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Short Communication: The nest characteristics of Wreathed Hornbill (*Rhyticeros undulatus*) in Mount Ungaran, Central Java, Indonesia

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Abstract. *Rahayuningsih M, Kartijono NE, Retnoningsih A. 2017. Short Communication: The nest characteristics of Wreathed Hornbill (*Rhyticeros undulatus*) in Mount Ungaran, Central Java, Indonesia. Biodiversitas 18: 1130-1134.* Java has three species of hornbills, one of them is the Wreathed Hornbill (*Rhyticeros undulates* Shaw, 1811) that can be found mainly throughout on Mount Ungaran, Central Java, Indonesia. The main threats to Wreathed Hornbill population are habitat fragmentation and forest clearing. The large trees used for nesting by the Wreathed Hornbill are usually located in areas of illegal logging. Therefore, it is necessary to study the characteristics of Wreathed Hornbill nests, especially in Mount Ungaran. Eight nests were discovered, six of which were active. The nests were found at 900-1200 m above sea level. Trees that were used as nest sites were between 24-35 m high, and had a diameter of 0.83-1.75 m. Nests were located at heights of 1-27 m, and had a hole diameter of 33-38 cm, hole length of 170-211 cm, entrance width of 4-11 cm, entrance length of 14-39 cm, nest thickness 6-18 cm, and a temperature of 20-21°C. The nest shapes were oval, ellipse, and irregular oval. Commonly, the Wreathed Hornbills used *Syzygium glabratum*, *Syzygium antisepticum*, and *Cratoxylum formosum* for nesting.

Keywords: Habitat fragmentation, Mount Ungaran, nest characteristic, Wreathed Hornbill

INTRODUCTION

Ungaran Mountain is one of the Important Bird Areas (IBA) in Indonesia, particularly in Central Java. The determination of Ungaran Mountain as an IBA due to the presence of the Wreathed Hornbill (*Rhyticeros undulatus* Shaw, 1811) and the Javan Hawk Eagle (*Nisaetus bartelsi* Stresemann, 1924). Hornbills were protected under the Government Regulation No. 5/1990 about Conservation of Natural Resources and Ecosystems, Government Regulation (GG) No. 7/1999 about Preservation of Plants and animals, and GG of Minister of Forestry No 57/Menhut-II/2008. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) also categorized the hornbills as fauna in Appendix II, as species that may be traded only under certain conditions, such as scientific research. Nowadays, some of the hornbills encounter many threats that interfere their population. The decline of hornbill population could be caused by several factors, such as loss of native habitat, hunting and trading, and the influence of pesticides, which might damage the reproductive function due to chemical residues that have accumulated through the food chain and caused eggshell thinning. Low public awareness on conserving forests has also influenced the sustainability of the hornbill (Sukmantoro 2002). Disruption of natural habitats, such as habitat fragmentation, forest clearing for coffee or tea plantations, illegal logging, hunting, and trading, has become a serious threat that could interfere with the presence of birds at Ungaran Mountain. Based on initial research by Margareta and Nugroho (2013), the Wreathed Hornbill population at Ungaran Mountain was 14.60 bird/km^2 with some nest sites. In conclusion, Ungaran Mountain has Wreathed Hornbill natural habitat.

The forest size, habitat structure, fruit abundance and distribution greatly affected the density and distribution of several species of hornbills in Asia (Poonswad and Kemp 1995; Kemp 1995; Kinnaird et al. 1996). Hornbill populations were affected by habitat disturbance, including illegal logging and forest firing (Johns 1983; Johns 1987; Kinnaird and O'Brien 1998; Cahill and Walker 2000). Therefore, this study aims to elucidate the nest characteristics, nest site, nest shape and habitat around the nest which are built by the hornbills to lay and to incubate their eggs. Data of Wreathed Hornbill are needed within in situ conservation planning and management of wildlife, especially birds. The most important things are sufficient space habitats and the availability of food, water, shelter and breeding grounds.

