure 1 Camera trap locations based on study sites of Taman Negara Kelantan and Terengganu.

Camera trapping

The sighting data on terrestrial vertebrates was collected using infrared digital camera trap technology, UWAY U250B 8MP Vigilant Hunter Series Camera (O'Connell *et al*., 2011) as camera trap were most frequently used in surveys of large to medium sized terrestrial animal (Tobler *et al*., 2008). The cameras allow for high capture rates (photographs) of mammals species that are otherwise rarely detected in the wild by human observers and are difficult to trap alive (Foster & Harmsen, 2012) with 5 second trigger speed which are automatically activated by movements from any object. These cameras were equipped with 8GB SD secure digital card capacity and eight double AA batteries to make sure the cameras work for a long period of time in the field. The cameras were also being equipped with a casing to protect it from rain, big mammals (i.e. Asian elephant, wild boar, tapir, and etc.) and human vandals. The casing was mounted to a tree with a bicycle cable lock.

A total of 58 sampling plot 2.5 km x 2.5 km were set up systematically at both national parks. The cameras were set up to cover all habitat types of interest and at the locations likely to be used by animals. At each location, cameras were in put in pairs with a distance of 7-10 m apart (Cheyne & Macdonald, 2011) in which

one of it was set as a camera while another was set as a video camera to increase detection. Each camera was mounted approximately 50 cm from the ground to allow photographic captured of animals ranging in sizes from rats to elephants (Mugerwa *et al*., 2012). A one hour interval in a sequence of observations of a specific species was introduced to prevent double count of individual animal (Azlan & Sharma, 2006; Tobler *et al*., 2008). Date and time for every image captured were also recorded.

The camera traps were placed starting from March 2014 until July 2014. Every camera trap will be marked using a Global Positioning System (GPS) receiver with a built-in barometric altimeter (Garmin GPS Map 62cs, Garmin International Inc. USA). Each visualised animals were identified based on Francis and Barrett (2008).

Data Analysis

Distance to the park edge, altitude elevation and distance to nearest main water body for each camera was calculated using GIS-Arc Map 10 for windows software package (Mugerwa *et al*., 2012). The recorded data were summarised in Microsoft Excel datasheets. Images without wildlife were excluded from our analysis. Photographs with one or more individuals of the same species were considered as a single camera event (Grassman *et al*., 2006; Mugerwa *et al*., 2012). A nonparametric measurement of statistical dependence of Spearman rank correlation coefficient (van Emden, 2008) was used to determine the relationship of park edge, elevation and main water body on species distribution.

Due to identification difficulties (i.e. low picture quality and weather conditions), avian and civet were not able to be identified up to species level and thus were identified as merely avian or civet, respectively. Wildlife species that are principally arboreal or rarely descend from the canopy was excluded from this analysis (Kingdon, 1997).

RESULTS AND DISCUSSIONS

Species Composition

A total of 58 units of cameras were set up in both study areas. As a result, a total of 43,799 images were recorded from 7,817 trap nights. Out of the 43,799 images, 8,836 (20.17%) images were further selected after removing 34,963 (79.83%)

of unidentifiable images. Separately, 6,879 and 1,957 images were recorded from 4,364 and 3,453 trap nights in Taman Negara Kelantan and Terengganu, respectively.

