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OBSERVATION ON PREDATORY BEHAVIOUR OF CAPTIVE MALAYAN TIGERS OVER THE EFFECT OF ILLUMINATION

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ABSTRACT

Tigers in a natural life are nocturnal and preys during the dark. This study was performed to observe the effect of illumination on predatory behaviour of captive tigers. Furthermore, it was also to compare the agility of different individual, gender and age in catching their prey. The subjects were four captive tigers (N=4) in National Wildlife Rescue Centre (NWRC), Sungkai, Perak comprising of two males and two females Malayan tiger (*Panthera tigris jacksoni* and *Panthera tigris* ssp.) of different ages. This study was conducted at night for a dark setting while spotlights were used to provide illumination in each animal enclosure. Average time to reach for prey was faster without spotlight compared to with spotlight at 21.44 ± 4.70 minutes and 41.75 ± 5.23 minutes respectively ($P<0.05$). Individual variability in time response was obviously faster in dark setting, however it was only statistically significant in one wild-caught adult female tiger compared to all the other three tigers. Time response among gender and genetic trait (purebred or hybrid) of Malayan tigers were not significant, while age factor showed old-aged tiger has a significantly slower response in dark settings as compared to an average adult aged tiger at 41.75 ± 13.98 minutes and 14.67 ± 2.39 minutes respectively. In conclusion, research in captive settings showed the agility of the tiger approaching the preys were more rapid in dark settings, simulating a better night vision. Individual variability in the time response needs further investigation and these findings

should be considered in designing feeding management in a captive setting to enrich and stimulate normal predatory behaviour.

Keywords: Malayan tiger, *Panthera tigris jacksoni*, vision sensitivity, agility, night vision, behavior, nocturnal

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INTRODUCTION

According to the International Union of Conservation Nature (IUCN) Red List of Threatened Species, the Malayan tiger (*Panthera tigris jacksoni)* is listed as Critically Endangered with an estimated population of about 250-340 mature individuals. This consists an estimated 80-120 breeding females (Kawanishi, 2015). Current strongholds for wild Malayan tigers in Peninsular Malaysia are in Pahang, Perak, Kelantan, Terengganu and Johor (DWNP, 2008; Kawanishi *et al*., 2010; Kawanishi, 2015). The potential tiger habitat left is only 51% (66,211 km^2) of the land cover in Peninsular Malaysia, ranging from southern Thailand to southern Peninsular Malaysia which includes the major protected areas and Permanent Reserved Forests (Kawanishi *et al*., 2010).

Tigers, being nocturnal animals, hunt their preys at night (Sankhala, 1977; Schaller, 1967). They are able to do this due to their retinal adaptation that reflects light back to the retina allowing the night vision of the tigers to be six times more superior to that of man. Tiger's eye structure comprises of more rods than cones which is responsible for visual acuity for shapes while cones are responsible for the colour vision to assist with their night vision (National Geographic, 2015). Therefore, they can detect movement of prey with the help of the increased number of rods where colour vision would not be as beneficial.

According to Jeeves (2016), 'rod receptors' are the primary components which make up the retinas of the eye of a tiger, which has the ability to detect the slightest movements in low levels of light. However, parts of the eyes are comprised of 'cone receptors' which are the colour receptors that actually facilitate day and monochrome visions. In addition to that, the eyes of tigers encompass a structure referred to as *tapetum lucidum*, thus making their vision even more accurate in low light (Dua *et al*., 2010; Jeeves, 2016).

Tigers, like other big cats, have a large home-range to hunt their prey, breed and raise their young (McGinnis, 2015). However, in captive setting, the enclosures are small and would affect their natural behaviours due to spatial constraints and negative human reactions to predatory behavior. Tigers may also more vigilant near human disturbance (Mellen *et al*., 1998). These human-made environments are not sufficient for them to express their instinctive behaviours (Carlstead, 1996). This can be mitigated with captive environmental enrichment to stimulate their psychological and physiological behaviour (Mellen *et al*., 1998). However, providing suitable enrichment to enhance wild behaviours for such big cats like tigers can be challenging due to their distinctive hunting behaviour and large spatial requirements (Mellen *et al*., 1998).

Captive environment for tigers has been also modified to suit human behavior in terms of access and visibility and therefore, artificial lighting has been introduced in such enclosures. However, very little has been done to compare the vision of the tiger through its behavioural reaction in different light intensities or amount of light produced by a specific light source. Thus, this case study was carried out among four captive tigers to evaluate their reactions towards different light intensity. The first objective of this study was to compare the effect of illumination on response time needed for the tigers to react and head towards the location of the cages which contained preys in two different settings. The second objective is to recommend modifications on feeding timings and lightings for such nocturnal carnivores.