MATERIALS AND METHODS

The mapping of nests of the Wreathed Hornbill was conducted by the observation of stations including Banyuwindu, Gajah Mungkur, Watu Ondo, and Gunung Gentong stations. The located of the station at the primary and secondary forest of Mount Ungaran, Central Java, Indonesia (Figure 1). The schedule of research was divided into two different schedules, i.e., from May to November 2013 and from August to November 2014 and 2015.

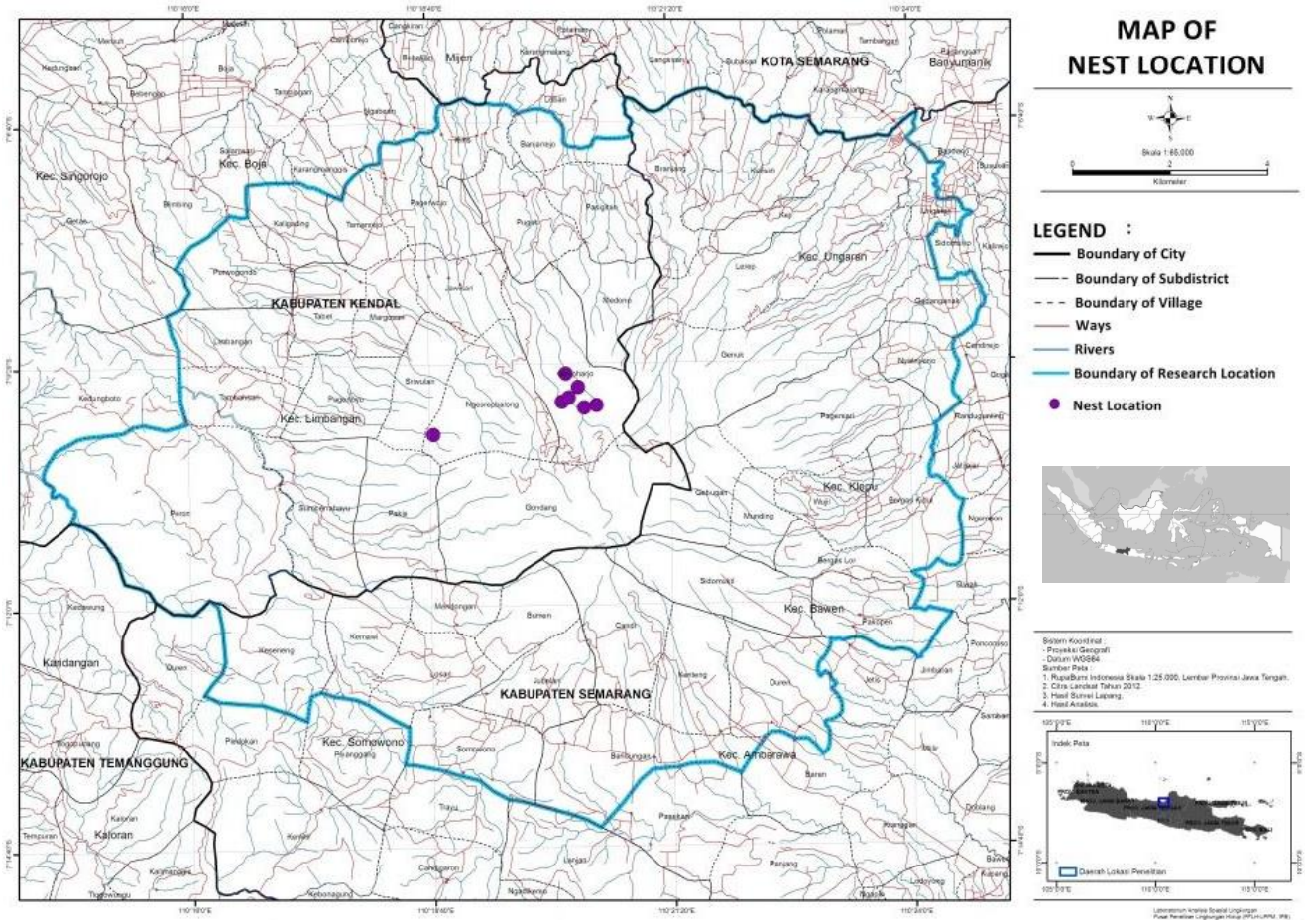

Figure 2. Location of Wreathed Hornbill nests in Mount Ungaran, Central Java, Indonesia

