



New Homes on Misty Mountains: Javan Hawk-eagle *Nisaetus bartelsi* and Changeable Hawk-eagle *Nisaetus cirrhatus* Nesting in Gunung Halimun Salak National Park, West Java, Indonesia

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Abstract

Raptors play important roles in forests but they are threatened by illegal trade, hunting, habitat destruction and the use of pesticides. The location of raptor nests is important for determining appropriate conservation measures and, to halt poaching for illegal trade, it is also important to involve local people in raptor conservation. Gunung Halimun Salak National Park in western Java, Indonesia, is one of the few remaining habitats of the endangered endemic Javan Hawk-eagle *Nisaetus bartelsi* and the Changeable Hawk-eagle *Nisaetus cirrhatus* in Indonesia. This research aimed to locate the nesting places of Javan and Changeable Hawk-eagles, to describe the characteristics of these locations, and also to monitor the breeding success of individuals at each nest. We discovered that finding Javan Hawk-eagle nests was more difficult than finding Changeable Hawk-eagle nests. The Javan Hawk-eagles build their nests in taller trees, at higher altitudes, on steeper slopes and closer to water sources. Based on three years of monitoring of seven nests of Changeable Hawk-eagles and five nests of Javan Hawk-eagles in the national park, the breeding success of the Changeable Hawk-eagle was found to be higher than that of the Javan Hawk-eagle.

1. Introduction

There are about 292–313 species of diurnal raptor of the order Accipitriformes distributed widely around the world (Ferguson-Lees & Christie 2001), and about 67% of these are found in tropical areas (Bildstein *et al.* 1998). In natural habitats, raptors are recognized as keystone species (Sergio *et al.* 2008), environmentally sensitive (Poirazidis *et al.* 2007), and also as indicators of ecosystem health (Rodríguez-Estrella *et al.* 1998; Poirazidis *et al.* 2007). Hiraldo *et al.* (1995) said that people believe that raptors play an important role in controlling disease.

Populations of raptors are threatened by illegal trade, hunting, habitat destruction and the use of pesticides (Bildstein *et al.* 1998; Rodríguez-Estrella *et al.* 1998; van Balen *et al.* 2000; Nijman *et al.* 2006; Supriatna 2012).

Most birds need to build nests for egg laying, hatching and rearing their young (Steenhof *et al.* 2007). Raptors build their own nests, take over the nests of other species or use their former nests. Birds of prey usually build their nests in tall trees or on rocky cliffs in healthy ecosystems to support their daily requirements during the breeding season. It is important to find their nests to understand their biology (Lewis *et al.* 2004). Knowledge of the reproductive rate in raptors can be valuable in

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assessing their population status and factors influencing their survival (Steenhof *et al.* 2007).

In the IUCN Red List, the endemic Javan Hawk-eagle *Nisaetus bartelsi* (hereafter JHE) is listed as Endangered and the Changeable Hawk-eagle *Nisaetus cirrhatus* (hereafter CHE) is listed as Least Concern. These two raptor species are found in Gunung Halimun Salak National Park. Nijman (2004) suggested that these two eagles may be competitors in terms of both habitat and diet. The CHE is widely distributed in a mosaic of more or less degraded, fragmented forests interspersed with clearings, small pastures and crop-fields (Gamauf *et al.* 1998) throughout southern and southeast Asia in India, Sri Lanka, the Andaman Islands, the Philippines, Borneo, and the Indonesian islands of Sumatra, Java and the Greater Sundas (Ferguson-Lees & Christie 2001; BirdLife International 2015; Sözer & Nijman 1995), while the JHE is endemic to the evergreen rainforest of Java (Gjershaug *et al.* 2004; Nijman *et al.* 2009). The JHE and CHE build their nests on emergent trees which are located on the slope of a hill.

Although the JHE and CHE inhabit the same locations, the characteristics of their nesting habitats are different. It is interesting to know why the JHE is rarer than the CHE in the park. This research was started in 2012, when

we obtained information from local people and national park officers that a JHE chick had been stolen from a nest in the Salak Mountain area.

