Occupancy modelling of the leopard (*Panthera pardus*)
as a function of human and natural factors
in Ayer Hitam Forest Reserve, Selangor

ABSTRACT

Very little is known about the leopard (*Panthera pardus*) in South-east Asia particularly Malaysian tropical rain forests where intensive deforestations have taken place in recent years. Current study has been carried out in a highly fragmented secondary forest namely Ayer Hitam Forest Reserve and its neighboring farm located within Klang Valley, fastest growing agglomeration in Malaysia. Objective of this study was to bring an understanding to the impacts of human disturbances and natural factors on occupancy status of the leopards and their potential prey species in the study area. Detection/non-detection data from leopards, their four *priori* identified prey species that were wild boar, lesser mouse deer, long tailed macaque and pig tailed macaque, a feral species (i.e. stray dogs) and human factors such as deforestation, plantation, local and indigenous people camping and construction activities have been recorded from February 2008 over a period of 13 months. Occupancy modeling of leopards and their potential prey species has been done using single season subprogram of PRESENCE software and Jacobs Preference Index. Correlation of leopard presence with disturbance factors, preys and feral species was tested using Spearman correlation coefficient test. Results indicated that habitat is constantly fully occupied by leopards and there is no evidence of lack of prey sufficiency. Presence of wild boar was the main factor affecting leopard movements in the area. Leopard distribution was obviously adapted to settlement status, while construction activities inside the forest had the most negative impact on leopard movements. Even though stray dogs were not principle food competitor for leopards, study showed that leopards avoided their grouping life style. Preys were mostly affected by deforestations and construction activities conducted during field surveys. Since leopards are the top predator species of this isolated forest, this study could be used to promote practices of environmentally friendly forest management.

PROBLEM STATEMENT

1. Intensive deforestations and rapid developments have taken place in Klang Valley during the last 30 to 40 years (Jaafar *et al.*, 2009) - Ayer Hitam Forest Reserve has lost almost 68% of its area within 14 years from 1983 to 1997 (Awang Noor *et al.*, 2007).

2. Studies estimated that 4 individuals of leopards are existed in Ayer Hitam Forest Reserve (Sanei *et al.*, in press). However, leopards are highly territorial species with smallest home range size of 8 km² reported from prey rich habitats (Grassman, 1999).

3. In addition to small size of the forest (i.e. 1248 ha) and being highly isolated from outer habitats, various human disturbance factors are occurring in the study area which affect leopard's viability in Ayer Hitam Forest Reserve.

4. Scientific data increasingly indicate that large carnivores play an important role in ecological health of ecosystems (Miller *et al.*, 2001). Elimination of the top predator would have substantial impact on the abundance of the herbivore species and eventually vegetation structure of the area.

5. Without having a research-based conservation plan in the region, the remaining leopard population would face an uncertain future (Rabinowitz, 1989).

Camera trapped pig tailed macaque (*Macaca nemestrina*) in the study area

Camera trapped Lesser mouse deer (*Trangulus javanicus*) in the study area

Camera trapped Eurasian wild pig (*Sus scrofa*) in study area

FINDINGS

1. PRESENCE modelling suggested that study area is fully occupied by leopards and the main factor affecting leopard distribution in the study area was presence/absence of wild boar.

2. Most of the leopard footprints were found in the site 1 - (64%), however, the probability of leopard detection in almost 77% of sampling occasions in this site was as low as 0.30 to 0.50. Jacob's preference index showed that site 1 is the most preferred site by the species (D_1= 0.69).

3. Comparison between site 4 (area with plantation and deforestation activities) with other sites that did not have any of these activities, showed that leopard avoid site 4 rather than other sites (D_4= -0.11, $D_{1, 2, 3}$= 0.11).

4. Comparison among sites (site 1, 2, 3 and 4) showed site 1 to be highly preferred by leopards rather than other sites with settlements and accommodations ($D_{2, 3, 4}$= -0.69).

5. The most ignorance of leopards appears to be seen in site 3 with construction activities during the sampling interval (D_3= -0.77).

6. In addition, Jacob's preference index showed that although there were leopard footprints in the farm, the forest is highly preferred (D forest = 0.53) rather than the neighboring farm (D farm = - 0.59).

7. Top ranked models developed for wild boar, macaque and mouse deer indicated that whole the study area is occupied by these species (i.e. occupancy rates=1). Therefore, it was suggested that there is no evidence of lack of prey sufficiency in the area and each leopard individual has a high chance of encountering prey species within its preferred weight range (i.e. less than 40 kg; Hayward *et al.*, 2006).

8. These models suggested that the probability of detection of wild boar and macaque in the study area were relatively high as p wild boar ≥ 0.64 ± 0.069 and p macaque ≥ 0.72 ± 0.064.

9. Distribution of wild boar and macaque was affected mostly by construction activities which took place inside the forest. In contrast, mouse deer was principally affected by deforestation activities.

10. A highly significant correlation of presence/absence was detected between leopard and wild boar ($P<0.01$, $\rho=0.456$), monkey ($P<0.05$, $\rho=0.300$) and mouse deer ($P<0.05$, $\rho=0.256$).

11. Leopard presence/absence had a highly significant negative correlation with presence of stray dogs in trails ($P<0.01$, $\rho=-0.866$) suggesting that leopards avoided encountering stray dogs which usually move in grouping style in the area.

Roaming of stray dogs in group style in study area.

SIGNIFICANCE OF RESEARCH

• This study suggested that construction activities inside the forest have the most profound effect on leopard survival in the study area. These activities cause the leopards to change their movement unexpectedly which may lead to conflicts among individuals and fatalities.

• Aside from active human factors inside the habitat, the main factors threatening leopard's survival in Ayer Hitam Forest Reserve were classified as (1) being highly isolated, (2) small size of the habitat to support current population size of leopard, (3) uncertain reproduction status of the existing population and (4) genetic depression following successive inbreeding.

• Perhaps, the relevant agency would acquire lands especially the plantations nearby to increase the habitat area and remove human disturbance factors.

• Surprisingly despite of what is thought of a logged tropical rain forest, there is no evidence of lack of prey sufficiency in Ayer Hitam Forest Reserve. However, studies are required to estimate population size of leopard's prey and to determine carrying capacity of leopard's habitat (Sanei *et al.*, in press).


ENDANGERED
Photo: Arezoo Sanei

Small scale plantation activity has been conducted by indigenous people in the southern part of the forest in an area of 0.64 ha.

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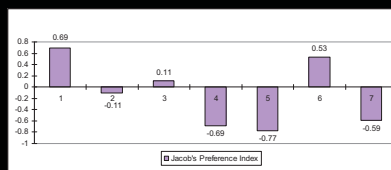
Comparison of Jacob's preference index for sites with various types and levels of human activities (Positive trends show the measure of selectivity and negative trends show the measure of avoidance by the species.1: Site 1 with no specific human factor; 2 : Site 4 with deforestation and plantation activities, 3: Sites 1, 2, 3 with no deforestation and plantation activities; 4: Sites 2, 3, 4 with local settlements; 5: Site 3 with construction activities; 6: Forested land; 7: farm.

An area of 48 ha forest located in eastern border of Puchong farm has been cleared in June 2008.

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