

Spatial Modeling of Whreathed Hornbill (*Acerosundulatus*) Habitat in Mount Ungaran Central Java

M. Rahayuningsih, N. E. Kartijono, and E. Suharini

Abstract—The objective of the research was to find the suitable habitat for Whreathed Hornbill (*Acerosundulatus*) using GIS in Mount Ungaran. The research was carried out in five stations: Banyuwindu, Gajah Mungkur, Watu Ondo, Gunung Gentong, and Gajah Mungkur. The method of data collection consisted of spatial data and tabular data. The determining of habitat and the nest distribution were carried out using GPS (Global Positioning System) and processing the data was using Arc Gis and Erdas Imagine 9.1 software. The results showed that very suitable area for bird habitat in Mount Ungaran was 2436.73 ha (13%), whereas 985.11 ha (51%) was considered as suitable area and 7171.37 ha or 36% as unsuitable area. The results validate the suitability of habitat for Whreathed Hornbill is 75%. The accuracy value of 75% indicates that the suitability map model for Whreathed Hornbill habitat is relatively good and is acceptable.

Index Terms—*Acerosundulatus*, mount Ungaran, spatial modeling.

I. INTRODUCTION

There are three species of hornbills in Java and one of them is Whreathed Hornbill (*Acerosundulatus*) which can be found in Mount Ungaran [1]. Disruption of the natural habitat poses a serious threat that can disrupt the presence of birds in Mount Ungaran, such as habitat fragmentation, forest clearing for coffee or tea plantation, illegal logging, hunting and trade of birds. Fragmentation of the landscape may have severe consequences for forest biota, including loss of suitable habitat for sensitive species [1] and increasing competition from generalist species [2], all of which may ultimately result in local extinction of native forest dependent species. The analysis of population showed that density value of Whreathed hornbill in Mount Ungaran was 14.60 bird/Km² [3]. In general it can be said that Mount Ungaran is a suitable habitat for Whreathed hornbill.

Mount Ungaran is one of the areas that has been designated as an Important Bird Area (IBA) in Indonesia, especially in Central Java by Bird Life of Indonesia [4]. Whreathed Hornbill that should be preserved from extinction. The main factors that could threaten its existence, if not anticipated it is estimated that the forest area as the natural habitat for the birds is getting less. One of the efforts that must be made is to identify zones of suitable habitat for the bird sustainability and also as an in-situ conservation strategy.

In addition, to the in-situ conservation planning and wildlife management including birds, it is necessary to have complete

data regarding the major life necessities and behavior. The necessity is the main living space of suitable habitat and availability of food, water, shelter and breeding. Good planning and management needs to be supported with accurate maps, such as administrative boundary maps, road maps, climate maps, contour maps, bird distribution maps, and a land cover classification maps. The maps can further support the efforts to manage and utilize the Mount Ungaran area.

The study of whreathed hornbill such as the individual frequency measurements and populations measurements as well as vegetation diversity in the observation stations only, not supported by habitat modeling in the region. Habitat modeling using GIS can provide data zones which are appropriate for the habitats of birds in an area as well as to determine its Home Range. Many Remote Sensing (RS) and Geographic Information System (GIS) applications have been used to develop spatially explicit wildlife habitat map [5]. GIS technique can be used to examine factors such as the availability of food and land cover, refuge from predators, and the suitability of an area as a nesting and reproduction of animals [6]. RS and GIS also support in monitoring areas of land for their suitability to endangered species, through integration of various habitat variables of both spatial and non-spatial nature [7]. The outputs of such models quite simple, easily understandable and can be used for the assessment of environmental impacts or prioritization of conservation efforts in a timely and cost-effective manner [8], [9]. GIS modeling has been used to examine the habitat and home range of some species such as grassland birds [10], diversity of birds [11] and Muntjak [12].

The objective of this study was to find the suitable habitat for Whreathed Hornbill (*Acerosundulatus*) by using GIS as part of strategic in-situ conservation effort in Mount Ungaran.

II. PROCEDURE

The study area was in Mount Ungaran Central Java with ordinate S 7° 12' E 110° 20' (Fig. 1). The research was conducted on May – December 2013.

The materials and equipments needed for this research are: binocular (Nikon 8 × 30, 8.3" CF WF), Monocular (Nikon 20 × 60), GPS (*Global Positioning System*) Garmin e-trex 12 chanel, Bird Field Guide : Sumatra; Java, Bali, Kalimantan [13], tally sheet, and stationeries.

