Assessing potential habitat of Javan Hawk-eagle \textit{(Nisaetus bartelsi)} based on landscape characteristic in Banten Province

R A Suyitno and Syartinilia
Department of Landscape Architecture, IPB University, Indonesia
Email: syartinilia@apps.ipb.ac.id

Abstract. Javan Hawk-eagle is an endangered raptor on natural forest in Java Island, Indonesia. Banten Province has six potential habitat patches based on previous research obtained from the updated of JHE habitat suitability models. The objectives of this study were to obtain landscape characteristics of potential habitat and to compare it to actual habitat characteristic based on literatures review. Data was collected through ground check activities and interviewed the key informants. Landscape characteristics were assessed through gap analysis between potential and actual habitat. Several information includes land cover, landform, slope, elevation, nest vegetation, corridor movement; human activity intensity, river, and home range were used for this study. Five levels of gap found between potential to actual habitat patches were determined from this analysis. Result showed that two patches were the highest potential, which were Mt. Karang and Mt. Aseupan in Pandeglang district. Three patches high potential (Gunung Tukung Gede Nature Reserve, Mt. Pulosari, and Mt. Honje), then one patch (South Coast) was moderately potential. Forest has dominated in six potential habitat patches with total area of 136.35 km$^2$ (71.09 %). Only three potential habitat patches (Mt. Pulosari, Mt. Karang, Mt. Aseupan) were located in the protected forest which is covered about 20.84 km$^2$ (9.54%). Six potential habitats JHE should be monitored continuously, increased the landscape quality, and offered conservation activities.

1. Introduction

Javan Hawk-eagle, JHE \textit{(Nisaetus bartelsi)} is an endemic raptor of tropical rainforest on Java Island. JHE is one of the non-migratory birds of prey which is the top-predator \cite{1}. This bird acts as an indicator species to determine the dysfunction of ecosystems like landscape quality degradation, besides that the JHE is also known as a keystone species. Based on the IUCN Red List of Threatened Species and KEPRES No.4 / 1993 JHE is included as endangered species. The estimation of this endangered species (JHE) based on The IUCN Red List of Threatened Species is caused by several factors, namely damage, disturbance, and degradation in habitat preferences. SK Dirjen PHKA No. 200 / IV / KKH / 2015 establish JHE as one of the endangered animals that are prioritized to increase its population by 10% in 2015-2019 according to biological conditions and habitat availability.

Habitat is a place to meet the needs of an organism such as living space, food, and shelter \cite{2}. JHE habitat is known to be in tropical rain forests from an altitude of 0 to 3000 masl \cite{3}. However generally, the existence of JHE is concentrated at an altitude of 500 to 2000 masl \cite{4}. Elevation, slope, NDVI, and auto-covariate are the environmental variable to obtain the prediction model of habitat distribution for JHE \cite{1}. However, the existence of the JHE is now endangered due to habitat destruction and illegal trade \cite{5}. Habitat damage includes deforestation and land fragmentation that occurs in Java Island. Besides, illegal hunting and animals trading have caused the number of JHE to decrease in the wild.
Banten is a province located in the west part of Java Island which is a habitat for JHE. JHE habitat is divided into two types of habitats; there are the actual habitat and the potential habitat that is located in the highland forest and lowland forest in Java Island. Actual habitats are habitats that have characteristics of physical, biotic and social components that support the survival of an animal, while potential habitats are habitats that have a similar level of suitability to the actual habitat [6]. Mount Honje which is located in Ujung Kulon National Park, Mount Aseupan and Mount Karang is an area that is known as the potential habitat of JHE in Banten Province [7]. Mount Honje and Mount Aseupan are two of four JHE potential habitat patches that have been declared isolated from other habitat patches, with a distance of more than 50 km from the other JHE habitat patches [7]. Banten Province has potential habitat patches obtained from the update of the JHE habitat suitability model in Banten Province [8].

Updating information about JHE's potential habitat in Banten Province was carried out to validate the existing potential habitats and their characteristics. The objectives of this study were to obtain potential habitat characteristics then compare it to actual habitat characteristics based on literature reviews. The purpose of this study was to provide basic information as a guideline for decision-makers to design the development plan in line with JHE conservation.

