

# Notes on Food Habits and Breeding and Nestling Behavior of Philippine Eagles in Mount Apo Natural Park, Mindanao, Philippines

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## Abstract

Food habits and diurnal activities of the Philippine Eagle (*Pithecophaga jefferyi*) in Mount Apo Natural Park, Toril District, Davao City were documented. A total of 73 different prey items were observed to be delivered to the nest and 68 of these were identified. Of the 12 prey species identified, six were the first time records for Philippine Eagles, namely the colemo, pit viper, water snake and three were domestic animals (chicken, cat, dog). The bulk (63%) of observed adult behaviors were maintenance activities such as preening or feeding. In addition, adults also performed other social behaviors with the chick. The chick spent most of its time in general maintenance (54%), although sleeping (5%), resting while awake (31%), playing (2%), flapping (1%), and socializing with parents (>1%) were also observed. Eight percent of feeding was assisted by the parents; the rest of the time the chick fed itself. The potential issue for conservation caused by predation of domestic animals is not expected to be a problem at this nest because of previous community education and favorable attitudes toward the eagles. However, similar predation by other nesting pairs poses potential trouble unless community education addresses the matter.

Keywords: breeding behavior, diurnal activity, nesting behavior, Philippine Eagle (*Pithecophaga jefferyi*)

## Introduction

Forty years after the pioneering exploits of the late Professor Dioscoro S. Rabor brought the world's attention to the plight of the Philippine Eagle (*Pithecophaga jefferyi*), the species remains critically endangered with probably fewer than 500 pairs left in the wild (Bueser et al., 2003). Threatened by destructive human activities and a rapid rate of forest destruction resulting to habitat loss, the Philippine Eagle precariously clings to survival in remnant forests (PEF, 2005).

It has been described as the largest and most remarkable eagle of the Philippines (Gonzales, 1968) and one of the air's noblest fliers (Kennedy, 1981). It is found only on four major islands of the country, namely: Luzon, Mindanao, Samar and Leyte (Gonzales 1968; Kennedy, 1977, 1981 and 1985; Rabor 1965).

Despite several decades of research, there is still admittedly a huge data gap in knowledge about this rare species (Ibañez et al., 2003). If conservation of Philippine Eagles is to be effective, there is an important imperative to gather additional basic natural history information on the species and its relationship to the environment it uses. This is especially true for its breeding and nestling behavior and food habits.

The nesting territory in *Barangay* Sibulan, Toril, Davao City is one of the oldest known Philippine Eagle nesting sites. It was first discovered in 1977 and since that time birds in this territory have used at least nine different trees for nesting - more than at any other known territory. There may have been different adults occupying the territory during this time period. This long history of research and the nest's fortuitous location within a protected area makes this nest especially well suited to continued research and observation.

This study focused on the breeding pair and the chick in Mount Apo Natural Park. It more specifically aims to report further information on food habits and the behavior of the adult and nestling birds.

## Methods

### Study area

This study was conducted at *Barangay* Sibulan, Toril, Davao City, approximately 30 km west southwest of the center of the city. This area is located within the bounds of the Mount Apo Natural Park (72,000 ha, peak at 2,954 m). The active nest, in a tanguile (*Shorea polysperma*, Dipterocarpaceae), was located at a south-western slope

at an elevation of 751 m, close to an uncultivated farmland in Sitio Mamaon The nest was located on the first primary branch of the tree and was made of ferns and sprigs. It was located within an agricultural site which was left untended after the discovery of the nest. All known nest trees of this pair are within a proposed 1,430 ha Habitat Management Zone within the Natural Park. Approximately 75% of this proposed zone is covered with both secondary and primary forest.

The terrain alternates between community sites located at flattened ridges and tropical rainforest of varying degrees of successional stages in valleys (van Gilst et al., 2006). Agricultural activities surround the community site in *Sitio Mamaon*, and major trails are easily found around this area but diminish further west.