Of the 8,836 images captured in the study site, 85.70% were mammals, 8.80% were avian and 5.49% were human, while only 0.02% was reptile (Figure 1). These constitute three classes, 14 orders, 25 families, 38 genera, and 43 species. The images were then categorised into 25 groups and examined for possible correlation between the effect of nearest park edge, altitudinal and nearest water bodies.
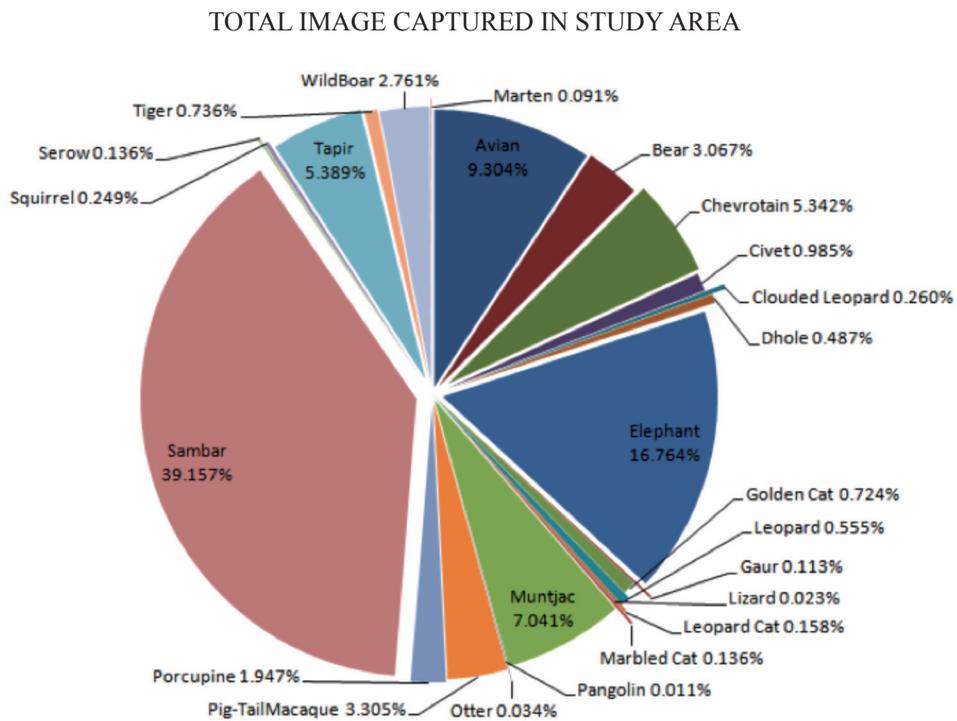
TOTAL IMAGE CAPTURED IN STUDY AREA

Figure 2 List of species based on percentages from the total captured images in the both study areas of Taman Negara Kelantan and Terengganu.

The most frequently photographed species was the Sambar deer (*Rusa unicolor*) with 3,270 images (39.16%) from 15 different camera locations followed by the Asian elephant (*Elephas maximus*) with 1,400 images (16.76%) from 31 different locations, avian with 777 images (9.30%) from 32 different locations, Southern red muntjac (*Muntiacus muntjak*) with 588 images (7.04%) from 38 different

locations, and the Malayan tapir (*Tapirus indicus*) with 450 images (5.39%) from 22 different locations. Camera traps from both study sites were able to capture only three images of otter (0.034%), two images of lizard (0.023%) and one image of the Sunda pangolin (*Manis javanica*) (0.011%).

Five species out of 25 small to large vertebrate significantly showed a pattern of increased detection with proximity to the park edge which is avian ($P<0.01$), chevrotain ($P<0.05$), civet ($P<0.05$), clouded leopard ($P<0.05$), and leopard ($P<0.05$). Four species were significantly detected at higher altitudinal elevations which is avian ($P<0.01$), Asian elephant ($P<0.05$), clouded leopard ($P<0.01$), and Sambar deer ($P<0.01$) while three species including avian ($P<0.05$), clouded leopard ($P<0.01$), and Sambar deer ($P<0.01$) were significantly detected biased to water distributions near to main water bodies (Table 1).

Table 1 Influence of distance to nearest park edge, higher altitudinal elevations and distance to nearest main water body on the distributions of terrestrial vertebrate species recorded in Taman Negara Kelantan and Terengganu. Only result that showed a clear trend is presented in the table.

