

Food Items and Foraging Sites of the Oriental Pied-Hornbill (*Anthracoceros albirostris*) during Breeding Season in Sungai Panjang, Sabak Bernam, Malaysia

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ABSTRACT

The Oriental pied-hornbill (*Anthracoceros albirostris*) is highly adaptable to habitat changes compared with other hornbill species. Although the species is omnivorous, their diet varies between seasons and can be restricted by food availability and abundance in the forest. Recently, Oriental pied-hornbills were spotted breeding at a human settlement in the rural area of Sungai Panjang, Selangor in abandoned clay jars. As the female seals itself in the nest, the male plays an important role in provisioning its partner and the chicks. Therefore, this study aimed at understanding the male's food items and foraging sites selection in Sungai Panjang during the breeding season. Three hornbill pairs were monitored between 2009 and 2011 to examine their foraging activities. Video recorders were used and the males were followed every alternate day to their respective foraging sites. Results showed the number of visits made and foods brought back by the males to the nests were dependent on the location of their nests. The average visits recorded were between four and 12 times a day (mean visit per day: 9.07 ± 3.40). In addition, they utilised different foraging areas, such as oil palm plantations, orchards and forest patches. Interestingly, 50% of animals were brought back to the nests after visits to plantations compared with fruits that were gathered mainly from the orchard (48%), while the rest (2%) was unidentified. Forest

patches were the least utilised site. In sum, the species has taken advantage of Sungai Panjang's agricultural background particularly during its breeding season. The findings confirm the species high adaptability to disturbed habitat.

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INTRODUCTION

The Oriental pied-hornbill (*Anthracoceros albirostris*) is common in Asia (Del Hoyo et al., 2001). However, in some areas like the Thai-Malay Peninsula, Laos and Vietnam, the population is threatened due to indiscriminate deforestation (Poonswad, 1995; Vyas, 2002), hunting by local tribes (Sethi & Howe, 2009) as well as fledgling trading (Wells, 1999). Despite these setbacks, the species is known to have high adaptability to habitat changes, provided ample supply of food and large mature trees for nesting are present (Chong, 1998). The species can also be found foraging and nesting in logged forest (Datta & Rawat, 2004). This is likely due to the species having broad diet in exploiting food resources compared with other hornbills (Kitamura et al., 2009). Therefore, the species is listed as 'Least Concern' under the IUCN Red List of Threatened Species (BirdLife International, 2016). Its subspecies, the Southern pied-hornbill (*Anthracoceros albirostris convexus*) is common in the southern part of Peninsular Malaysia and can be differentiated by the white outer-tail feathers (Robson, 2002). According to Ismail et al. (2015), this subspecies has been increasingly observed foraging in the agriculture area of Sungai Panjang, Sabak Bernam, Malaysia. However, there have been no detailed studies to date on their

food items and foraging sites selection in such area.

Generally, the hornbill's diet may vary between seasons depending on food availability and abundance. Having broad habitat preferences, the Oriental pied-hornbill in particular can thrive very well in modified landscapes. Many studies have highlighted the hornbill's foraging activities in undisturbed or semi-disturbed areas including logged forest (Datta & Rawat, 2003, 2004). On the contrary, the hornbill's foraging activity in agricultural lands has never been reported, unlike those in the logged forest (Sethi & Howe, 2009) and human habitation (Chong, 1998). This is probably due to the infrequent or rare sightings of the species in these areas. Ismail et al. (2015) reported that several groups of Oriental pied-hornbills (subspecies: Southern pied-hornbill) in Sungai Panjang, Sabak Bernam have recently adapted to an unconventional method of nesting by using abandoned clay jars in the area. Thus, there is a high possibility that the population is depending on the extensive agricultural land for food to sustain themselves during the breeding period. Like most hornbills, the Oriental pied-hornbills are monogamous and often establish relationship over a long period of time (Kemp, 1995; Ng et al., 2011). Hence, strong bonding develops between couples and best displayed particularly during the breeding activity. Ismail et al. (2015) reported that as the females were sealed inside clay jars, the males played an important role to provide for their partners and the chicks. Thus, this study examines

the food items and foraging sites selection of the Oriental pied-hornbills (subspecies: Southern pied-hornbill), particularly during their breeding seasons.

METHODS

Study Area

Sungai Panjang (N 3° 44', E 101° 5') is located in the Sabak Bernam District of Selangor (Figure 1). Palm oil plantations and paddy fields are the main agriculture activities here. Most of the lands were

converted to support this industry. Sungai Karang Forest Reserve (SKFR) is the closest natural and undisturbed habitat, approximately five kilometres from the study area. With an area of more than 50,000 ha, it is home to at least five different hornbill species, including the Oriental-pied hornbill (Ismail et al., 2015). However, as the number of nesting hornbills began to increase in Sungai Panjang, this study was conducted to investigate their foraging activity in this particular area.