The data collection consisted of spatial data and tabular data. Spatial data included topographic maps consisting of residential maps, road maps, river map, elevation maps, slope maps and land cover derived from landsat image 2012, while the tabular data used is the distribution of Whreathed hornbill

nest in Mount Unggaran. The process of determining habitat and nest distribution was carried out by using GPS (Global Positioning System). Processing was using Arc Gis and Erdas Imagine 9.1 software.



Fig. 1. Approximate of the study area (box area), between Kendal and Semarang Residence in the Central Java.

The modeling was done through spatial analysis and statistical analysis using GIS based on overlay method, class, classifying, scoring, and weighting (Table I). The ranking method with the professional judgment using for the weighting factor [14].

TABLE I: THE FACTOR AFFECTING OF THE HABITAT OF WHRETAHED HORNBILL IN MOUNT UNGGARAN

No	Class	Code	Weighed (%)
1	Land cover	X_1	30
2	Elevation	X_2	25
3	Slope	X_3	25
4	River distance	X_4	5
5	Road distance	X_4	5

TABLE II: CLASS, CLASSIFICATION, SCORING FACTOR

1 Landcover Class			
Class	Land Cover	Classification	Score
1	Primary Forest	Very Suitable	30
2	Secondary Forest	Suitable	20
3	Plantation Area	Not Suitable	10
4	Residence Area	Not Suitable	10
2 Height Class			
Class	Height (mdpl)	Classification	Score
1	700-1600	Very Suitable	20
2	>1600	Not Suitable	10
3 Slope Class			
Class	Slope	Classification	Score
1	50-80	Very Suitable	30
2	30-50	Suitable	20
3	<30	Not Suitable	10
4 Water resource distance class			
Class	Distance (m)	Classification	Score
1	<500	Very Suitable	20
2	>500	Not Suitable	10
5 Road distance class			
Class	Distance (m)	Classification	Score
1	>1000	Very Suitable	20
2	<1000	Not Suitable	10

Layers that have been graded and scored, superimposed using the “union” (Table II). Overlay performed to obtain the final map which is a combination of the five factors mentioned above. Overlay results were further validated by using coordinate points of Whreathed Hornbill nesting observations that have been done.

The area suitability model is composed as follows:

$$\text{Total Score} = 0.3 \times \text{score } X_1 + 0.25 \times \text{score } X_2 + 0.25 \times \text{score } X_3 + 0.05 \times \text{score } X_4 + 0.05 \times \text{score } X_5$$

III. RESULT AND DISCUSSION

WhreathedHornbill’s habitat suitability models using 5 (five) factors that may influence WhreathedHornbill habitat such as land cover, altitude, slope, the distance from the river and the distance from the road. Wildlife habitat occupied in accordance with the necessary environment to support life. A suitable habitat for a species is not necessarily appropriate for other types, because every type of wildlife requires different habitat conditions. Therefore, the determining factor for the suitability of a particular type of wildlife habitat is affected by the needs of that wildlife itself.

Layers that have been graded and scored, superimposed using the “union” and overlay performed to obtain the final map which is a combination of the five factors. Overlay results were further validated by using coordinate points of Whreathed Hornbill nesting observations that have been done. The fifth overlay layer produced WhreathedHornbill habitat suitability map (Fig. 2).

TABLE III: THE DISTRIBUTION OF WHREATHED HORNBILL SUITABILITY HABITAT IN MOUNT UNGGARAN

No	Information	Width (Ha)	Percentage (%)
1	Very Suitable	2436.73	13
2	Suitable	9851.11	51
3	Not suitable	7171.37	36

Suitability class is divided into three (3) classes area; they are very suitable class, suitable class and not suitable class with the details as shown in the table below (Table III). The area which is highly suitable for Whreathed Hornbill habitats in Mount Unggaran covers 2436.73 ha (13%), the suitable area covers 9851.11 ha (51%) and the not suitable area covers 7171.37 ha (36%) (Table III, Fig. 2).

To test the structured model, whether it is suitable or not in predicting habitat suitability, the final result of the model is validated by using the encounter points data of Whreathed Hornbill’s nests (Table IV, Fig. 3). The results of the model validation is showed that Whreathhead Hornbill’s nest points is located in the very suitable area, the nest is located in the suitable area and during the studied there is no nest of Whreathed Hornbill were found in the not-suitable area.