No.	Influences	Species	*r*
1.	Distance to park edge (m)	Avian	-.340**
		Chevrotain	-.320*
		Civet	-.288*
		Clouded leopard	.329*
		Leopard	-.312*
2.	Altitudinal elevations (asl)	Avian	-.539**
		Asian elephant	-.335*
		Clouded leopard	.369**
		Sambar deer	-.466**
3.	Distance to main water body (m)	Avian	-.259*
		Clouded leopard	.358**
		Sambar deer	-.383**

r = degree of correlation by the correlation coefficient
** correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

Effect of Distance to Park Edge on Species

Five out of 25 small to large terrestrial vertebrate were significantly more frequently detected close to the park edge. Preference for the park edge may

be a response to the availability of food sources and their good adaptation to exploited human areas as documented by Whitmore (1984). The productivity of these areas are generally higher which may support the composition for certain species. Differences in habitat structure between the park edges from the interior forests could also influence species distribution (Oluput & Sheil, 2010).Our analysis found that avian and chevrotain (greater mouse-deer and mouse-deer) were detected significantly closer to the edge.

The chevrotains spend the most time in the edge by browsing and consuming the abundant fruits, seeds, and soft leaves (Heydon & Bulloh, 1996; Matsubayashi *et al*., 2003; Matsubayashi & Sukor, 2005) produced by pioneer colonist. Chevrotains are partly frugivorous but also eat substantial quantities of shoots and young leaves, mostly from fast-growing gap pioneer species rather than closed forest species (Dang, 1968; Medway, 1983; Kuznetzov & Puzachenko, 1992; Matsubayashi *et al*., 2003). Chevrotains heavy use of disturbed habitats was strengthen by Johns (1997) from his study in Peninsular Malaysia which found that densities of chevrotains are higher in disturbed areas (i.e. edge, logged and open areas) and tend to decrease once the forests matures. In this study, chevrotains were regularly detected spending most of the time searching for food in the succession areas where higher abundant of food are available.

There is no historical evidence for the existence of terrestrial avian species (i.e. crested partridge, great argus, Malay crested fireback, Malay crestless fireback, Malay peacock-pheasant, and rail-babbler) occurring in the interior area except for Malayan banded pitta (Lambert & Woodcock, 1996), red junglefowl and short-tailed babbler which are commonly found in secondary growth, over grown plantations and scrub (Yong *et al*., 2011). Results in this study further concur to this situation wherein avian species were increasingly detected in proximity to the park edge.

In this study, predators such as clouded leopard and leopard are attracted to the park edge areas which might be due to the high density of prey species. Clouded leopard and leopard are versatile, opportunistic hunters and have a very broad diet which includes both arboreal and terrestrial vertebrates such as terrestrial avian and chevrotain (Sunquist & Sunquist, 2002). Athreya *et al*., (2013) in their study found that leopard populations sometimes live in proximity to human settlements and even in semi-developed areas. In other cases, clouded leopards (Lynam *et al*., 2001; Rao *et al*., 2005; Grassman *et al*., 2006) and leopards (Athreya *et al*., 2013) may occur at higher densities when densities of larger cats (e.g. tigers) are low.

Civets (i.e. Malay civet, large Indian civet and large spotted civet) are adaptable in a variety of environmental conditions. Their diet consists of a wide range of small animals including fish, birds, lizards, frogs, insects, scorpions (and other arthropods), and crabs, as well as poultry and garbage (Lekagul & McNeely, 1977). Therefore, they are commonly associated with community land close to the park edge where they also consume agricultural crops such as bananas, coffees, mangoes, rambutans, and others.

Effect of Elevation

Our analysis indicated that avian, Asian elephant, clouded leopard, and Sambar deer have elevation preferences. Detection rates were significantly higher towards higher elevations. Terrestrial avian species recorded in this study preferred higher elevation range of 1,000 - 1,500 m above sea level (asl) (Jeyarajasingam & Pearson, 2012). This finding further supported the finding by Davison (1981) which revealed that topography is an important factor as a site selection for great argus dancing ground. The display of courtship usually occurs on top of a hill or ridge. However, these results were not very encouraging because most the species such as the Malay crested fireback, Malay crestless fireback, Malay peacock-pheasant, and red junglefowl are widely distributed in lowland area and rarely occur in upper area (Del Hoyo *et al.,* 1994; Madge & McGowan, 2002). The effects of deforestation on lowland forest could have a negative impact on the terrestrial avian in such that these species are now taking refuge in higher elevation forest.

