Habitat preferences of current record of JHE (*Nisaetus bartelsi*) in lowland forest in Ujung Kulon National Park

I Fahmi and Syartinilia
Department of Landscape Architecture, IPB University, Indonesia
Email: syartinilia@apps.ipb.ac.id

**Abstract.** Ujung Kulon National Park (TNUK) used camera traps to help monitoring the occurrence of Javan Rhinos (*Rhinos sondaicus*) but the result accidentally recorded the occurrence of Javan Hawk-eagle (JHE). According to the latest habitat modelling, JHE’s presence was only in highland forests. The new report of JHE occurrence in TNUK confirmed JHE’s presence in lowland forest. The objective of this study was to identify the landscape characteristics that become the habitat preferences of JHE in TNUK. Observation and analysis were conducted around the occurrence location to obtain the information about JHE’s preferences for selecting their nesting and hunting sites. Vegetation analysis was conducted to obtain Important Value Index (IVI) and diversity index that represented plants species domination. The results indicated that in TNUK lowland forest, JHE’s habitat was distinguished into two habitat preferences based on the behaviour. JHE hunted and nested around Cigenter River and its tributary with sloping ground. Hunting and nesting habitats were both dominated by bay trees (*Syzygium polyanthum*) with IVI of 88.97% and 69.49%, respectively. Tree dominance that provided habitats for JHE’s diet was an important factor in determining hunting preferences, while species diversity was an important factor in determining nesting preferences.

1. **Introduction**

Ujung Kulon National Park (TNUK) has been using camera traps to monitor the population of Javan Rhinos (*Rhinos sondaicus*) since 2010. Besides capturing Javan Rhinos (*Rhinos sondaicus*) images, the camera trap installed also succeeded in capturing the presence of various other animals including Javan Hawk-eagle (JHE). As an endemic raptor on the Island of Java, JHE’s populations are threatened with extinction due to habitat fragmentation, habitat destruction and illegal poaching. JHE as an indicator species and key species (keystone species) in their habitat can maintain the balance and stability of the ecosystem. Additionally, this raptor is also very sensitive to environmental changes that cause the population will be disrupted if the quality of the environment is disturbed [1]. In 2013 the existence of the JHE was recorded by a camera trap installed in the lowland forest inside of TNUK. The discovery of the JHE in TNUK does not fit with the previous JHE habitat distribution model that showed the JHEs only found in highland forest of Java Island ([2], [3]).

The selection of suitable habitat is an action taken by wild animals in order to obtain a series of conditions that are favourable for reproductive success and survival [3]. The chosen habitat of JHE is influenced by the habitat preferences of the JHE itself, therefore it is necessary to study the landscape of the JHE habitat and its preferences in TNUK to support the baseline data in the conservation of JHE in TNUK. Therefore, the main objective of this study was to determine the landscape characteristics of JHE nesting and hunting site preferred habitats in TNUK. These characteristics were in the form of...
biophysical and vegetation structures used by JHE to meet their habitat needs. Results of this study will be important for managing the habitat of JHE in TNUK as basic information.

2. Methods

2.1 Materials

This study used tools such as digital cameras that was used to document the research activities, GPS to retrieve point data during field checks, binoculars to observe raptor, and laptops that had been equipped with ArcGIS 10.3 software and ERDAS Imagine 2014. The spatial data used was land cover maps and JHE encounters data from camera trap. The research was conducted in TNUK, Banten (Figure 1) with an area of 122,956 ha.

![Figure 1. Study area: Ujung Kulon National Park (TNUK)](image)

2.2 Methods

2.2.1 Field Observation Field observations were conducted from 25th – 31st of July 2018 on the location based on locality records from data of camera traps, semi structural interview among TNUK officers, and encounter grid to get estimation of nesting and hunting sites. The observation was conducted intensively on the selected sites to carry out any information about JHE’s activities and its habitat preferences.

2.2.2 Analysis To find out the characteristics of the hunting habitat and the nesting habitat of JHE including composition and structures of vegetation, vegetation analysis was conducted in the nest location and the location of JHE’s encounter. Vegetation analysis was conducted by using 30 sample plots with the size of 20 m x 20 m for each plot located around hunting habitats (18 plots) and nesting habitats (12 plots). While the number of plots in each habitat was determined based on the variety of vegetation seen during field observation.