Materials used to conduct the observations included binoculars (Nikon 8 x 30, 8.3"CF WF), a monocular (Nikon 20 x 60), GPS (*Global Positioning System*) *Garmin e-Trex 12 channel*, compass, camera, video, CCTV, laptops, *tape recorder*, a set of tools tree climber, and *tally sheet*. Nests were discovered by following the males which flew and brought food to the nests, or by finding the location of large trees which had holes and the possibility of a nest. Observations were conducted during the high activity periods of the hornbills, between 7:00-15:00 pm (Margareta and Nugroho 2013). The active nest could be characterized while females entered into the nest. The nest could be observed when females and its offspring out of their nest (the process lasted between 3-4 months). The results were identified to determine its type and measured with several variables (Table 1). The nest characteristics in this study were developed from Staufer and Smith (2004) method which shown in Figure 3 and Figure 4. According to the records of Kinnaird and O'Brien (1998), the breeding period of the Wreathed Hornbill occurs during May - November. The nest condition was determined by climbing a tree and measuring the nest cavity (Figure 2).

Table 1. Variables to determine the nest characteristics of Wreathed Hornbill according to Staufer Method (2004)

Variables	Description
Tree	
Species	The type of the tree where the nest is found
Tree diameter	The diameter of the nest tree
Tree height	Measured from the ground surface
Nest height	Measured from the ground surface
Trees percentage	% estimation from the canopy
Nest cavity	
Nest width	Directly measured
Nest height	Directly measured
Nest depth	Directly measured
Nest volume	Width x height x depth
Width of the nest door	Directly measured
Height of the nest door	Directly measured
Area of the nest door	Width x height
Nest thickness	Directly measured
Nest orientation	The opening direction of the nest from the main axis

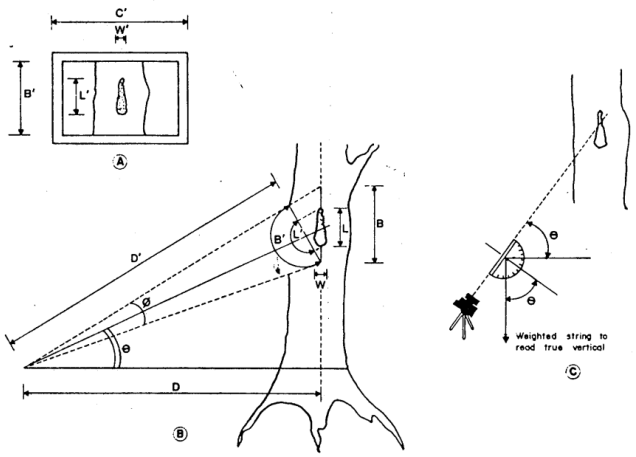

Figure 2. The nest site characteristic (Poonswad 2015)