Over a wide range of habitat types, elephants (Choudhury, 1999) and clouded leopard (Nowell & Jackson, 1996) occur up to 2,500 m asl and possibly as high as 3,000 m asl. Wheelock (1980) speculated that elephant occupy a wide variety of habitats from sea levels to montane in response to availability of water, food and shade. However, the relationship between elevation and the occurrence of the Asian elephant and clouded leopard especially in Peninsular Malaysia has not been described.

In accordance with previous studies, our present result demonstrated that Sambar deer prefers higher elevation. Several studies have observed Sambar deer at higher elevations (Kushwaha *et al*., 2004), tall dipterocarp forests on steep terrain (Payne *et al*.,1985), up to 3,000 m asl at Mount Kinabalu, Sabah (Payne *et al*., 1985), and up to 2,150 m asl in Myanmar (Zaw *et al*., 2008). Nevertheless, Sambar deer also makes wide use of secondary forests and gently-sloping terrain of plains areas (Payne *et al*., 1985) such as in the Hukaung Valley in Myanmar (Zaw *et al*., 2008). However, how much this reflects the real habitat selection

and whether it is a natural pattern or due to effects of human activities (habitat conversion and hunting) remains unclear.

Effect of distance to main water bodies

In this study, our analysis revealed that the detection of avian, clouded leopard and Sambar deer increased significantly the closer the distance is to the nearest water bodies. This is surprising due to the fact that rivers are generally used as the main living course by local community as well as main recreational concentration of tourist (Shuib, 1995) and clouded leopard and Sambar deer are generally elusive animals and avoid contact with humans. For the avian species, the finding observed in this study mirror those of a previous study that have examined the effect of water source. Davison (1981) conducted a study on great argus from Malaysia and noted that its dancing ground during mating ritual was close to water source. However, this does not represent all the terrestrial avian recorded in this study. Nevertheless, it is important to bear in mind that due to the small sample size and short period of study, the result could be biased and thus should be considered as preliminary.

Human disturbance

The detection of 485 (5.49%) images of Orang asli and illegal poachers in both study area shows that hunting and poaching remains a potential threat to the wildlife species in the study areas. We predicted that poaching may influence the distribution and abundance of terrestrial vertebrates in the study area. The presence of human activities could alter some of the local ecological parameters and should be considerate as a serious impact that could potentially threaten the survival of the wildlife community in the both national parks. Thus, continuous monitoring programmes via camera trapping offers significant temporal information to assess the impact of human activities to the diversity and abundance of wildlife species.

CONCLUSION

This study indicated that the increased detection of avian, chevrotain, civet, clouded leopard, and leopard correlates with park edge purportedly due to availability of food resources. Effects of altitudinal level and distance to main water bodies should be further investigated with continuous observations employing longer study period and larger data sets to have a clear and significant trend. A greater focus on correlation between a particular species and the

variables could provide interesting findings which can be useful for conservation management. It is important to note that species that ranged close to the park edge are vulnerable to the impacts of human activities. Terrestrial avian and chevrotains are at risk of being poached and hunted for its meat while civet are occasionally hunted for pet trade and sometimes persecuted as pest. The detection of lowland species at higher elevations indicated that forest clearing for human activities poses a major threat to the lowland wildlife diversity.

ACKNOWLEDGEMENTS

REFERENCES

Ahumada, J.A., Silva, C.E.F., Gajapersad, K., Hallam, C., Hurtado, J., Martin, E., McWilliam, A., Mugerwa, B., O'Brien, T., Rovero, F., Sheil, D., Spironello, W.R., Winarni, N. & Andelman, S.J. (2011). Community structure and diversity of tropical forest mammals: data from a global camera trap network. *Philosophical Transactions of the Royal Society B: Biological Sciences*, **366(1578)**: 2703–2711.

Athreya, V., Odden, M., Linnell, J.D.C., Krishnaswamy, J. & Karanth, U. (2013). Big cats in our backyards: persistence of large carnivores in a human dominated landscape in India. *PLoS One*, **8(3)**: e57872.