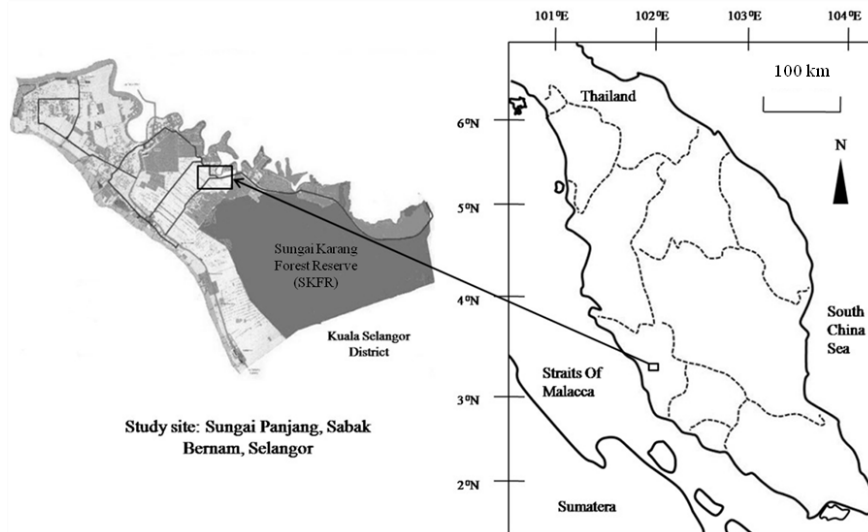


Figure 1. Map of the study area, Sungai Panjang, Sabak Bernam, Selangor

Sites Selection and Surveys

Three hornbill pairs were monitored during their breeding activities at three different sites between 2009 and 2011. Table 1 shows the description of the study sites. Each of the breeding sites was located close to a villager's house and in an abandoned clay jar on the ground. These jars were 58 cm in length, 39 cm in width, with an

opening diameter of 12 cm. Ismail et al. (2015) had reported on this unique nesting selection. The Oriental pied-hornbills usually begin to nest in early January (sometimes earlier) and it could last until late April, lasting for 70-78 days. To study the males' provisioning activity, three video recorders (Sony HDR series), were plugged into the main electricity from the nearby

residential areas for continuous recording. The recorders were set up at a distance between three to five metres from the nests. Most of the diets supplied by the males were identified from these recordings. In order to study the males foraging activity, they were followed every alternate day, during the breeding period, by foot or vehicle (if accessible). The males were individually identified by the unique markings on their casques and features. However, most of the data for this particular study was collected towards the end of the 2011 breeding season. More efforts were focused on surveying the different habitats available as well as

identifying the actual habitat in which the males foraged on as they usually made short stops before they proceeded to the foraging sites. The presence of other non-breeding hornbill individuals also made the identification process difficult earlier but this was overcome later on as the researchers became more familiar with the subjects. Foraging distances varied between nesting locations and can range from 10 metres and up to one kilometre. Field observations were aided by binocular (Nikon II Egret). Nest inspection was only done if deemed necessary and only after the male had left so as to not disturb the provisioning activity.

Table 1

Description of the study sites in Sungai Panjang, Sabak Bernam

Site	Longitude/ Latitude	Site Description
1	3°43'30.90" N 101°04'43.36" E	Clay jar abandoned near a villager's house and surrounded by forest patches and palm oil plantation
2	3°43'46.03" N 101°05'48.60" E	Clay jar abandoned in an orchard and close to a palm oil plantation
3	3°43'58.60" N 101°05'57.10" E	Clay jar abandoned in an orchard and close to forest patches

Data Analysis

Kruskal-Wallis and Mann-Whitney U tests were employed to test the differences of the visits made by the males between the nesting sites and foraging habitats. Pearson Chi-Square test was also employed to assess the association between the foraging habitats and the types of food brought back by the males. All statistical analysis was done using Statistical Package for the Social Science

(SPSS). Comparisons were made at 95% level of significance.