2. Study area and Methods

2.1 Study Area

This research was conducted in Gunung Halimun-Salak National Park (Fig. 1) which is located in the western part of the island of Java. The park covers an area of 113,357 ha and lies in two provinces; West Java and Banten. The area is one of the few remaining habitats for many endemic species in Java (Wiharto *et al.* 2008; Wiharto & Mochtar 2012), and is also important as a water catchment area (Galudra *et al.* 2005; Ahadi *et al.* 2013) with relatively high rainfall of up to 3,000 mm/year (Wiharto *et al.* 2008; Wiharto & Mochtar 2012). The park is in a mountainous area with steep terrain at altitudes of 400–2,211 m (Wiharto & Mochtar 2012). There are two mountains within the park, namely Halimun Mountain and Salak Mountain. Salak Mountain is one of the many active volcanoes in Indonesia and produces geothermal power for the generation of electricity (Pasikki *et al.* 2010). The vegetation of the park varies according to altitude and comprises lowland forests (500–1,000 m), sub-montane forests (1,000–1,500 m) and mountain forests ($\geq 1,500$ m) (Galudra *et al.* 2005).

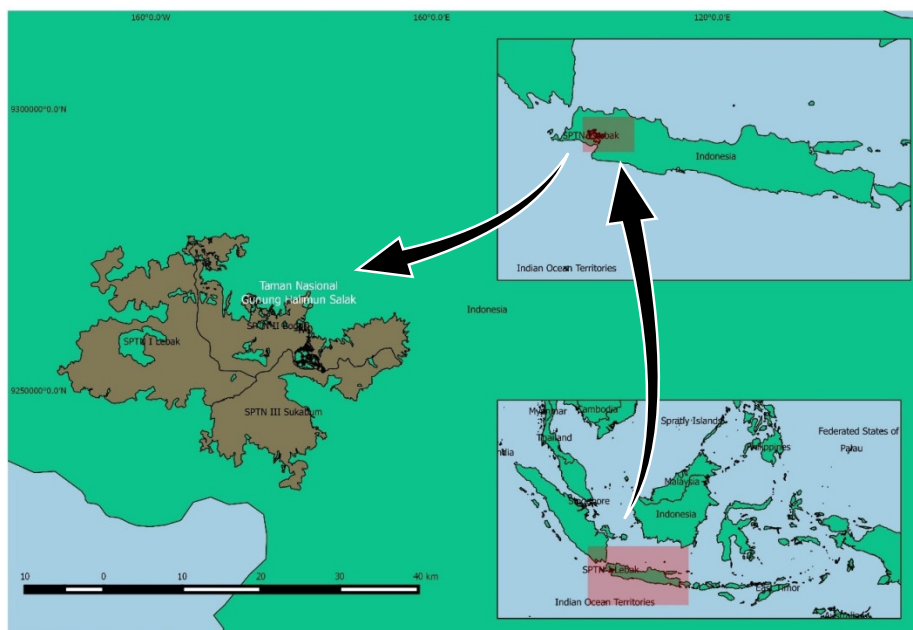


Fig. 1. Map of Gunung Halimun Salak National Park, Java.

2.2. Methods

The study was conducted during the breeding season from March to October 2012–2014. In 2012, we searched for JHE nests and checked nest condition. Sözer & Nijman (1995) had mentioned that it was not easy to find JHE nests. Therefore, we visited villages around Salak Mountain to obtain information from local people about the location of nests. Firstly, we conducted semi-structured interviews with six national park officers and 20 people from the villages. One ex-hunter told us that he usually took eaglets of one to three weeks in age from the nests and sold them to the local market. We discovered that many local people were engaged in daily activities in the Salak Mountain area, such as gathering fire-wood, farming and collecting wild fruits. During 2012–2014, we found a total of 12 hawk-eagle nests consisting of seven Changeable Hawk-eagle nests and five Javan Hawk-eagle nests. In 2012, we found six nests (three JHE nests, two active CHE nests and one former nest of JHE). In 2013 and 2014, we monitored these five active nests. In 2013, we also located one new nest of the CHE and one nest of the JHE, while in 2014 we located four nests of the CHE and one nest of the JHE. Each nesting site shown to us by local people was monitored for 1–3 days to make sure that the nest belonged to JHE or CHE. During the period of nest occupation, we monitored the nests for 3–5 days every month. At the nesting site, we collected data on the condition of the nesting habitat, the type of tree in which the nest was situated and the condition of the nest. The parameters of nesting habitat were the type of habitat in which the nest was found, altitude, slope, distance from water sources, and distance from human activities. We collected data on species of tree and the height and diameter of the nest tree. The position of the nest in the tree was also measured, *i.e.* the height from the ground, the location over the branch, and the direction and size (length and width). We monitored the nests every year to check whether or not they were re-occupied.