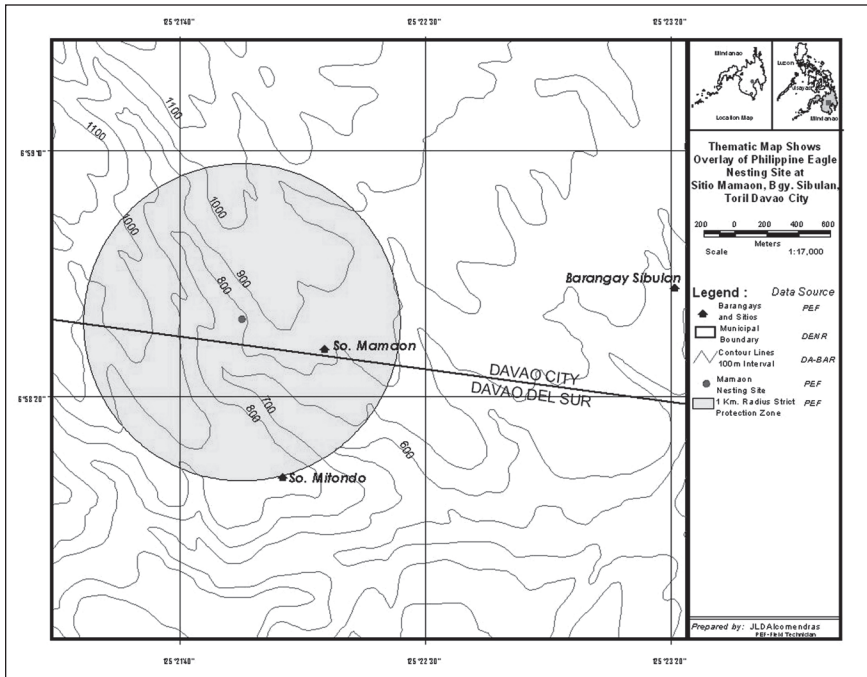


Figure 1. Map of Brgy. Sibulan showing the Philippine Eagle nest location

### Behavioral observations

Ninety-seven days were spent in observation, from 5 May to 10 August 2006 (except 25 May 2006), accumulating 916 observation hours. Observation was conducted from a blind, 100 m north of the active nest. Binoculars (10x56 Swarovski) and variable powered field scope (x80 mm Nikon) were used to aid in observation.

Daytime observations from early morning to late afternoon were divided into five periods: 0600-0800 h, 0800-1000 h, 1000-1200 h, 1200-1400 h and 1400-1600 h. Breaking the time into segments allowed for flexibility of observation time based on weather condition and behavior of the eagles. Further, it allowed testing of the effects of time period on the behavior of the Philippine Eagles. In some instances, additional observations were recorded in other time periods, particularly from 0500-0600 h and 1600-1700 h.

Behavior of the eagles was measured and recorded “instantaneously” using standard data sheets, following the Observation and Recording Protocol of the Philippine Eagle Foundation (2005). The birds were observed for 10-min intervals and behavior was recorded using codes listed in the ethogram for Philippine Eagles. “Rare events” or behaviors that were exhibited between the 10-min intervals were also recorded appropriately in the same data sheets.

The Chi-square test was used to determine significance in differences of behavior frequency per period.

#### *Adult activity patterns*

Adult activity patterns were analyzed by calculating the number of hours the individual was observed spending for general maintenance (perching, preening and feeding self), flight (soaring, gliding, flapping flight and flights related to prey and sprig delivery), intruder chase, nest building, feeding the chick and other social behavior with the chick (allo-grooming, billing and brooding). Instances or counts of occurrence were computed for prey and sprig delivery.

Since it was not always possible to differentiate the adult male from the adult female, their activity pattern data were pooled and comparisons of time spent and instances for certain activity per adult were generated only when data were available.

#### *Chick activity patterns*

Activity patterns for the chick were analyzed by calculating the number of hours spent for general maintenance (preening, stretching and feeding), sleeping, resting while awake, feeding (whether with or without assistance from adults), play behavior, flapping exercises and social behavior with the adults (allo-grooming, billing and brooding).