TABLE IV: THE DISTRIBUTION POINTS OF WHREATHED HORNBILL AGAINST THE ARRANGED SUITABILITY CLASSES

No	Suitability class	The amount of nests and individual
1	Suitable	2
2	Highly suitable	6

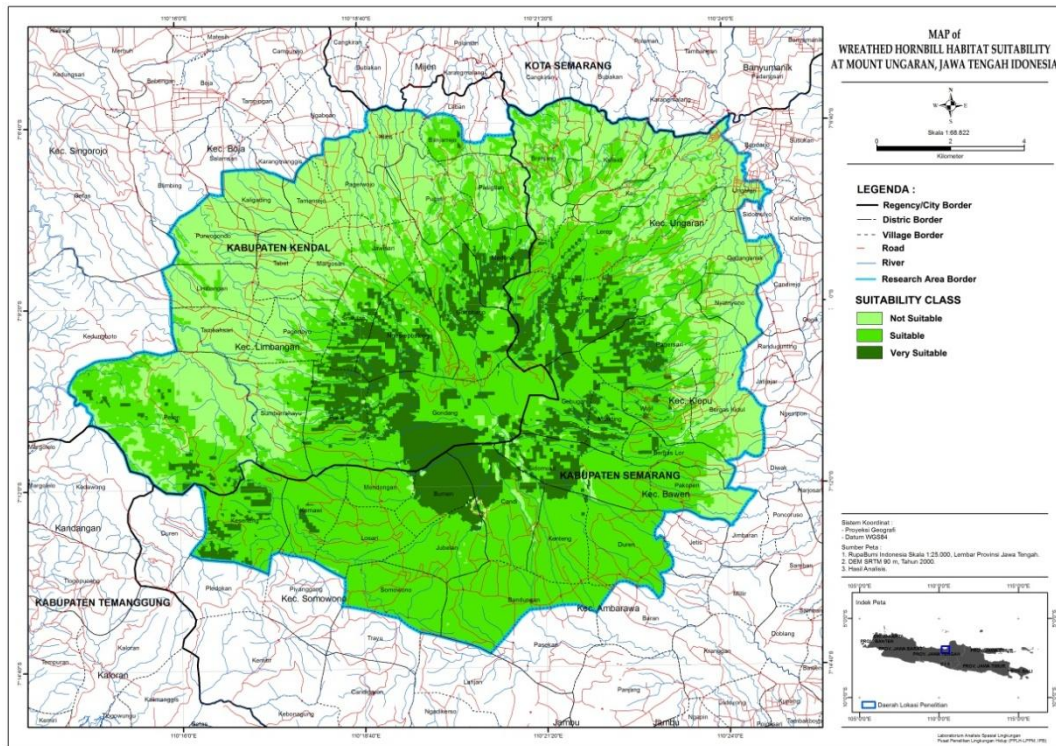


Fig. 2. Wreathed hornbill suitability habitat in Mount Ungaran.