The parameters used consisted of stem diameter, tree height, and the number of individual and species of trees. Stem diameter measurements (dbh) were carried out at a height of 1.3 meters or 20
cm above the root of the board if the root of the board was higher than 1.3 meters [4]. The measurement data was used to calculate the Important Value Index (IVI) and the Shannon-Wiener Diversity Index. The importance value index (IVI) is a quantitative parameter that can be used to express the level of dominance (mastery level) of species in a plant community [5]. The species which has the greatest IVI is the most dominant species. IVI is obtained by summing the relative density (RD), relative frequency (RF), and relative dominance (RDo). The equations to calculate the RD, RF, and RDo are explained as below.

\[
RD = \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100
\]

\[
RF = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100\%
\]

\[
RDo = \frac{\text{Dominance of a species}}{\text{Total dominance of all species}} \times 100
\]

Species diversity was used to measure community stability, namely the ability of a community to maintain itself stable despite interference from its components [5]. The diversity index was calculated by using the Shannon-Wiener method, by negatively multiplying the number of individual species divided by the total number of species (Pi) by ln (Pi). Based on the stratification of space used in the forest profile as well as horizontal distribution in various habitat types, there was a close relationship between JHE and their environment, especially in adaptation patterns and strategies to obtain food sources [6].

3. Results and discussion

JHE can be found in natural forests with elevations of 0 - 3000 masl [7]. The field observations indicated that JHEs in TNUK utilized lowland natural forests with elevations of 0-100 meters above sea level for hunting and nesting. The location of the encounter was included in the core zone of TNUK located around the edge of the tributary of the Cigenter River with a slope of 3-8% (low slope). In contrast to condition which states that JHEs can only be found in undulating forests in mountainous regions [8].

During observation the JHE was ever seen hunting the juvenile Javan Langur (Trachytheicus auratus) with the technique of perch hunting (from branch to branch) in the kiara tree (Ficus gibbosa) in the morning on July 31st 2018. In addition, besides langurs, other potential animals for JHEs diet was also recorded, such as weasels (Paradoxurus hermaphoditus), squirrels (Calloctius notatus), black giant squirrel (Ratufa bicolor), and green junglefowl (Gallus varius). JHEs generally prey on birds, reptiles and small mammals such as bats, squirrels, squirrels, mice, and even a young monkey [9].

Trees serve nest for JHE and other animals that become diet for JHE. Trees used as nests were often found in steep slopes and were usually located above rivers or at the upper part of the river in the mountains [10]. In TNUK, JHE nests were found in kiara trees (Ficus gibbosa) at locations with elevation of 0 - 100 meters above sea level and slope of 3-8% (sloping) around the Cigenter tributaries and were included in the core zone. In other lowland forests such as in Alas Purwo National Park, the JHE nest was found in Bendo (Arthocarpus elastica) trees around Savana Sadengan with flat land conditions and elevation of 72 meters above sea level [11]. Even though the nest trees from lowland forest and highland forest had various type of tree species, most of them had the same tree architecture which had half round and open canopy (Rauh) [12].

Not only the landscape characteristics were observed in both habitat preferences, vegetation analysis was also carried out to determine habitat characteristics that were reflected in the structure,
dominance, and diversity of plants used by JHEs to carry out their activities [12]. The following table is the comparison of vegetation analysis in both habitats (Table 1).

| Vegetation Structure | Habitat Preferences | Species                  | RD (%) | RF (%) | RDo (%) | IVI (%) |
|----------------------|---------------------|--------------------------|--------|--------|---------|---------|
| Tree                 | Hunting habitat     | Bay tree (*Syzygium polyanthum*) | 19.35  | 14.58  | 55.03   | 88.97   |
| Pole                 | Nesting habitat     | Bay tree (*Syzygium polyanthum*) | 24.11  | 16.13  | 29.25   | 69.49   |
|                      | Hunting habitat     | *Langkap* (*Arenga obtusifolia*) | 40     | 40.63  | -       | 80.63   |
| Stem                 | Nesting habitat     | *Langkap* (*Arenga obtusifolia*) | 85.45  | 50.00  | -       | 135.5   |
| Seedlings            | Hunting habitat     | *Jejerukan* (*Acronychya laurifolia*) | 19.39  | 10.07  | -       | 29.46   |
|                      | Nesting habitat     | *Bayur* (*Pterospermum javanicum*) | 17.65  | 8.11   | -       | 25.76   |

| a Relative density   | b Relative frequency | c Relative dominance | d Important value index |