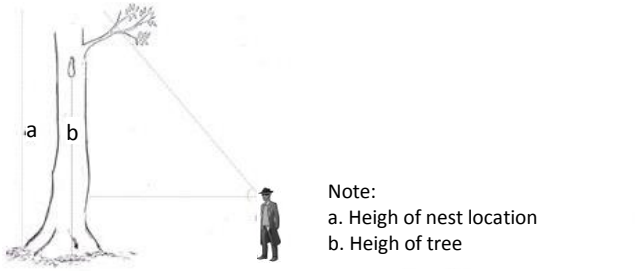

Figure 3. The measurement of tree height and nest location height

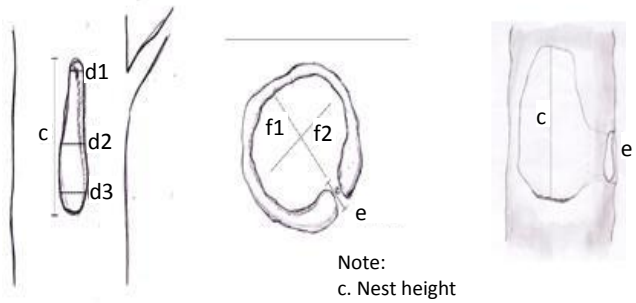

Figure 4. The measurement of nest hole size

RESULTS AND DISCUSSION

Nest distribution of Wreathed Hornbill at Mount Ungaran

The observers found 8 nests, 6 of which were active, and 2 of which were non active. However, the observers are able to measure only five of the active nests, while one nest could not be observed (nest No. 7) (Figure 5). Nest locations were scattered in Watuondo (1 nest) and Gunung Gentong (7 nests) (Figure 2). Total nest record, especially on Gunung Gentong from 2010-2016, were 10 nests (Rahayuningsih et al 2016), but the three of the nest tree on Gunung Gentong were not measurement because the location was difficult to reach.

The trees that were used for nests were: Salam Klontong (*Syzygium glabratum)* (2 nests), Nagasari (*Syzygium antisepticum*) (5 nests) and Marong (Cratoxylum formosum)(1 nest). *S. glabratum* and *S. antisepticum* belong to families of Myrtaceae. The height of *S. glabratum* trees ranged between 27-35 m with diameter 1.10-1.75 m, *S. antisepticum* had heights of 24-32 m and diameter 0.83-1.15 m, while (*C. formosum* had height 34 meters with diameter 1.62 m (Table 2).

The height and diameter of the tree as nest habitat represented the body size of Wreathed Hornbill.The observations indicated that Wreathed Hornbills selected specific trees that were taller than 20 meters and had a diameter of approximately 1 meter.

Based on nest locations in Watuondo and Gunung Gentong, Himmah et al. (2010) stated that Watuondo and Gunung Gentong had the potential to be the habitat of breeding Wreathed Hornbills. Watuondo has 52 individual trees/ha with a diameter more than 60 cm, whereas Gunung Gentong has a great amount of biodiversity and single tree.

Based on Figure 2, the location of Wreathed Hornbill nests in Mount Ungaran showed that nests could be found in between 900-1200 meters above sea level. According to Nugroho (2011), Wreathed Hornbills that lived in the area of reforestation were found roughly at 0-165 meters above sea level. Meanwhile, Mackinnon et al. (1998) stated that Wreathed Hornbill usually lived at an altitude of 0-2000 meters above sea level.

Marthy (2008) explained that the Wreathed Hornbill would make nests in trees with a height greater than 20 meters, and with a diameter of approximately 40-267 cm. However, the diameter of trees in Watuondo was more than 60 cm, whereas in Gunung Gentong they ranged from 35 to 60 cm. Datta and Rawat (2004) described the most suitable trees, which were used by Wreathed Hornbills for nesting, had heights of more than 18 meters.

Nest characteristics

The Wreathed Hornbills in Ungaran Mountain generally built the different nest forms (see Table 3 and Figure 5). Poonswad (1993) said that Wreathed Hornbills regularly utilized taller and larger trees for nesting, and selected specific trees such as *Dipterocarpu*s and *Eugenia*. However, on Mount Ungaran, Wreathed Hornbill usually built nests on *S. glabratum* and *S. antisepticum*. Both tree species are the part of *Eugenia* family, namely Myrtaceae. We believe that the tallest tree was chosen for nesting by the hornbills likely happened as a result of storm damage, that resulted in damage, including broken branches, which in some cases would naturally form a hole. In addition, the strongest trees can survive longer than other trees, so the possibility of using it as a nest was higher than other trees.