Azlan, J.M. & Sharma, D.S.K. (2006). The diversity and activity patterns of wild felids in a secondary forest in Peninsular Malaysia. *Oryx*, **40(01)**:36–41.

Cheyne, S.M. & Macdonald, D.W. (2011). Wild felid diversity and activity pattern in Sabangau peat-swamp forest, Indonesian Borneo. *Oryx*, **45(01)**: 119–124.

Choudhury, A.U. (1999). Status and conservation of the Asian elephant *Elephas maximus* in north-eastern India. *Mammal Review*, **29(3)**: 141–73.

Dang, Huy Huynh. (1968). Some data concerning the biology of *Tragulus javanicus affinis* Gr. (Artiodactlya, Tragulidae) in the Democratic Republic of Vietnam. *Zoologicheskii Zhurnal*, **47(3)**: 432–437.

Davison, G.W.H. (1981). Sexual selection and the mating system of *Argusianus argus* (Aves: Phasianidae). *Biological Journal of the Linnaean Society*, **15(2)**: 91–104.

Del Hoyo, J., Elliott, A. & Sargatal, J. (1994). Handbook of the birds of the World-volume 2: New World vultures to guineafowl. Barcelona, Spain: Lynx Edicions.

Francis, C.M. & Barrett, P. (2008). A field guide to the mammals of South-East Asia. United Kingdom: New Holland Publishers.

Foster, R.J. & Harmsen, B.J. (2012). A critique of density estimation from camera-trap data. *The Journal of Wildlife Management*, **76(2)**: 224-236.

Grassman, L.I., Haines, A.M., Janečka, J.E. & Tewes, M.E. (2006). Activity periods of photo-captured mammals in north central Thailand. *Mammalia*, **70(3/4)**: 306–309.

Heydon, M.J. & Bulloh, P. (1996). The impact of selective logging on sympatric civet species in Borneo. *Oryx*, **30(01)**: 31–36.

Jeyarajasingam, A. & Pearson, A. (2012). A field guide to the birds of Peninsular Malaysia and Singapore. Oxford: Oxford University Press.

Johns, A.G. (1997). Timber production and biodiversity conservation in tropical rainforests. Cambridge: Cambridge University Press.

Karanth, K.U. (2003). Tiger ecology and conservation in the Indian subcontinent. *Journal of the Bombay Natural History Society*, **100(2&3)**: 169–189.

Kingdon, J. (1997). The Kingdom field guide to African mammals. London: Academic Press Ltd.

Kushwaha, S.P.S., Khan, A., Habib, B., Quadri, A. & Singh, A. (2004). Evaluation of sambar and muntjak habitats using geostatistical modelling. *Current Science*, **86(10)**: 1390–1400.

Kuznetzov, G.V. & Puzachenko, Y.G. (1992). Food consumption digestibility and certain forms of feeding behaviour in the Javan chevrotain *Tragulus javanicus* under captive conditions. In *Materials of zoological research in Vietnam (1987–1990)*, (Sokolov, V.E. & Kuznetzov, G.V. eds.), pp. 39–46. Moscow, Russia: A.N. Severtsov Institute of Evolutionary Morphology and Zhivotnik Ecology.

Lambert, F. & Woodcock, M. (1996). Pittas, broadbills and asities. East Sussex, England: Pica Press.

Lekagul, B. & McNeely, J.A. (1977). Mammals of Thailand. Bangkok: Saha Karn Bhaet Co.

Lynam, A.J., Kreetiyutanont, K. & Mather, R. (2001). Conservation status and distribution of the Indochinese tiger (*Panthera tigris corbetti*) and other large mammals in a forest complex in north eastern Thailand. *Natural History Bulletin of the Siam Society*, **49**: 61–75.

Madge, S. & McGowan, P. (2002). Pheasants, partridges, and grouse: a guide to the pheasants, partridges, quails, grouse, guineafowl, buttonquails, and sandgrouse of the world. London: Christopher, Helm.

Maffei, L. & Noss, A.J. (2008). How small is too small? Camera trap survey areas and density estimates for ocelots in the Bolivian Chaco. *Biotropica*, **40(1)**:71–75.