Hunting and nesting habitats were both dominated by bay trees (*Syzygium polyanthum*) with IVI of 88.97% in hunting habitats and 69.49% in nesting habitats. In the second pole phase the habitat was equally dominated by *langkap* (*Arenga obtusifolia*) with an IVI of 80.63% in the hunting habitat and 135.45% in the nesting habitat. The presence of *langkaps* was preferred by black giant squirrels (*Ratufa bicolor*) because it produced fruit [13]. Existence of diverse fruit trees provided food for JHE’s preys, making it easier for JHEs to hunt in the wild. In addition to producing fruit, *langkap* was invasive so that it threatened the diversity of plants and vegetation in the ecosystem [14], especially in JHE’s nesting habitats. The predominance of *langkaps* in nesting habitat exceeded a hundred percent. This indicated that the nested canopy habitat covered the undergrowth very tightly, that could block the sunlight, resulted in plant incapability to grow to the tree phase.

Based on observation and analysis results, each phase of vegetation in both habitat preferences were significant to support JHE hunting and nesting activities. According to the observation, tree had important roles for both habitat preferences, providing diet and spaces to lay a nest. JHE used tree for nesting and eating its prey [12]. Pole vegetations provided more diet for JHE since they provided nests for black giant squirrel (*Ratufa bicolor*) and weasels (*Paradoxurus hermaphoditus*). Besides providing habitat for JHE’s prey, stem and seedling vegetations would grow to trees which was very important to habitat sustainability for JHE. Accordingly, keeping the balance of vegetation dominance was important to JHE conservation undertaking. The following graphic is a comparison of each vegetation structures dominance in each habitat preferences in TNUK.
Figure 2. IVI comparison of each vegetation structures in each habitat preferences.

Both habitat preferences had different IVI for each phase. The most striking difference of IVI was in pole phase due to the dominance of langkap (*Arenga obtusifolia*). JHE was not seen and not heard in nesting habitat due to the existence of *langkap* that its canopy covered landscape around tightly. Dominance of *langkap* was inhibitory for sunlight penetration towards lower vegetation [14]. The *langkap*’s canopy cover complicated the sight to the above of the canopy. That is in accordance with the result of vegetation analysis which showed that in nesting habitat, *langkap* had IVI more than a hundred percent. Stem in nesting habitat had a greater IVI than that of the hunting habitats IVI. Seedlings in both habitat preferences had a low IVI. Base on those facts, the most important vegetation for JHE in TNUK was trees.

Habitat characteristics was not only seen from the dominance of species (IVI) but also the diversity (H’). Here is the diversity index for each vegetation structure in both habitat preferences.

| Vegetation Structure | Habitat Preferences | H’    | Information      |
|----------------------|---------------------|-------|------------------|
| Tree                 | Hunting habitat     | 2.13  | Moderate diversity |
|                      | Nesting habitat     | 2.48  | Moderate diversity |
| Pole                 | Hunting habitat     | 1.78  | Moderate diversity |
|                      | Nesting habitat     | 0.67  | Low diversity    |
| Stem                 | Hunting habitat     | 2.42  | Moderate diversity |
|                      | Nesting habitat     | 1.96  | Moderate diversity |
| Seedlings            | Hunting habitat     | 2.67  | Moderate diversity |
|                      | Nesting habitat     | 3.09  | High diversity   |

Note : 
H’>3: high diversity, 1<H’<3: moderate diversity, H’<1: low diversity

The seedling phase in hunting and nesting habitats had a relatively higher diversity value than the other phases. Nesting habitats had an H’ of 3.09 which categorized as high diversity, while in the nursery habitat the seedling phase has an H’ 2.67 which categorized as moderate diversity. The tree phase in both habitats was categorized as moderate diversity which were 2.13 in hunting habitats and 2.48 in nesting habitats. The pole phase had the smallest diversity compared to other phases. Hunting habitat had an H’ of 1.78 in the pole phase. The pole phase in the nesting habitat has an H’ of 0.67.
Diversity that tends to be classified as low in the pole phase was due to the presence of an invasive *langkap* (*Arenga obtusifolia*).

The results of observation described a landscape condition for each habitat preferences, meanwhile vegetation analysis described vegetation structures and composition and their role for JHE. The illustration below is a landscape condition within vegetations for each habitat preferences.