METHODOLOGY

Sampling Animal and Site

This study was conducted on four captive tigers from National Wildlife Rescue Centre (NWRC) Sungkai, Perak. Those four tigers were combination of two males and two females with different age groups as shown in Table 1. The study was approved by the Department of Wildlife and National Parks, (DWNP) Peninsular Malaysia (Permit no.: HQ-00009-15-70) and Institutional Animal Care and Use Committee, Universiti Putra Malaysia (AUP no.: UPM/IACUC/AUP-U005/2017).

Table 1 Individual background for each tiger.

TIGERS ID	AGE	AGE GROUP	GENDER	TRAITS	REMARKS
Tanjung	12	Adult	Female	*Panthera tigris jacksoni*	captive-bred
Kinta	12	Adult	Female	*Panthera tigris jacksoni*	wild-caught; abnormal gait due to snare
Scarface	20	Old	Male	*Panthera tigris jacksoni*	wild-caught; nuclear sclerosis due to aging factor
Tee	4	Adult	Male	*Panthera tigris*	captive-bred; hybrid

Methods

This study was conducted at night for a dark setting without any lights, while spotlights (2 units of 200 watt) were used to provide illuminations. Each tiger was placed in the night stall that has two adjoining exercise yards. The tigers were fasted a day prior to the day of test. A prey in the form of live chicken (caged) was placed at the far end of the exercise yard to prevent the tiger from having a direct contact with the chicken. The detail of the experimental layout is shown in Figure 1. Time was measured once the tiger was released from the night stall into the exercise yard till it reaches the prey (standardized release time for all trials at 9:00 pm). A motion-sensor camera trap was set up at each enclosure for 1 hour (9:00 to 10:00 pm) to minimize human interaction which might affect the results of this study. Each animal has to undergo four trials of experiments with and without spotlight settings, with a day rest period prior to each trial. This makes it a total of eight tests per animal. Data on the response time taken for the tigers to catch its prey were collected and analyzed.

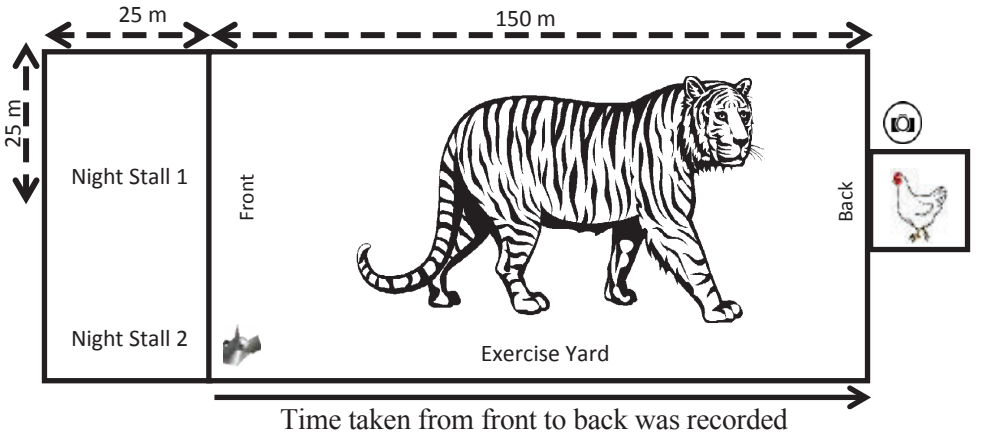

Figure 1 Experimental layout. Note the position of the spotlight, caged chicken and recording camera.

RESULTS AND DISCUSSION

The four Malayan tigers showed differences in response time towards the stimuli provided which were the chickens in the cages (Figure 2). Generally, for all four Malayan tigers, the response times were faster when there was no illumination used. Since the sample size was small and one test tiger was undertaken, the statistical analysis used was t-test (significant value <0.05). However, the results were only statistically significant for the tiger Kinta. It had a significantly different response times (P=0.02) with shorter response time under darkness as compared to with illumination. There were no statistical differences in response time with and without spotlights for the other three tigers namely Tanjung, Scarface and Tee, at P value of 0.18, 0.24 and 0.34 respectively (Figure 2). The average time taken for the four tigers to reach the caged chicken without the presence of illumination was 21.44 ± 4.70 minutes. This is significantly faster compared to response time with the presence of illumination which is 41.75 ± 5.23 minutes (P=0.007). Therefore, the result shows that the agility of all tigers approaching the prey were more rapid in dark settings, stimulating a better vision as presumed previously by Jeeves (2016) and theory-based evidence shows that cats navigate faster towards the end of the maze in complete darkness compared to dogs (see Veterinary Practice News).