2. Methods
2.1. Materials
This research was conducted in Banten Province; Java, Indonesia (Figure 1). Banten Province is geographically located at the astronomical boundary of 105°1’11″ - 106°7’12″ East Longitude and 5°7’50″ - 7°1’1″ South Latitude, with an area of 9662.92 km². Banten Province consists of eight classes of land cover; there were water bodies, forests, developed land, natural (grassland, savanna, etc) or non-natural (man made open land for public or private use) open land, plantations, swamps, rice fields, and clouds. The land cover class that dominated in Banten Province was forest by 30.51% (2857.2 km²). The elevation in Banten Province ranges from 0 to more than 1800 masl. Elevation of 200-400 masl has the largest area of 6979.61 km² (74.76%), while elevation more than 1800 masl has only 21.59 km² (0.23%). The slope in Banten Province is from flat to very steep. The slope of 3-8% has the largest area of 330.82 km² (39.10%), while slope more than 45% only 9.66 km² (1.14%).

Figure 1. Study Area
The study was conducted in several locations known as potential habitats for JHE based on an updated model of habitat suitability of JHE in Banten Province. This research used some tools such as stationeries, digital camera, GPS (Global Positioning System), and binoculars. Data processing was using four applications such as Microsoft Office software, ArcGIS 10.3, and Erdas Imagine 2015.

2.2. Methods

2.2.1. Analysis of the JHE Actual Habitat Characteristics. Analysis of the actual habitat characteristics was carried out through literature reviews by gathering various information about the characteristic of the actual habitat based on previous research that has been done and published. References used in publications in the range 1998 to 2017. The results of this analysis then become a reference for the characteristics of the JHE potential habitat assessment in Banten Province.

2.2.2. Analysis of the JHE Potential Habitat Characteristics. The characteristic of the potential habitat was obtained based on ground truth checked and key informants’ interview. Ground truth checked were carried out to check the landscape characteristics and several information regarding JHE existence in potential habitat patches. Potential habitat patches in Banten Province were identified in the update of the JHE habitat suitability model in Banten Province [8]. Patches that were identified in the model include Mount Pulosari, Mount Karang, Mount Aseupan and patch Citorek. Then, potential habitat patches were also made at several locations that were not identified in the update of the JHE habitat suitability model in Banten Province. There was Gunung Tukung Gede Nature Reserve, Mount Honje in Ujung Kulon National Park, and lowland forest on the southern coast of Banten Province. In this analysis, validation of JHE potential habitat patches was based on the results of the ground truth checked and interview activities on each patch. Ground-truth checked was carried out from July to August 2018 in potential habitat patches. Then, the distribution of JHE potential habitat was overlying with a protected forest to find out which patch area of potential habitats located in the protected forest. Also at this validation stage, an overlay with a land cover map was carried out to determine the land cover in the potential habitat patches. Potential habitat patches in Banten Province can be seen in Table 1.

| Patch Number | Location                                        | Status               | Patch Area (km²) |
|--------------|-------------------------------------------------|----------------------|------------------|
| 1            | Gunung Tukung Gede Nature Reserve               | CF                   | 54.53            |
| 2            | Mount Pulosari                                  | PF/PPF              | 19.52            |
| 3            | Mount Aseupan                                   | PF/CF/LPF/PPF       | 87.01            |
| 4            | Mount Karang                                    | PF/LPF/PPF          | 38.19            |
| 5            | Mount Honje (Ujung Kulon National Park)         | CF                   | 143.22           |
| 6            | Southern Coast of Banten Province               | LPF                  | 18.49            |
| 7            | Citorek (Mount Halimun Salak National Park)     | CF                   | 319.72           |
| **Total Area**| **Area of JHE potential habitat patches in Banten Province** |                      | **680.68**       |

Note: Protected Forest (PF), Limited Production Forest (LPF), Permanent Production Forest (PPF), Conservation Forest (CF)

2.2.3. Analysis of the JHE Potential and Actual Habitats Comparison. The potential and actual habitats was compared using the GAP analysis. This analysis was carried out to identify the gap between the characteristics of the actual and potential habitat of the JHE in Banten Province. Potential habitat patches assessment was based on the suitability between characteristics of the actual habitat that have been obtained in the previous analysis. The results of the potential habitat assessment on each characteristic than classified the result based on a Likert scale. Scoring was given on a scale of 1 to 5 (low to high potential). Then, total score was categorized into 5 levels of gap, namely the lowest potential (9 – 16.1), low potential (16.2 – 23.3), moderate potential (23.4 – 30.5), high potential (30.6 – 37.7), and the highest potential (37.8 – 45). The assessment was based on the characteristics of the actual habitat of the JHE.
that has been obtained. These characteristics included land cover (X1), landform (X2), slope (X3), elevation (X4), nest vegetation (X5), corridor movement (X6), human activity intensity (X7), river (X8), and home range (X9). After evaluating the characteristics, a class range calculation was then performed to determine the characteristic categories for each potential habitat patch. The class range (R) was calculated by the following formula in Eq. (1) and for the detail calculation can be seen in Table 2 and Table 3.