### **Food habits**

Each prey item brought to the nest was identified to the lowest taxonomic level possible. The time at which the prey item was

delivered, which adult delivered and the state of the prey item (whether fresh or old kill, what portion was delivered, partially or fully consumed) were also recorded. The percent frequency of each prey species was calculated by dividing the total number of items delivered to the nest.

## Results and Discussion

### Behavioral observations

#### *Adult activity patterns*

It was difficult initially to differentiate the male from the female. Activity patterns for the adults were therefore pooled (Table 1) although, when possible, the results were separated by gender such as for sprig deliveries.

The adults spent the most time in general maintenance behavior (an accumulated 133 h of 916 observation hours) that includes preening, remaining at perch and feeding self. Sixty-nine hours were spent feeding the young, 7 h spent in flight (soaring, gliding, flights to and from the nest) and 1 h was spent in social behavior with the chick (intruder chase, nest building, allo-grooming, billing and brooding).

The bulk of the adults' time was spent at perch because it is from perch that soaring raptors, such as the Philippine Eagle, watch their surroundings and look out for prey (PBS, 2007; World Book, 2007). Preening, on the other hand, is the simplest and most common form of feather care (Earthlife, 2007). A good portion of time is dedicated to preening, straightening barbs of feathers and applying oil from the uropygial gland, to maintain a solid surface for air to push against during flight (NHM, 2006).

**Table 1.** Summary of observation hours spent for each behavior by the adults and the chick.

Behavior	Adults		Chick	
	Hours	%	Hours	%
General maintenance	133	63	495	54
Resting while awake	-	-	283	31
Sleeping	-	-	45	5
Assisted feeding of the young	69	33	69	8
Flight	7	3	-	-
Social behavior of adults with young	1	1	1	0
Object play	-	-	18	2
Flapping exercises	-	-	5	1
<b>Total</b>	<b>210</b>	<b>100</b>	<b>916</b>	<b>100</b>

The adults were observed only in 1,188 out of 6,001 instantaneous samples collected at 10-minute intervals. Of the 726 instances when the adults were identified, the female spent 68% of the time in the nest or nest tree, while the male only spent 23% of the time in the nest or nest tree. Both adults were in the nest at the same time only 4% of the time. Although a portion of the instances of the adults in the nest include feeding the chick and nest building, the vast majority involved perching and preening on branches near and around the nest.

The limited attendance of the adults to the nestling is probably due to the age of the chick at which observation began. Philippine Eagles are semi-altricial birds, born with little down feathers, eyes closed and dependent on the adults for feeding (Ehrlich et al., 1988). Post-hatchlings therefore, are only able to produce enough heat in response to cold when they are about a week old (Marjoniemi, 2001). This explains the importance of brooding newly hatched chicks. Such behavior was observed by Ibañez et al. (2003), the female adult first leaving the chick in the nest alone for a minimal time only when it was 8 days old.

Being over a month old at the beginning of our observations, the chick in *Sitio* Mamaon was already able to tolerate cold even without brooding. The adult, particularly the female, was free to leave the chick to hunt and fly for extended periods. The time that the adults spend in the nest tree is presumably to keep a watchful eye on the chick against intruders, and this does not necessarily have to be done from the nest itself.

There were 63 sprig deliveries made to the nest. Thirty-five (35) were by the adult female and 11 were by the adult male. The delivering adult was not identified in the remaining 17 occasions. Coinciding with previous work by Rabor (1965), Gonzales (1968), Kennedy (1985) and Ibañez et al. (2003), majority of sprig deliveries occurred early in the morning from 0600-0800 h (n=19; 36%) and 0800-1000 h (n=24; 45%). The difference of frequency of deliveries in these time periods are statistically significant ( $P < 0.05$ ).

Out of the 35 deliveries by the female, nest building was done right after in 13 occasions. Similarly for the male, nest building was done in four occasions after sprig delivery. Lastly, nest building was done immediately after sprig delivery during five of the 17 instances when the adult was not identified.

The female also performed nest building on six other occasions, the male in three and unidentified adult in four. The female spent an average of 1.2 min per instance building and fixing the nest, while the male spent an average of 2.9 min.

