

Population of diurnal raptors and first description of the breeding characteristics of the North Philippine Hawk Eagle (*Nisaetus philippensis*) on Luzon Island, Philippines

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Forest raptor communities in Luzon

Species distribution modelling of six forest raptor species

Breeding biology of the North Philippine Hawkeagle

# **Study Objectives**

Abundance and Methods Habitat Breeding Biology

### To assess the status of forest raptors in Luzon

The population status of forestdwelling raptors in Luzon is uncertain due to the absence of raptor surveys. The trend in deforestation, along with the continuing threat of hunting and trade, suggests that these species are in decline. Given this, there is a need to understand their biology, and assess their status to effectively conserve them. This study aims to:

(1) Estimate the abundance of the forest raptors in Luzon

(2) Compare two road survey method, the line and point transect

(3) Assess relative suitability of areas of Luzon region for six forest raptors

(4) Describe the breeding biology of the North Philippine Hawk-eagle

# Forest Raptor Community in Luzon

What are the raptors

inhabiting our forests?

How abundant are they

relative to each other?

What is a good method to survey them?



# **Survey Method**

### **Study Sites**

- 1. Calanasan, Apayao
- 2. Baggao, Cagayan
- 3. Ilagan, Isabela
- 4. Aurora Memorial National Park, Aurora
- 5. Mt. Isarog National Park, Camarines Sur
- 6. Subic Bay Forest Reserve, Bataan



Figure 1. The six study sites distributed in Luzon, Philippines

Between November 2019 and January 2020, I repeatedly surveyed each site at least four times. If weather permits, I conducted a paired survey of a line and a point transect from mid-morning to early afternoon (0900-1300).

### **Point Transect Survey**

At each station placed 1 km apart along the road, I recorded all raptors seen or heard for 10 minutes.

### **Line Transect Survey**

All raptors seen and heard on both sides of the road while the motorcycle was moving at a slow speed of 20 kph was recorded.

### **Plot mapping**

All observations from the line and point transect were plotted on Google Earth to create a distribution map of raptors within the study area. The number of unique individuals in the site was inferred.

# Thirteen raptor species inhabit Luzon forest

The road transect surveys covered 218 km of line transect, and 293 km of point transect, with the average abundance indices across sites of  $4.22 \pm 1.83$  raptors per 10 km, and 6.97  $\pm$  3.33 raptors per 10 km, respectively

The abundance indices obtained from the road transects were reflective of the general prevalence of the encountered species. Species that are considered common in literature obtained high occurrence and abundance indices from the surveys, while the opposite is true for uncommon species. However, it was mostly accurate for soaring raptor species.

Species	Occurrence	Abundance index (individual/10km)				
		Point	Line	Plot map		
Western Osprey	1	0.27	-	1.33		
Crested Honey Buzzard	4	0.91 ± 0.08	$1.07 \pm 0.06$	3.60 ± 1.64		
Philippine Honey Buzzard	5	0.53 ± 0.03	0.44	1.53 ± 0.47		
Philippine Serpent Eagle	6	2.44 ± 0.16	1.53 ± 0.94	6.55 ± 3.45		
North PH Hawk-eagle	5	0.53 ± 0.02	0.41 ± 0.25	1.83 ± 0.55		
Rufous-bellied Eagle	5	0.54 ± 0.01	0.53 ± 0.11	1.36 ± 0.96		
Chinese Sparrowhawk	1	0.13	-	1.33		
Besra	1	0.17	-	0.67		
Brahminy Kite	5	$1.88 \pm 0.16$	0.85 ± 0.35	6.07 ± 6.13		
White-bellied Sea Eagle	1	0.27	0.27	1.33		
Grey-headed Fish Eagle	2	0.27 ± 0.00	-	1.12 ± 0.30		
Grey-faced Buzzard	2	0.74 ± 0.02		3.77 ± 2.75		
Philippine Falconet	4	0.38 ± 0.03	0.93	3.31 ± 2.73		

Table 1. Abundance and occurrence of raptors encountered in the six study sites using three survey methods.

\* Occurrence is the number of sites where the raptor species was seen

# Diurnal Forest Raptors of Luzon

Species were ranked from the most common to the least common based on the abundance indices and occurrence data in the previous table.

The ranking reflected general prevalence of these species in literature, with species high in the ranking classified as common, and vice-versa.

However, it was only correct for soaring species. Those that stay within the canopy, and rarely soar were most likely missed by the road transect survey methods.