Matsubayashi, H. & Sukor, J.R.A. (2005). Activity and habitat use of two sympatric mouse-deer species, *Tragulus javanicus* and *Tragulus napu*, in Sabah, Borneo. *Malayan Nature Journal*, **57(2)**: 235–241.

Matsubayashi, H., Bosi, E. & Kohshima, S. (2003). Activity and habitat use of lesser mouse-deer (*Tragulus javanicus*). *Journal of Mammalogy*, **84(1)**: 234–242.

Medway, L. (1983). The wild mammals of Malaya (Peninsular Malaysia) and Singapore. Kuala Lumpur, Malaysia: Oxford University Press.

Mugerwa, B., Sheil, D., Ssekiranda, P., Heist, M.V. & Ezuma, P. (2012). A camera trap assessment of terrestrial vertebrates in Bwindi Impenetrable National Park, Uganda. *African Journal of Ecology*, **51**(**1**): 21–31.

Nowell, K. & Jackson, P. (1996). Wild cats: status survey and status conservation action plan. Gland: IUCN.

O'Brien, T.G., Kinnaird, M.F. & Wibisono, T.H. (2011). Estimations of species richness of large vertebrates using camera traps: an example from an Indonesian rainforest. In *Camera traps in animal ecology: methods and analyses* (O'Connell, A.F., Nichols, J.D. & Karanth, K.U., eds.), pp. 233–252. Tokyo: Springer Japan.

O'Connell, A.F., Nichols, J.D. & Karanth, K.U. (2011). Camera traps in animal ecology: methods and analyses. USA: Springer.

Oluput, W.A. & Sheil, D. (2010). A preliminary assessment of large mammal and bird use of different habitats in Bwindi Impenetrable National Park. *African Journal of Ecology,* **49(1)**: 21–30.

Payne, J., Francis, C.M. & Phillipps, K. (1985). A field guide to the mammals of Borneo. Kota Kinabalu, Malaysia: The Sabah Society.

Rao, M., Myint, T., Zaw, T. & Htun, S. (2005). Hunting patterns in tropical forests adjoining the Hkakaborazi National Park, north Myanmar. *Oryx*, **39(03)**: 292–300.

Rowcliffe, J.M. & Carbone, C. (2008). Surveys using camera traps: are we looking to a brighter future? *Animal Conservation*, **11**: 185–186.

Shuib, A. (1995). Tourism in Taman Negara Malaysia its contribution as perceived by resident of Ulu Tembeling. *Akademika*, **47(2)**: 37–48.

Stander, P.E. (1998). Spoor counts as indices of large carnivore populations: the relationship between spoor frequency, sampling effort and true density. *Journal of Applied Ecology*, **35**: 378–385.

Sunquist, M. & Sunquist, F. (2002). Wild cats of the world. Chicago: University of Chicago Press.

Tobler, M.W., Carrillo-Percastegui, S.E., Pitman, R.L., Mares, R. & Powell, G. (2008). An evaluation of cameras traps for inventorying large- and medium-sized terrestrial rainforest mammals. *Animal Conservation*, **11**: 169–178.

Van Emden, H.E. (2008). Statistics for terrified biologists. Oxford, UK: Blackwell Publishing Ltd.

Wheelock, N.D. (1980). Environment sodium as a factor in the behaviour and distribution of African elephants. *Elephant*, **1**: 169–177.

Whitmore, T.C. (1984). Tropical rain forests of the Far East. Oxford: Oxford University Press.

Yong, D.L., Qie, L., Sodhi, N.S., Koh, L.P., Peh, K.S.H., Lee, T.M., Lim, H.C. & Lim, S.L.H. (2011). Do insectivorous birds communities decline on land-bridge forest islands in Peninsular Malaysia? *Journal of Tropical Ecology*, **27(01)**: 1–14.

Zaw, T., Htun, S., Po, S.H.T., Maung, M., Lynam, A.J., Latt, K.T. & Duckworth, J.W. (2008). Status and distribution of small carnivores in Myanmar. *Small Carnivore Conservation*, **38**: 2–28.