3. Results

In 2012, we found six nests in Salak Mountain: four nests of the JHE and two nests of the CHE

(Table 1). Only two of the JHE nests and one of the CHE nests were successful to fledging, producing two juvenile JHE and one juvenile CHE. One light morph pair of CHE started their new nest in June 2012 and appeared to be incubating later in July. In the second year, 2013, we saw the pair destroying their nest in May and starting to build a new nest in other branches of the same tree. Intensive monitoring showed that this nest was successful, with a juvenile of the light morph fledging. This juvenile started to fly in October when it was aged about 8–9 weeks. In the third year, 2014, we continued our observations of this CHE pair. In June 2014, we saw a light morph CHE sitting on the nest and a dark morph CHE perch at the nest and the young light morph CHE.

In 2013, we monitored three nests of the JHE and three nests of the CHE, including one CHE nest which was located in June. Only one JHE nest and three CHE nests were occupied in 2013 (Table 1). All three CHE nests succeeded in producing fledged juveniles, but the JHE nest failed. In 2014, we monitored three JHE nests and six CHE nests (Table 1). Five of these nests (four CHE nests and one JHE nest) were located in October. Our monitoring results showed that two JHE nest and six CHE nests succeeded in producing fledged juveniles. According to our research during 2012–2014, 14 young hawk-eagles were successfully raised to fledging in the park: four JHE from five nests and ten CHE from seven nests.

Our comparison of the nest trees used by the JHE and CHE reveals that the JHE uses higher trees closer to water sources and at higher altitude and on steeper slopes than the CHE (Table 2). However, the tree diameter of the JHE nests was less than that of the CHE nests. The nest dimensions of the JHE were also smaller than those of the CHE. The JHE chooses native trees in which to construct its nest, while the CHE sometimes uses plantation trees (such as *Altingia excelsa* and *Ceiba pentandra*) for nest building. The JHE build their nests on trees close to rivers (water sources). The average distance of the nesting trees from the river was 36.25 m. This is much closer than the average distance of the CHE nesting trees from a river (143.6 m).

Table 1. Nest occupation of Javan and Changeable Hawk-eagles in Gunung Halimun Salak National Park during 2012–2014.

Year Species	2012			2013			2014				
	Checked	Occupied	Successful	Checked	Occupied	Successful	New	Checked	Occupied	Successful	New
Javan HE	4	2	2	3	1	0	0	3	2	2	1
Changeable HE	2	1	1	3	3	3	1	6	6	6	4
Total	6	3	3	6	4	3	1	9	8	8	5

Table 2. Nesting habitat requirements of Javan and Changeable Hawk-eagles in Mount Halimun Salak National Park.

Parameter	Javan Hawk-eagle	Changeable Hawk-eagle
Nesting tree location		
Number of nests	5	7
Average altitude	1,017.50 m	789.57 m
Average slope	57.50 °	42.86 °
Average distance from water sources	36.25 m	143.57 m
Nest tree		
Number of nests	5	7
Tree species	<i>Phoebe grandis</i> , <i>Toona sureni</i> , <i>Gluta reinghas</i>	<i>Elaeocarpus ganitrus</i> , <i>Quercus</i> sp., <i>Schima walichii</i> , <i>Altingia excelsa</i> , <i>Ceiba pentandra</i>
Average height	51.25 m	39.57 m
Average diameter	63.00 cm	148.57 cm
Nest		
Number of nests	5	7
Average height of nest from ground	45.25 m	32.43 m
Average length of nest	70.00 cm	87.86 cm
Average width of nest	49.25 cm	54.00 cm

4. Discussion

4.1. Breeding success

Well (1999) in Iqbal *et al.* (2011) mentioned that the genus *Nisaetus* breeds in the Thai-Malay Peninsula from November to February. Harianto *et al.* (2009) and Prawiradilaga *et al.* (2003) stated that the breeding season of the JHE was between February and May, but in our study, we found one JHE nest with a chick in March and another JHE nest with an incubating pair in June. Harianto *et al.* (2009) and Prawiradilaga *et al.* (2003) also stated that the breeding season of the CHE was from February to August, and we found a pair of CHE with a chick in June and July.