For example, the Besra, Philippine Falconet, Greyfaced Buzzard, and Chinese Sparrowhawk had low ranking but they are supposedly common species. These species do not soar much.

### Ranking in green circles are based on this study Status are obtained from IUCN



Philippine Serpent Eagle Least Concern



Brahminy Kite Least Concern



Crested Honey Buzzard Least Concern



Rufous-bellied Eagle Near Threatened



North Philippine Hawk-eagle Endangered



Philippine Honey Buzzard Least Concern

Figure 2. The six forest raptor species ranked from most common (1) to least common (6).

# Aurora Memorial National Park, Aurora

Number of species: 6

Species with IUCN status:

North PH Hawk-eagle (EN), Rufous-bellied Eagle (NT)

Most common species: Philippine Serpent Eagle

### Table 2. Raptor survey data obtained from Aurora Memorial National Park, Aurora.

Species	11/6/19	11/7/19	11/8/19	11/9/19	Total
Barred Honey Buzzard	-	1	4	-	5
Besra	-	_	-	1	1
Crested Honey Buzzard	1	-	2	3	6
North Philippine Hawk-eagle	-	1	2	-	3
Philippine Serpent Eagle	1	3	8	7	19
Rufous-bellied Eagle	-	3	_		3
Accipiter sp.	-	-		1	1
Raptor sp.	1	6	5	14	26
Total	3	14	21	26	64

# llagan, Isabela

Number of species: 6

Species with IUCN status: North PH Hawk-eagle (EN)

Most common species: Philippine Serpent Eagle

Table 3. Raptor survey data obtained from Ilagan, Isabela.

Species	11/16/19	11/17/19	11/19/19	11/21/19	Total
Barred Honey Buzzard	2				2
Brahminy Kite		2		1	3
Crested Honey Buzzard	1	1		1	3
Philippine Falconet		1			1
North Philippine Hawk-eagle			1	1	2
Philippine Serpent Eagle	1	2		1	4
Raptor sp.			1		1
Total	4	6	2	4	16

\* Only sightings during transect survey are indicated. Off-transect data was not included.

# Baggao, Cagayan

Number of species: 9

Species with IUCN status:

North PH Hawk-eagle (EN), Rufous-bellied Eagle (NT), Grey-headed Fish-eagle (NT)

Most common species:

Philippine Serpent Eagle, Rufous-bellied Eagle

Species	11/28/19	11/29/19	11/30/19	12/1/19	12/2/19	Total
Barred Honey Buzzard	-	-	-	1	-	1
Brahminy Kite	1		=	1		2
Grey-faced Buzzard	-	-	2	1	-	3
Grey-headed Fish-eagle	-	-	1		-	1
Peregrine Falcon	_	-	1	_	-	1
Philippine Falconet	1	-	-	-	-	1
North Philippine Hawk-eagle	_	2	_	_	_	2
Philippine Serpent Eagle	1	1	-	3	-	5
Rufous-bellied Eagle	1	-	_	3	1	5
Accipiter sp.	-	-	-	1	-	1
Raptor sp.	-	-	1	-	1	2
Grand Total	4	3	5	10	2	24

### Table 4. Raptor survey data obtained from Baggao, Cagayan.

# Subic Bay Forest Reserve, Zambales

Number of species: 8

Species with IUCN status:

North PH Hawk-eagle (EN), Grey-headed Fish-eagle (NT) Most common species:

Brahminy Kite, Philippine Serpent Eagle

### Table 5. Raptor survey data obtained from Subic Bay Forest Reserve, Zambales.

Species	12/10/19	) 12/11/19	12/12/19	12/14/19	12/15/19	Total
Brahminy Kite	4	7	5	10	9	35
Chinese Sparrowhawk	1	-			-	1
Grey-headed Fish-eagle	1	_	1	-	_	2
Western Osprey		-	-	1	1	2
Philippine Falconet	2	2	2	1	1	8
North Philippine Hawk- eagle	-	2	5	-	-	7
Philippine Serpent Eagle	13	2	3	7	5	30
White-bellied Sea Eagle	1	1	1	1		4
Raptor sp.	2	3	2	5	1	13
Grand Total	24	17	19	25	17	102

\* Only sightings during transect survey are indicated. Off-transect data was not included.