The adult female doing the majority of nest maintenance also coincides with results of previous works on Philippine Eagles referred to above. Additionally, this behavior is similar to what has been reported for other raptors including harpy eagles (Rettig, 1978), golden eagles (Collopy, 1984), double-toothed kites (Schulze et al., 2000) and Madagascar harrier-hawks (Throstrom and La Marca, 2000), to name a few. Newton (1979) explained that the attendance of the female is expected to change in subtle stages. However, due to the difficulty met in differentiating the male from the female adult, such stages could not be mapped clearly here.

The adult male was expected to perform most nest building activities at the beginning of the breeding season, from courtship to egg-laying (Ibañez et al., 2003). This period was not however covered during these observations.

The seemingly longer average of nest building by the male, though less frequent than the female, is probably due to interaction with the chick. As the chick grew, it became more active, curious and playful. The chick normally tries to play with sprigs delivered, which in general, forces the male to take longer pauses in between nest building, therefore prolonging the process.

#### *Chick activity patterns*

Similar to the adults, most of the chick's time was spent on general maintenance, particularly preening (Table 1). Frequent preening by the chick helps in removing feather sheaths of developing pin feathers which first appear when the chick is roughly a month old (Kennedy, 1985). Resting while awake came second with 282 (31%) accumulated hours observed. The rest of the chick's time was spent on object play, flapping exercise, sleeping and social behavior with the adults.

The chick was first seen flapping its wings on 5 May 2006, at over a month old. It is not certain, however, if this was the first time the chick flapped its wings since data collection did not begin at hatching. The intensity at which flapping exercises were performed by the chick increased during the course of the observations. This is expected as the chick's strength grows and develops, and its confidence in exploring beyond the nest increases. Flapping exercises graduated from flapping the wings once or twice to flapping the wings coupled with jumping. Eventually, the chick was able to cross the width of the nest and go beyond it during flapping exercises. The chick first explored beyond the nest on 28 May 2006, maybe at approximately two months old. Object play was also observed to increase in intensity as the chick grew. Object play in the first month only involved biting

and pulling leaves and sticks. Toward the second half of the study, object play also involved hanging on branches and mock grabbing at epiphytes and nest materials. The chick would likely continue engaging in play behavior beyond fledging as this would help hone its hunting skills (Afan et al., 2000).

The chick accidentally fledged on 2 August 2006, at approximately four months of age. It had been perched at the crown of the nest tree, some 15 m above the nest. The chick tried to jump down to the nest when the female adult delivered prey. However, it missed the nest and tried to glide back to the nest but the height and distance of the nest were too great for the chick.

The fledging of the chick resembled Rabor's (1965) observations. Similar to what was reported by Rabor, the adult delivered food to the chick to the day that it fledged. In fact, the delivery of prey apparently triggered the fledging here as the chick tried to return to the nest to feed, but failed. The fledgling returned to the nest the next day and was fed two days after it first left the nest tree. During this feeding, the juvenile mantled after receiving the kill from the adult female and only relaxed and fed itself after the female left the nest.

### **Food habits**

A total of 73 prey items were delivered to the nest by the adults during observation. Sixty-eight (68) of these were identified as one of 12 prey species (Table 2). The flying lemur *Cynocephalus volans* (26%) appeared to be the preferred prey with the large rats (14%) following in second. The flying lemur was also recorded to be the preferred prey in previous food habit studies done (Concepcion, 2005; Ibañez et al., 2003; Kennedy, 1985) of Philippine Eagles in Mindanao. Six of the identifiable prey items were first records for this species namely the colemo (*Sarcops calvus*), pit viper (Viperidae), water snake (Colubridae), domestic chicken (*Gallus domesticus*), cat (*Felis domesticus*) and dog (*Canis domesticus*).

The broad variety of prey species recorded supports the view that Philippine Eagles have a wide food niche, as expected for large raptors (Thorstrom, 2000). In addition, first records of prey species also provides further confirmation that Philippine Eagles are opportunistic hunters, feeding on whatever is either more abundant or vulnerable, including domestic animals.