Figure 3 and 4 shows the comparison between cohorts which were inclusive of gender and age respectively. The agility of the tigers in relation to their gender, the response time between both males and females in two different illumination settings were not statistically different (P=0.89 with illumination and P=0.09 without illumination). Thus, this result suggests that gender does not affect the

agility of these four tigers towards their predatory behaviour. The agility of the tigers in relation to their ages, Tanjung, Kinta and Tee which were 12, 12 and 4 years old respectively, were categorised as adult tigers whereas Scarface which was 20 years old was categorized as old-aged tiger.

It is important to note that Scarface was diagnosed with nuclear sclerosis due to its age and this health issue may have affected Scarface's performance in visualising the prey. This assumption was proven by the prolonged time taken by Scarface to reach the cage containing the chicken compared to three other tigers that were involved in this research. Furthermore, Figure 4 also showed that the adult tigers were significantly faster compared to old-aged tiger in both parameter settings (with and without illumination) with a P=0.038 and 0.007 respectively. Hence, the differences between adult and old-aged tigers could be said to be statistically significant especially in the setting of without illumination where adult tigers respond faster to the given stimuli compared to old-aged tigers. However, as the only old tiger used in this trial, had diagnosed vision impairment, the results should be interpreted with care to eliminate bias.

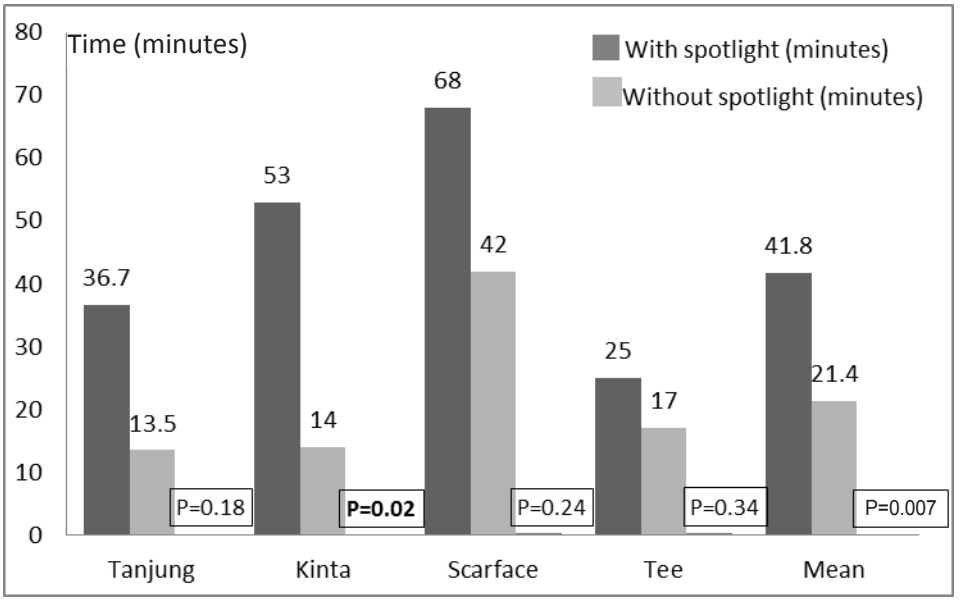

Figure 2 Average time taken for the tigers to reach the prey. Number in the box is a significant value (significant at P<0.05 using individual t-test).