RESULTS

The hornbills' activity and behaviour were monitored for more than 1700 hours. In general, the frequency of the males' visits to the nests varied, between four and 12 times a day (mean visit per day: 9.07 ± 3.40) with increasing pattern of visits

recorded as the times progressed. Figure 2 shows the variations in the visits made by the males at each nesting site. In terms of yearly visits, no significant differences were recorded in Site I (S1: $X^2(2) = 3.99, p = 0.136, N = 720$). However, nest in Site II recorded significantly lower feeding visits in 2010 compared with 2009 and 2011 ($X^2(2) = 9.45, p = 0.009$, with mean visit per day of 11.13 ± 1.38 for 2009, 10.7 ± 1.4 for 2010 and 11.24 ± 1.4 for 2011). This coincides with the sudden increase in the number of Long-tailed macaques (*Macaca fascicularis*) in Site II in 2010, causing the male to spend more time guarding its nest. The videos also recorded the birds, clearing the debris and food waste near their three nests between 0700 to 1900 hours. Such behaviour suggests that the males play an active role in protecting the nests from potential predators in the area. As for the nest in Site III, significant increase in terms of visit frequency in 2010 ($U =$

$645.5, p = 0.002$, with mean visit per day of 10.64 ± 1.5 for 2010 and 11.62 ± 1.3 for 2011) were recorded. Prolonged stays or exposure of the pairs particularly the males to the new environment could have played a role. The 2009 data for Site III was not included as the breeding attempt was from a different pair which was not successful. Interestingly, lower male visits (total) were recorded at Site I (4.40 ± 0.79 visit per day, $N = 720$) as compared with Site II (11.02 ± 1.40 visit per day, $N = 1980$) and Site III (11.13 ± 1.48 visit per day, $N = 1320$). Proximity of the nest to the foraging areas could have contributed to the differences. In terms of utilisation of foraging area, the males studied relied upon different habitats available including plantation, orchard and forest patch for food sources. Highest visits by the males were recorded in plantations (42% out of the total number of visits) followed by orchards (40%) and forest patches (18%) (Figure 3).

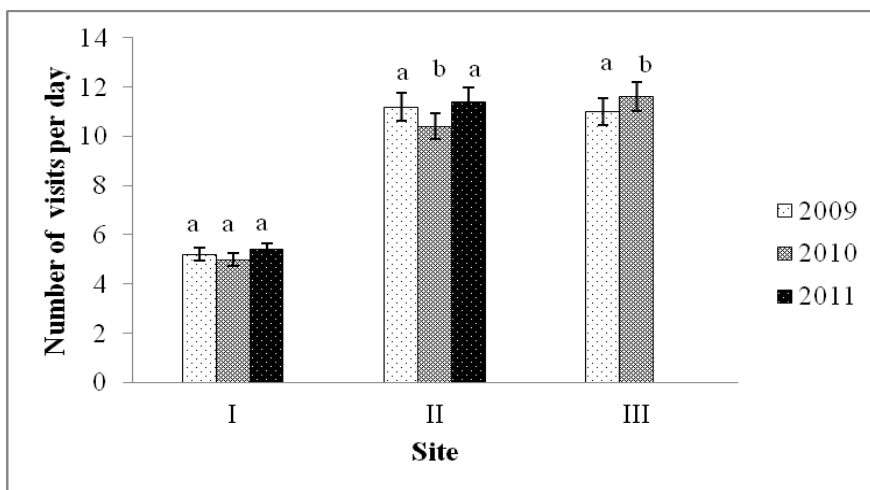


Figure 2. Visits made by the males at the different nesting sites throughout the study period (N = 4020) * 'a' and 'b' are statistically different at $p = 0.05$

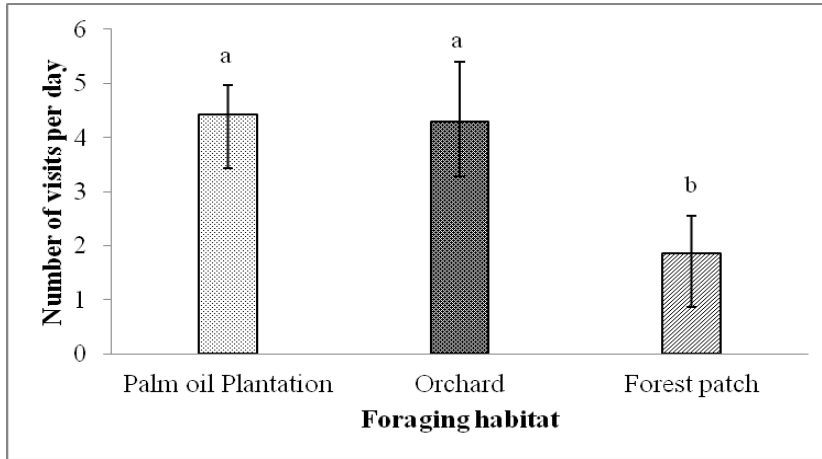


Figure 3. Types of habitat visited by the male Oriental pied-hornbills during the study (N = 420) * 'a' and 'b' are statistically different at $p = 0.05$