The prey items were delivered at the rate of 0.75 items/day. On 10 instances, prey was delivered to the nest as much as three times



in a day by the same or both adults. This possibly eliminates low food supply as a factor for the low breeding success of this pair, as hypothesized by Miranda et al. (2000). In comparison, the breeding pair in Mount Sinaka has a 100% breeding success but delivers prey to the nest once every two or three days only (Ibañez et al., 2003). Two alternate hypotheses that could be explored therefore, as an explanation to the low breeding success of this pair are the ages of the breeding pair (Miranda et al., 2000) and the effects of weather on nestling survival (Dawson and Bortolotti, 2000).

A majority of prey deliveries were done during the periods of 1000-1200 h and 1200-1400 h (n=19 each). The difference of frequency of delivery for these periods are statistically significant ( $P < 0.05$ ). Prey delivery peaking during these periods may be explained by the Philippine Eagle's hunting behavior. Although there have been few direct and reliable observations of the actual catching of prey because they hunt under the canopy and generally do not forage close to the nest, Kennedy (1977) provided a clear three-phase hunting sequence. The majority of the sequence is soaring, especially if prey was not caught during a first attempt. Observations of Philippine Eagles soaring usually occur from 1000-1400 h, when thermals are at peak. It is logical that the peak of prey delivery, which is heavily related to hunting (based on delivery of only fresh kills), would occur during the peak of soaring time.

**Table 2.** Prey species and number of individuals captured by adult male and female Philippine Eagles in Mount Apo Natural Park, Toril.

Prey Items	Individuals Captured	Percent of Total (%)
<b>Mammals</b>		
Flying Lemur ( <i>Cynocephalus volans</i> )	19	26
Large Rats (Muridae)	10	14
Palm civet ( <i>Paradoxus hermaphroditus</i> )	9	12
Fruit Bat (Pteropodidae)	6	8
Dog ( <i>Canis domesticus</i> )*	3	4
Long-tailed Macaque ( <i>Macaca philippensis</i> )	3	4
Squirrel (Scuridae)	2	3
Cat ( <i>Felis domesticus</i> )*	2	3
<b>Birds</b>		
Domestic chicken ( <i>Gallus domesticus</i> )*	7	10
Coledo ( <i>Sarcops calvus</i> )*	1	1
<b>Reptiles</b>		
Pit Viper (Viperidae)*	3	4
Water Snake (Colubridae)*	3	4
Unidentified Prey	5	7
<b>Total</b>	<b>73</b>	<b>100</b>

\* - first records of prey species

Only 10 out of the 73 prey items delivered to the nest were delivered whole (one squirrel, one colemo, three fruit bats, and five large rodents). The rest were either decapitated, gutted, plucked or dismembered. All of the prey items delivered to the nest appeared to be from fresh kills. The prey items were mostly fully consumed (including bones, tails and some internal organs). Portions of the prey not eaten immediately were left in the nest and in most cases were consumed later either by the adults, independently by the chick, or assisted by the adults. Any leftover food or pellets found in the nest by the adults were removed. Observations of delivery of only fresh kills to the nest along with removal of leftovers and pellets from the nest agree with observations by Ibañez et al. (2003).

Both adults shared the duty of delivering prey to the chick almost equally when the gender of the adult was identified (female n=29; male n=25; unidentified n=19). This provides further evidence that they share responsibility for feeding the chick, as previously stated by Kennedy (1985). However, their responsibilities in feeding the chick changed gradually throughout the nestling period. For example, during the month of June, there were 23 instances of prey delivery to the nest, 16 of which the adults were identified. Ten of the 16 identified were by the adult male, while only six were by the adult female. In contrast, during the month of July, only nine instances were by the adult male, while 13 were by the adult female. This is similar to observations for other raptors, where the male's responsibility in delivering food to the chick eventually diminishes as the chick grows and the female gradually takes his place (Newton, 1979).