According to our research, the CHE nests were occupied in almost every year and were successful in producing chicks, but the JHE nests were occupied in every 2–3 years on average and also sometimes failed to produce any chick. During 2012 to 2014, we identified 12 hawk-eagle nests comprising seven CHE nests and five JHE nests. From these nests, there were 14 eaglets that fledged as new

individuals in the national park. According to Newton (1977), raptors generally lay only one egg, and our research also similarly found that the JHE and CHE laid only one egg. The new individuals consisted of ten CHE and four JHE. On average, the breeding success of the JHE in Salak and Halimun Mountain was 40% of nests which is lower than the average breeding success of the CHE at the same area (66.7% of nests) (Table 1).

The failure of the JHE nest in 2013 was probably because the pair started their breeding season very late. Sözer & Nijman (1995) and Nijman *et al.* (2000) mentioned that the JHE may breed twice in the same year, but our three-year study revealed that some pairs of the JHE did not breed in Salak Mountain every year. This finding agrees with that of Sozer *et al.* (2012), who stated that species of the genus *Nisaetus* sometimes leave their nests and return after 2–3 years.

One of the main factors influencing breeding in raptors is food availability (Newton 2010), but in some cases, breeding success is also

influenced by other factors, e.g. weather and interference from humans and other animals. Kristiyawan (pers. comm. 2015) stated that some cases of nest failure in the JHE in Merapi Mountain (Yogyakarta) were caused by the Long-tailed Macaque *Macaca fascicularis*, and some cases of nest failure in the Crested Serpent Eagle *Spilornis cheela* in Gunung Kidul (Yogyakarta) were caused by typhoons and human activities around the nest tree.

4.2. Nesting habitat

The location of nests is very important for understanding breeding biology (Lewis *et al.* 2004), because birds need specific habitats in which to build their nests and to guarantee their breeding success. Probably the JHE and CHE are in competition with one another for habitat and food (Nijman 2004). Nijman *et al.* (2000) found that the JHE nests in sub-montane forest $\geq 1,000$ metres a.s.l., but Cahyono (pers. comm. 2015), in contrast, found that the JHE nests in lowland forest less than 500 metres a.s.l. These species usually select emergent trees in which to build their nests. We found that the average altitude of the JHE nesting sites was higher than that of the CHE, but both species can build their nests in lowland rainforest (500–1,000 metres a.s.l.).

We compared the nesting sites of the two species in the national park and found that JHE nests were mostly found at higher elevations and in better quality forest than CHE nests. The average steepness of the slope with JHE nesting trees was 57.50° , while that for CHE nesting trees was 42.86° . According to Andi *et al.* (2000), the steepness of slopes with JHE nesting trees is about $30\text{--}80^\circ$, but there appears to be no published information concerning the steepness of slopes with CHE nesting trees. The JHE builds its nest on native trees such as *Phoebe grandis*, *Toona sureni* and *Gluta renghas*, but the CHE prefers trees such as *Elaeocarpus ganitrus*, *Quercus sp.* and *Schima walichii* and also plantation trees such as *Altingia excelsa* and *Ceiba pentandra*. The JHE uses higher trees and higher branches than the CHE, but the average diameter of trees with JHE nests was less than that of trees with CHE nests. Higher trees will help the adult eagles to watch and care for their nests from potential

predators and intruders (Andi *et al.* 2000). The form of the nest of both species was ellipsoid.

We discovered that the JHE was more sensitive to human disturbances and dependent on evergreen rainforest in Java than the CHE. The CHE can breed in forest edges and even cultivated lands, but the JHE is mainly confined to forest (Sözer & Nijman 1995). We believe that this is one of the reasons why the JHE has more difficulty in choosing nesting habitat than the CHE. Therefore, it is important to increase and protect at least 10% of the remaining original natural rainforest on Java (Gjershaug *et al.* 2004) to conserve the endemic Javan Hawk-eagle.

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