In this study, the diet of the Oriental pied-hornbill (subspecies: Southern-pied) consists of fruits such as wild berry (*Vitis difussa*) (6%), palm oil fruit (*Elaeis guineensis* Jacq.) (7%), banana (16%), papaya (16%), cherry (*Muntingia calabura*) (5%), to small animals such as bird's chicks (2%), insects i.e. leaf bugs, grasshoppers, praying mantis (35%), other arthropods (6%), snails (3%) and reptiles

(2%). However, the remaining 2% could not be identified. The males supplied their partners with relatively higher proportion of fruits (50%) compared with animals (48%). Details of the hornbill's diet are shown in Figure 4. Significant association was found between foraging habitats - plantation and orchard - and the types of food brought by the males. In general, small animals and insects were predominantly caught by the

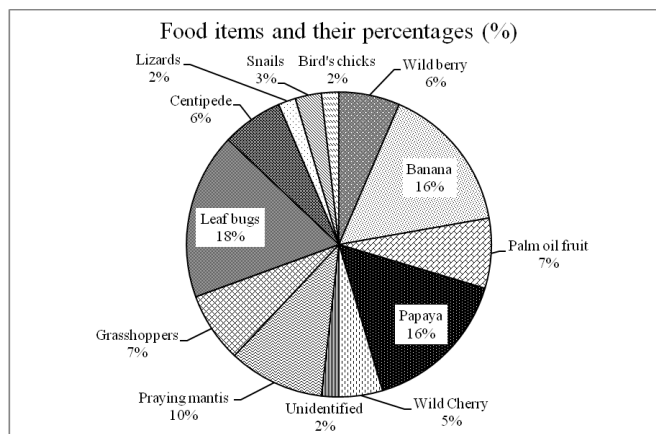


Figure 4. Food items brought back by the males Oriental-pied hornbills in the study

males after their visits to palm oil plantation ($\chi(33) = 216.12, P < 0.01, N = 115$). On the other hand, fruits (not including palm oil fruit) were mostly obtained from the orchard ($\chi(96), p < 0.01, N = 115$). Due to limited visits made to the forest patch, no association was found for the area.

DISCUSSION

Generally, the male fed its partner for the duration of the nesting or concealment. Once the eggs hatched, the number of visits to the nest also increased, corresponding to the higher demand for food supply by the nestlings. The male also protected the nest and its content by removing excess foods outside the nest's opening. Such behaviour is viewed as important to avoid unwanted attraction from potential predators and is highly unique as the conventional tree-nesting does not require such interaction due to its height (Ismail et al., 2015). Throughout the study period, the food items were mainly gathered from plantation and orchard. Nest sites located near orchards and plantation (Site II and III) are linked to higher number of visits or returned trips made by the males. The selection of nesting location may have been influenced by the presence of food sources (Kemp, 1995; Mudappa & Kannan, 1997). Prolonged utilisation of the foraging sites following consecutive breeding activities in the same site may also be a contributing factor. Palm oil plantation and orchard remained as areas heavily visited by the males - suggesting they provided very important food sources (including insect and fruits). However, this particular result

could be biased as researchers would have lost sight of the males as they moved swiftly between areas. Moreover, most of the data recorded was collected towards the end of the 2011 breeding season.

Although all hornbill species are omnivorous, most rely heavily on fruits (Kemp, 1995). Hence, hornbill diets are largely dependent on fruiting seasons which can also be both temporally and spatially restricted. Although figs which are commonly associated with their diet and are available all year round (Poonswad et al., 1998), this study did not record any type of figs being consumed by the birds. This could be because the surrounding areas have been converted either into plantation or orchards, leaving only small area of forest strips or patches. Moreover, it has been reported that the chicks require more protein and the food brought by the male contains more animal components as the nestling progresses (Teo, 2017). However, this was not investigated in detail during this study. In addition, the nature of the agricultural areas in the study area had allowed the birds to forage for foods all year-round. There is a high possibility of the population dispersed to Sungai Panjang due to competition for limited resources. Competition with other species may have also led the hornbill to shift the location of their foraging activity outside their natural habitat, the SKFR. No sighting of the males leaving the Sungai Panjang area was observed. However, further study is needed to ascertain this as the sampling effort is not exhaustive. As most of the land activities in Sungai Panjang

are for agricultural use, the Oriental-pied Hornbill could also play an important role as a seed disperser agent, particularly for the orchards and fruit farms in the area. Hence, the public awareness should be increased to protect the species and their population in the future.

CONCLUSION

The Oriental pied-hornbills in Sungai Panjang have taken advantage of Sungai Panjang's agricultural land, particularly during the breeding season. The findings prove the species high adaptability to disturbed habitat.

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