# Calanasan, Apayao

Number of species: 7

Species with IUCN status:

North PH Hawk-eagle (EN), Rufous-bellied Eagle (NT)

Most common species: Philippine Serpent Eagle

Species	1/4/20	1/6/20	1/7/20	1/8/20	1/9/20	Total
Barred Honey Buzzard	-	-	2	2	-	4
Brahminy Kite	2	7	3	3	3	18
Crested Honey Buzzard	-	2	6	8	1	17
Philippine Falconet	_	2	_	_	6	8
North Philippine Hawk-eagle	1	1	4 <del>.</del>	1	1	4
Philippine Serpent Eagle	3	9	23	5	1	41
Rufous-bellied Eagle	1	-	2	3	i <del>, </del> i si s	6
Raptor sp.	_	3	4	5	2	14
Grand Total	7	24	40	27	14	112

Table 6. Raptor survey data obtained from Calanasan, Apayao.

# Mt. Isarog National Park, Camarines Sur

Number of species: 3

Species with IUCN status: NA

Most common species: Philippine Serpent Eagle

Table 7. Raptor survey data obtained from Mt. Isarog National Park, Camarines Sur.

Species	1/19/20	1/20/20	1/21/20	1/22/20	1/23/20	Total
Crested Honey Buzzard		2	1	1		4
Grey-faced Buzzard				2		2
Philippine Serpent Eagle	3	5	3	2	2	15
Raptor sp.		2		2		4
Grand Total	3	9	4	7	2	25

\* Only sightings during transect survey are indicated. Off-transect data was not included.

# Best method for raptor survey is ...

Between the road survey methods, line transect was more time-efficient, but point transect detects more species. Both are biased in detecting raptors in flight.

Both were not able to detect all the species of the site. Combining transect and off-transect data using plot mapping allowed a more complete assessment.



Figure 3. Comparison of the species richness obtained from the three survey methods per site.

### Table 8. Comparison of the data and efficiency of the line and point transect survey method.

Parameters	Point	Line
Time spent	4x longer	Shorter
Abundance	No difference	No difference
Richness	13 species	8 species
Density	No difference	No difference

Species Distribution Modelling of Six Forest Raptors in Luzon

Where are the remaining suitable habitats for raptors in Luzon?

# Species Distribution Modelling in Maxent

Maxent was used to analyse habitat suitability of areas in the Luzon for six raptors.

It compares the environmental variables of points with known species occurrences against randomly selected background points representing the availability and range of environmental conditions of the modelled region to predict potential suitable habitats (Elith et al., 2011).



# Species models spell trouble for certain raptors

High suitable areas are shown in red, while least suitable areas are in blue



Species models were generated for (A) Crested Honey Buzzard, (B) Philippine Falconet, (C) Philippine Honey Buzzard, (D) North Philippine Hawk-eagle, (E) Philippine Serpent Eagle, and (F) Rufousbellied Eagle.

The hawk-eagle has the most bleak prediction, while the serpent eagle is doing better than the rest.



Figure 4. Relative habitat suitability maps generated from Maxent modelling for the six raptor species.

# 13-25% of Luzon is predicted to be suitable for six raptor species

Strongholds are located along the Sierra Madre Mountain Range, the northern part of the Cordillera Central, and the mountains in Zambales and Bataan

The forest in these areas has high conservation importance and urgently needs to be protected.

# converted to richness maps by applying a threshold



Figure 5. Map of Luzon showing the predicted number of species (out the six) that may occur based on the Maxent models.



Habitat suitability maps

These models are predictions which are heavily dependent on the occurrence records and environmental predictors used. Thus, these are not actual species range, but guides for conservation planning. Breeding Biology of the North PH Hawk- eagle

How does this endangered species breed?





### One nest was monitored remotely and actively from Feb 1 - Apr 22, 2020.

Direct observation was done using binoculars and spotting scope. Remote monitoring was done through an improvised surveillance system built using Raspberry Pi, and Pi Camera running MotionEyeOS (Crisan, 2020). One still image was captured every minute along with a video record of daytime.

The large image dataset generated was processed through manual sorting, and machine learning. Convolutional neural networks (CNN) was used to train models to determine the presence (present or absent) and position (standing or sitting) of parent eagles on the nest.

From the observations, nest activities, breeding behavior, prey items, and nestling development were described.