Based on the nesting characteristics of Hornbill nests, Datta and Rawat (2004) explained that there were differences in nest characteristics among the Wreathed Hornbill (*Rhyticeros undulatus*), Great Hornbill (*Buceros bicornis*), and Oriental Pied Hornbill (*Anthracoceros albirostris*). The differences included the height of the nests, nest thickness, and the shape of the nest.

Figure 5. The nest shape of Wreathed Hornbills at Mount Ungaran, Central Java, Indonesia

Table 2. Location, elevation, species, height and tree diameter

Nest number	Coordinate point		Elevation	Tree species		Trees height (m)	Trees diameter (m)	Information
	S	E		Scientific name	Local name			
1	07^0 09' 26.8"	110^0 20' 11.8"	939	*Syzygium glabratum*	Salam Klontong	27	1.75	Active
2	07^0 09' 35.7"	110^0 20' 19.5"	1056	*Syzygium antisepticum*	Naga Sari	24	1.15	Active
3	07^0 09' 50.7"	110^0 20' 33.1"	1241	*Syzygium antisepticum*	Naga Sari	32	1.37	Active
4	07^0 09' 37.2"	110^0 20' 30.5"	1185	*Syzygium antisepticum*	Naga Sari	30	0.83	Active
5	07^0 09' 36.5"	110^0 20' 27.5"	1105	*Syzygium antisepticum*	Naga Sari	26	0.89	Active
6	07^0 09' 45.7"	110^0 20' 20.3"	1112	*Cratoxylum formosum*	Marong	34	1.62	Active
7	07^0 09' 41.7"	110^0 20' 13.6"	1039	*Syzygium antisepticum*	Naga Sari	30	1.15	Non active
8	07^0 09' 56.9"	110^0 19' 33.8"	1180	*Syzygium glabratum*	Salam Klontong	30	1.10	Non active

Table 3. Nest characteristics of Wreathed Hornbill

Tree species	Nest height (m)	Hole diameter(cm)		Hole height (cm)	Entrance Width (cm)			Entrance length (cm)	Thick-ness	Shape	Temp. in nest (^{0}C)
		I	II		Top	Middle	Bottom				
Syzygium glabratum	17	79	61	211	6.7	11.3	6.8	39	18	Irregular oval	21
Syzygium antisepticum	10.1	40	37	110	6	7	9	40	15	Irregular oval	20
Syzygium antisepticum	11	60	55	130	10.2	14.8	12	30	15	Irregular oval	20
Syzygium antisepticum	12	50	20	190	4	7.2	5	15	6.3	Oval	20
Syzygium antisepticum	16	47	39	265	4.87	9.13	5.54	15.3	20	Irregular oval	21
Cratoxylum formosum	16	11.3	70	170	8	6	11	30	18	Ellipse	21
Syzygium antisepticum	27	-	-	-	-	-	-	-	-	Irregular oval	21
Syzygium glabratum	11	116	108	266	11	15	8	32	16	Irregular oval	-
Average	15	58	56	192	7	10	9	29	15		
SD	6	35	31	66	3	4	3	10	5		

The average nest height for Wreathed Hornbill in Java and Sumatra ranged between 18-26 m and the height and nest inner width were between 45-47 x 60-85m, and nest shape was generally rounded (Marthy 2008). These results supported Datta and Rawat (2004) which explained that the form of Wreathed Hornbill nests was generally oval. Poonswad (1993) specified the shape of Wreathed Hornbill nests was generally elongate or oval. The nests were used by females to incubate their eggs and to guard their offspring until they are able to fly. The females stayed at the nest, while males hunted and feed their females. During the observation, the females always closed to the nest hole using ground, mud and a small gap left to receive food from the males. In addition, the small gap was also used to protect their eggs or offspring from predators. When the females wanted to leave the nest, then the females unloaded the soil, mud, so the gap became wider than before.

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