**Figure 3** Landscape illustration in hunting habitat(a) and nesting habitat (b).

### 4. Conclusion

This research confirmed the occurrence of JHE in TNUK was in lowland forests with slopes that tend to low slope (3-8%), elevation of 0-100 m above sea level, and close to the tributary of the Cigenter River. This site was found inside the core zone of TNUK. Hunting and nesting habitats were both dominated by bay trees (*Syzygium polyanthum*) with IVI of 88.97% and 69.49%, respectively. Tree dominance was an important factor in determining hunting preferences, while species diversity was an important factor in determining nesting preferences. The characteristics of JHE’s hunting habitat in the order of dominance level (IVI) were dominated by tree (*Syzygium polyanthum*), pole (*Arenga obtusifolia*), stem (*Donax cannaeformis*), and seedling (*Acronychya laurifolia*). The characteristics of nesting habitats in the order of dominance level (IVI) were dominated by vegetation of poles (*Arenga obtusifolia*), trees (*Syzygium polyanthum*), stem (*Donax cannaeformis*) and seedlings (*Pterospemum javanicum*). The highest diversity index (H’) in hunting and nesting habitats were both in the seedling phase with medium diversity (H’ = 2.67) and high diversity (H’ = 3.09), respectively. JHE’s nest found on the top of Kiara (*Ficus gibbosa*) tree which had 40 meters height from the ground. It was possible for JHEs to select any tree species for nesting as long as the trees had canopy model as Rauh architecture. Meanwhile, nesting habitats had a higher diversity index for taller trees than in hunting habitats.
Acknowledgements
Great thanks to Mr. Toru Yamazaki as the President of the Asian Raptor Research and Conservation Network for the opportunity to receive the International Student Grant in the 11th ARRCN International Symposium. The author also would like to thank all TNUK staff for primary data support and guidance on finding the JHE. This research was supported by the Ministry of Research, Technology, and Higher Education of Republic Indonesia under "Penelitian Dasar Unggulan Perguruan Tinggi" fiscal year 2019-2021 (grant number 1/AMD/E1/KP.PTNBH/2020).

References
[1] Prawiradilaga D M 2003 Panduan Survei Lapangan dan Pemantauan Burung-Burung Pemangsa (Jakarta: PT Binamitra Megawarna)
[2] Syartinililia and Tsuyuki S 2008 Biol. Conserv. 141 756
[3] Syartinililia, Tsuyuki S and Lee J S 2009 Gis-Based Habitat Model of Javan Hawk-Eagle (Spizaetus bartelsi) using Inductive Approach in Java Island, Indonesaia Wildlife: Destruction, Conservation and Biodiversity (New York: Nova Publisher) 302-311
[4] Loetsch F, Zohrer E and Heller K E 1973 Forestry Inventory Volume II (Munchen: BLV Verlagssesselhalf)
[5] Soegianto A 1994 Ekologi Kuantitatif (Surabaya: Penerbit Usaha Nasional)
[6] Peterson R 1980 Pustaka Life (Jakarta: Tiara Pustaka)
[7] van Balen S, 1999 Birds on Fragmented Islands: Persistence in the Forests of Java and Bali PhD thesis (Wageningen: Wageningen University)
[8] van Balen S, Nijman V and Prins H T 2000 Biol. Conserv. 96 297
[9] Prawiradilaga D M 1999 Elang Jawa Satwa Langka: Seri Pendidikan Konservasi Keanekaragaman (Jakarta: Pusat Penelitian dan Pengembangan Biologi [P3B] Direktorat Jendral Perlindungan dan Konservasi Alam [DJPHKA] Japan International Cooperation Agency [JICA])
[10] Pradiwiradilaga D M 2006 Ornithol. Sci. 5 177
[11] Murad A R P 2017 Evaluasi Distribusi Habitat Elang Jawa (Nisaetus bartelsi) di Jawa Timur Bachelor thesis (Bogor: IPB University)
[12] Sitorus D N 2016 Studi Habitat dan Perilaku Burung Pemangsa Famili Accipitridae di SPTN 1 Tegaldlimo Taman Nasional Alas Purwo, Jawa Timur Bachelor thesis (Bogor: IPB University)
[13] Haryanto 1997 Media Konservasi Edisi Khusus 95
[14] Schenkel R, Hulliger L and Ramono W S 1978 Malayan Nat. J. 4 253