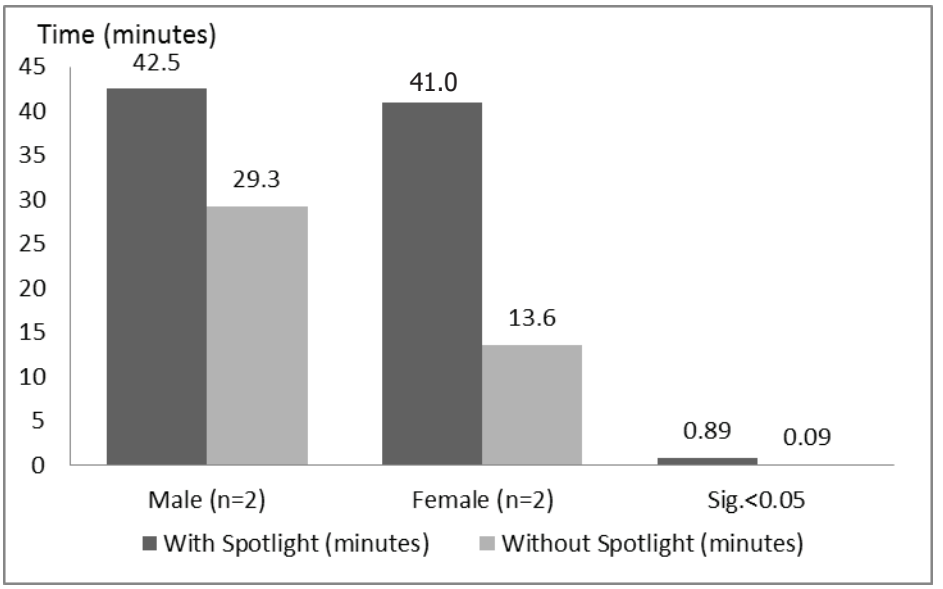

Figure 3 Comparison between genders of Malayan tigers on time taken to reach the prey (significant at P<0.05 using individual t-test).

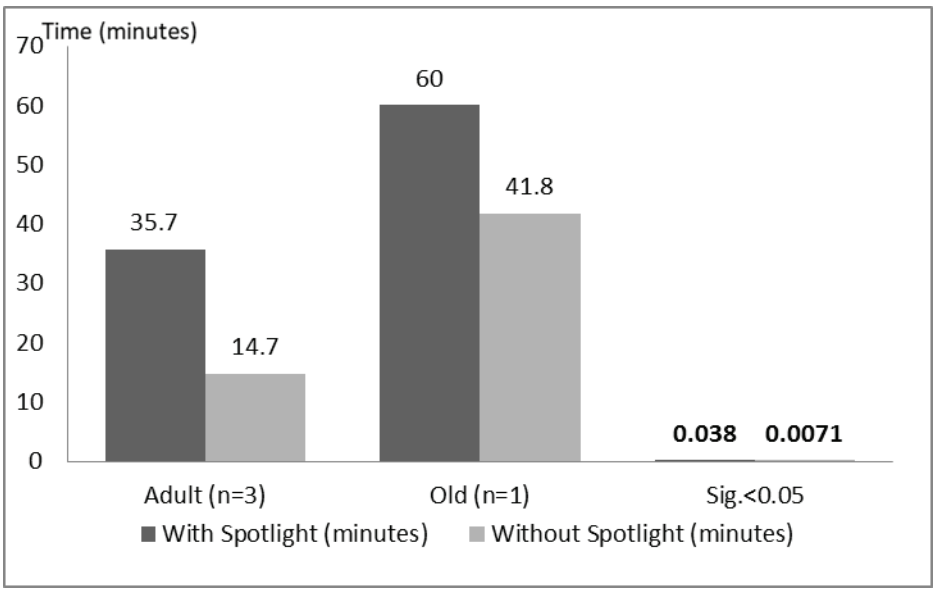

Figure 4 Comparison between ages of Malayan tigers on time taken to reach the prey (significant at P<0.05 using individual t-test).

Wild animals in captivity or artificial habitats are challenged by many potential environmental differences that eventually may lead to stress (Morgan & Tromborg, 2007). Lighting conditions in captive environments present a potential problem. For example, in some captive settings, constant or nearly constant light or artificially maintained photoperiodicity and contrasts between light and dark areas of the environment may arouse fear and generally may adversely affect animal welfare (Grandin & Johnson, 2005). For animals living in captivity, attempt to search for food in a restricted environment can cause frustration of appetite behaviour (Morgan & Tromborg, 2007). In captive carnivores, prepared diets have been found to have deleterious effects on the dentition (Wenker *et al*., 1999) compared to feeding whole-prey diet (Lindburg, 1998). In addition, a study on zoo-housed leopard showed that the frequent presence of personnel may suppress the overall activity and increase pacing, a behavioral indicator of agitation or stress. Therefore, minimised personnel presence should be practiced (Mallapur & Chellam, 2002) in such enclosed environment. Based on our findings, the tigers are navigating well towards the prey in the dark setting and considering the factors mentioned above, it can be suggested that feeding activity could be performed at night. However, the number of personnel involved could be minimised to minimise the stress and to preserve their natural hunting behavior.

CONCLUSION

In conclusion, these preliminary trials showed that the tigers respond faster in the dark (without illuminations) in targeting their preys. However, due to small sample size and lack of repeated observations, the results could neither be generalised to the general tiger population in captivity nor the tigers in the wild. These results will provide a better understanding to improve management of tigers in captivity such as optimising the feeding time and for enrichment of the captive enclosure.

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