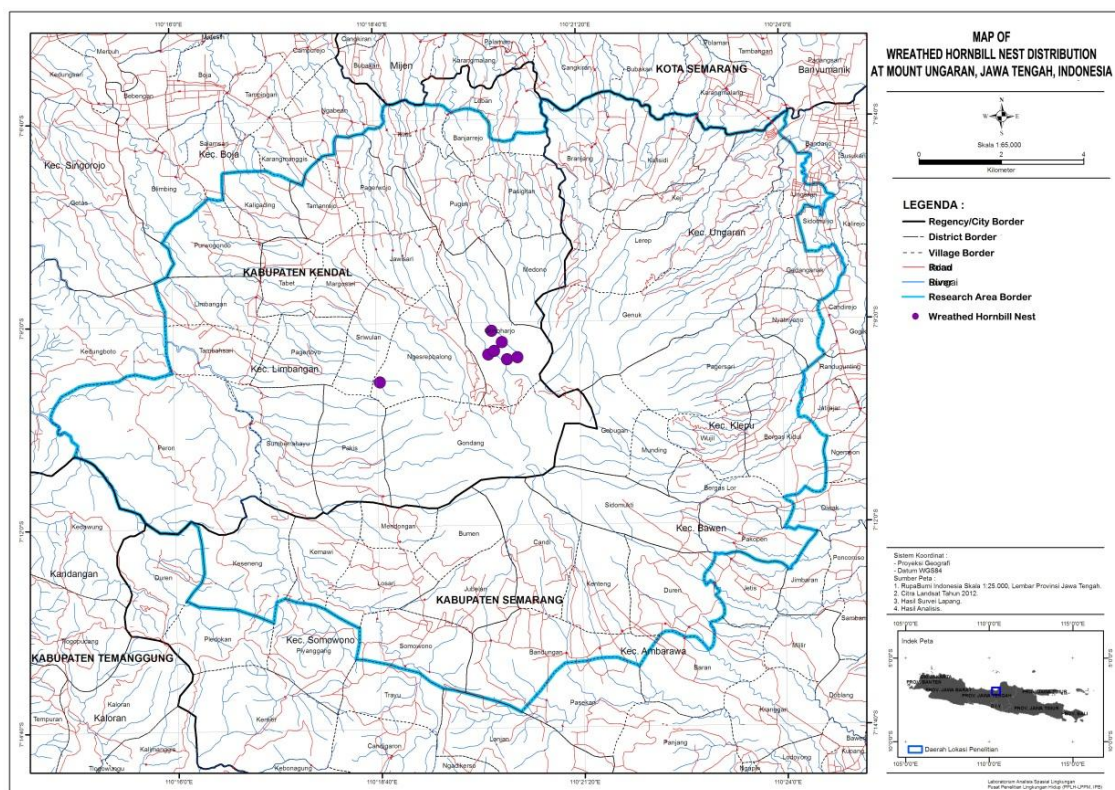


Fig. 3. Nest location of wreathed hornbill in Mount Ungaran.

The validation results on the suitability of Wreathed Hornbill habitat is 75 %. The accuracy value of 75% indicates that a model for Wreathed Hornbill habitat suitability maps is quite good and is acceptable (50 % - < 85 %) [14]. The modeling result shows that generally Mount Ungaran is a suitable habitat and is very suitable for the survival of Wreathed Hornbill. Most of the areas which are suitable for Wreathed Hornbill are located in Semarang Regency.

The “very suitable” area was covers 2436.73 hectares or about 13% of the total area in Mount Ungaran. While the

area that belongs to the “suitable” area was covers 9851.11 ha or about 51 %. Another 7171.37 ha belongs to the not suitable area (36 %). Habitat types in this region is forest, padi fields, tea and coffe plantations, settlements, rivers, and grassland. The most important factor is the location of Wreathed Hornbill nesting habitat which are categorized as very suitable area are located in the forests, on the tree with the height of > 25 meters, located at an altitude of 900-1200 meters above sea level, and the slope of > 30. The elevation of habitat location of Wreathed Hornbill between 0-2000

meters above sea level [15]. The loss of habitat is a serious threat for Whreathed Hornbills in Mount Unggaran. Forest as their habitat is a land ecosystem that contains natural resources dominated by trees is facing a dangerous threat. At Mount Unggaran, habitat fragmentation, forest clearing into coffee or tea plantation, as well as the existence of illegal logging is very influential in accelerating the destruction of the forest. Hornbills tend to be affected by habitat disturbance, including logging, forest fires and other habitat disturbances [15]-[17]. Fragmentation of the landscape may have severe consequences for forest biota, including loss of suitable habitat for sensitive species [18] and also increasing competition from generalist species [19]. All of which may ultimately result in local extinction of native forest dependent species [19]. Large trees is the main target by illegal loggers, meanwhile large trees are the ones that became Whreathed Hornbill's habitat. The large and higher of the tree will be attract hornbills especially for nesting [20]. Based on a review of the characteristics of the nest, some researchers explained that the kind of Whreathed hornbill nest tree has a height of over 20 meters and the diameter between 40-267 cm [21]. Therefore, the predicted location of the suitability class, especially the ones located on very suitable areas' should be protected and preserved.

IV. CONCLUSION

The that belongs to the "very suitable" class covers 2436.73 hectares or about 13% of the total area in Mount Unggaran. The validation results on the suitability of WhreathedHornbill habitat is 75 %. The accuracy value of 75% indicates a model for Whreathed Hornbill habitat suitability maps is quite good and acceptable (50 % - < 85 %).

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