# The North PH Hawk-eagle biology and threats

IUCN Assessment: ENDANGERED

Population: 400-600 adults

Population trend: decreasing

*Threats: deforestation, hunting* (BirdLife International, 2016) Breeding period: January to June Incubation: Feb 1 – Feb 29 Brooding: Mar 1 – Apr 22 Nest dimensions: 95 cm x 80 cm x 40 cm Tree: Malabulak (Bombax ceiba) Nest height: 20 – 25 m high Area: Heavily disturbed forest edge



# As the chick matures, parents spend less time sitting on the nest

### **Incubation period**

At least one parent was sitting on the nest most of the day. Parents were guarding and incubating the egg.

### **Brooding period**

Time spent on the nest was very high during the first week, but it progressively decreased as the chick developed homeothermy, or the ability to regulate its own body temperature. Instead of sitting, parents were mainly standing over the chick to provide shade by the 2<sup>nd</sup> month.

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### Role asymmetry in parental care

Female : Incubation, brooding, guarding, feeding





Figure 6. Nest attendance and time spent sitting by at least one adult hawk-eagles decreased as the chick grew older.

# They are master hunters of various vertebrates

Hawk-eagles are skilled at capturing grounddwelling mammals and birds. Their favorite food were rails, and rats! They were also seen eating bats, lizards, and skinks.

Domesticated animals were also observed in their diet (11%). Specifically, they ate chickens, doves, and cats.



# Chick development focused on size then on feathers

It underwent rapid growth rate during the first three weeks, as typical for many raptors (Wellfair, 2012). This rapid body growth preceded any visible feather growth, and expansion of behavior. Once the feathers started to grow, the body growth rate leveled down to a steady pace.



1<sup>st</sup> – 3<sup>rd</sup> week Body size doubled every week **Day 53** 



4<sup>th</sup> – 7<sup>th</sup> week Feathers developed and juvenile plumage was generally attained

# Raptor research and conservation needs attention



## There are few studies on raptors in the Philippines.

Aside from having limited resources allocated for biodiversity studies in the country, raptor research is perhaps unpopular due to its challenging nature.

Without surveys and other research, the population of forest raptors may decline unnoticed, and therefore hinder their conservation.



### Survey results are baseline data for future studies

Road transect survey methods proved to be useful in obtaining data on raptor abundance and distribution in a tropical forest landscape.

If repeated over time, the raptor surveys can give us insights on population trends.



## Forest protection of remaining habitats is crucial for raptors.

Species distribution models can already inform possible conservation actions for the six raptor species.

Priority areas for conservation are the strongholds located in Sierra Madre Mountain Range, northern Cordillera Central, and southern Zambales Mountains.

# Education and Community Engagement

### **Strategies**

Social Media Sites Online Nest Cam Public Talks



PHE stickers for giveaways!



### **Facebook Page**

Posted information about PH Hawk-eagle (PHE) and updates of the project

### YouTube Channel

Broadcasted live feed and videos from the nest camera.

### **Storytelling Activity**

Helped create a fictional story about PHE as part of the Wild Bird Club of the Philippine's virtual bird festival

### **Community and Public Talks**

Discussed importance of raptors and results of the study to communities and online groups

### **Report Submission to Local Officials**

Submitted a report on the findings and recommendations of the study to the local environmental offices and management boards.



Poster for an online talk about the PHE family.

# Next Steps.....



### **Antipolo Valley Ecological Society**

Inspired by the nesting PHE in the area, a community was formed to promote the appreciation and protection of environment. Its vision is to restore, conserve, and connect forest habitats in the Antipolo Valley.

We also collaborate with homeowner associations and golf course administration to reduce impact to the environment. Some of our successes are the establishment of native tree arboretum and revision of tree-cutting policies. We also have organized tree planting, bird walks, tree walks, and citizen science projects for the community.

AVES will continue working towards the vision with the residents at its helm.



A threatened species arboretum was established last February 2021

Residents enjoyed seeing the birds in the area while adhering to health Safety protocols



# Next Steps.....

There were leftover OBC funds from reduced spending and cancelled community engagement project due to the COVID19 pandemic.

### **GPS-tracking of the PHE**

We received a generous donation of a solar-powered tag from Ko-Eco. It was successfully attached to the female PHE last March 2021 and continuously sends location data until now. We used the leftover fund for the fieldwork expenses (i.e., trapping materials, transportation, food).



The female PHE (aka Dark) was released after tagging it with a GPS transmitter



Movement track of Dark shows the core areas of its territory within the green space surrounded by urbanized areas.

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