In some raptor species, only the female is capable of caring for the chick. There have been documented instances where the chick of other raptor species dies of hunger even when food is available because the male does not know how to assist the chick (Newton, 1979). For Philippine Eagles and a few other raptor species such as merlins, peregrine falcons, and white-tailed eagles, to name a few, the adult males are also capable of feeding the young. This was observed in all instances by Kennedy (1985), Ibañez et al. (2003) and Concepcion (2005). However, like those other raptor species, the adult male is not as proficient as the female in feeding the chick. There were several instances where the adult male was seen struggling with the chick for food, wanting to feed on it himself rather than giving it to the chick. This behavior was absent from

the adult female. The chick only struggled with the adult female for food when it has neared fledging age. Even then, the female only left the chick to eat alone in the nest, and did not try to take the food away from it.

The majority of the chick's feeding was assisted by the adults, normally by the delivering adult. There were four instances when the adult male delivered the prey but the adult female fed the young. The chick was approximately a month old when observation began and is already learning to feed on its own. It was mostly unsuccessful in feeding itself during the first month of observation.

As expected, the chick's ability to feed on its own increased gradually, beginning with simply picking at the kill to eventually holding it with its own talons and tearing the flesh of the prey on its own. It gradually moved from eating small pieces of plucked meat, as given by the adults, to eventually swallowing pieces of skin and even limbs of macaques and lemurs. Similar behavior is observed in captive-bred Philippine Eagles already trying to pick at ground meat being given them by the animal keeper as early as when they are about two months old (Sumaya, 2007).

#### *Preying on domestic animals*

This breeding pair provided the first records for domestic animals being brought to the nest. However, domestic animals were only brought during extended periods of rain, possibly when natural prey were less visible, sheltering from the weather. The domestic animals, found in more open community and agricultural sites, are therefore more vulnerable to predation by the Philippine Eagle.

Only a total of 18% of the identifiable prey items were domestic animals. Natural prey was still preferred by the Philippine Eagles in *Barangay* Sibulan. However, Davies (1999) warns to be careful in interpreting such figures since it only comprises prey taken during breeding. Non-breeding birds may cause more livestock depredation. He also warns of "imprinting" or "wedding" of the juveniles to favor domestic animals over the natural prey species.

Possible methods to deal with raptor predation problems when they occur, if they do really exist in this nesting territory, have been suggested by Kenward (1999). Exclusion of the animals by penning free-roaming livestock, especially during breeding season, might help protect them against Philippine Eagle predation, although this might be impractical or too expensive for most local farmers. Concerns were raised for protection of this pair of Philippine Eagles

following the observations of predation on domestic animals in Brgy. Sibulan. Fortunately, the people in this particular locality were taught by the founders of the community that Philippine Eagles are part of their family. There are, therefore, reduced fears that the Philippine Eagles might be punished for taking domestic animals here. However, the same can not be assumed for other Philippine Eagle nesting territories.

## Conclusion

Behavioral observations on both the breeding pair and the nestling in *Barangay* Sibulan, Toril District, Davao City, were collected from 5 May to 10 August 2006. Food habit information was also recorded.

Results concurred with research conducted by various other individuals throughout the years. In addition, it provided further information on nestling behavior from around a month old until fledging. Those data have not been collected or described in detail in the other published studies.

Six additional prey species were recorded for the Philippine Eagle, once again demonstrating that they are opportunistic hunters.

## Implications for conservation

Since the inclusion of domestic animals to the list of prey species brought to the nest during breeding, concerns have been raised about safety and protection of the Philippine Eagle pair in Brgy. Sibulan. The settlers in this particular locality were taught by the founders of the community to respect the Philippine Eagles as part of their family. Thus, it is less likely that the Philippine Eagles might be harmed for taking domestic animals here. However, that might not be the case for other Philippine Eagles nesting elsewhere.

This new information should be used to design and update information and education materials, particularly for use during field visits to nesting territories. It is vital to emphasize that, so far, the taking of domestic prey has only been recorded for this breeding pair and may not occur with other pairs.

The Philippine Eagle's ability to take a broad variety of prey probably contributes to its continued survival in a fragmented habitat. And although this pair lives in such close proximity to human settlements, they were not observed in any behavior that indicates defending the nest from people. These may suggest that, at

least for this Philippine Eagle pair, as long as they are not threatened or harmed by humans, the eagles and people may co-exist.

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