\[ R = \frac{S_{\text{max}} - S_{\text{min}}}{K} \]  

(1)

**Table 2. Specified characteristic class range calculation**

| No | Characteristic    | Specification                        | Xmin | Xmax | Smin | Smax | Range |
|----|-------------------|--------------------------------------|------|------|------|------|-------|
| 1  | Land cover        | Primary forest                        | 1    | 5    | 4    | 20   | 3.2   |
|    |                   | Secondary forest                      | 1    | 5    |      |      |       |
|    |                   | Production forest                     | 1    | 5    |      |      |       |
|    |                   | Cultivated land                       | 1    | 5    |      |      |       |
| 2  | Landform          | Mountainous                           | 1    | 5    | 3    | 15   | 2.4   |
|    |                   | Hilly                                | 1    | 5    |      |      |       |
|    |                   | Flat                                 | 1    | 5    |      |      |       |
| 3  | Slope             | Steep slope                           | 1    | 5    | 1    | 5    | 0.8   |
| 4  | Elevation         | 0-3000 masl                           | 1    | 5    | 2    | 10   | 1.6   |
|    |                   | Highland >1000 masl                   | 1    | 5    |      |      |       |
| 5  | Nest vegetation   | Emergent tree                         | 1    | 5    | 4    | 20   | 3.2   |
|    |                   | Open canopy                           | 1    | 5    |      |      |       |
|    |                   | Model vegetation architecture "rauh" | 1    | 5    |      |      |       |
|    |                   | Dead or leafless                      |      |      |      |      |       |
| 6  | Corridor movement | Tree corridor                         | 1    | 5    | 2    | 10   | 1.6   |
|    |                   | Non-tree corridor                     |      |      |      |      |       |
| 7  | Human activity    | Hunting area, high human activity     | 1    | 5    | 2    | 10   | 1.6   |
|    | intensity         | intensity                             |      |      |      |      |       |
|    |                   | Breeding area, low human activity     |      |      |      |      |       |
|    |                   | intensity                             |      |      |      |      |       |
| 8  | River             | The nest near the river flow          | 1    | 5    | 1    | 5    | 0.8   |
| 9  | Home range        | Primary forest                        | 1    | 5    | 2    | 10   | 1.6   |
|    |                   | Secondary forest                      |      |      |      |      |       |

*a Score minimum; b Score maximum; c Total score minimum; d Total score maximum.

**Table 3. Characteristic class range calculation**

| No | Characteristic    | Xmin | Xmax | Smin | Smax | Range |
|----|-------------------|------|------|------|------|-------|
| 1  | Land cover        | 1    | 5    | 9    | 45   | 7.2   |
| 2  | Landform          | 1    | 5    |      |      |       |
| 3  | Slope             | 1    | 5    |      |      |       |
| 4  | Elevation         | 1    | 5    |      |      |       |
| 5  | Nest vegetation   | 1    | 5    |      |      |       |
| 6  | Corridor movement | 1    | 5    |      |      |       |
| 7  | Human activity    | 1    | 5    |      |      |       |
| 8  | River             | 1    | 5    |      |      |       |
| 9  | Home range        | 1    | 5    |      |      |       |

*a Score minimum; b Score maximum; c Total score minimum; d Total score maximum.
3. Results and discussion

3.1. Characteristic of the Actual Habitat for JHE

Characteristics of the actual habitat for JHE were obtained from study literature based on previous research. The characteristics actual habitat of JHE can be seen in Table 4.

| Table 4. Characteristic actual habitat of JHE in Banten Province |
|-----------------|----------------|-----------------|
| No   | Characteristic       | Specification                          | Location                                                                                     | Source |
|------|---------------------|----------------------------------------|------------------------------------------------------------------------------------------------|--------|
| 1    | Land cover          | Primary forest (undisturbed natural forest) | TNGHS; TNGP; Telaga Warna Nature Reserve; TWA Telaga Warna; TWA Jember; Ciamis, West Java; Banten and South Coast Java Island. | [3]; [7]; [8]; [9]; [10]; [11]; [12]; [13]; [14] |
|      |                     | Secondary forest (disturbed natural forest) | TNGHS; TNGP; Telaga Warna Nature Reserve; TWA Telaga Warna; TWA Jember; Ciamis, West Java; Banten and South Coast Java Island. | [1]; [7]; [9]; [10]; [11]; [12]; [14]; [15]; [16] |
|      |                     | Production forest (woodland, tree plantations, etc) | TNGP; TNAP; TWA Telaga Warna; TWA Jember; Ciamis, West Java; Banten and South Coast Java Island. | [9]; [8]; [15]; [17] |
|      |                     | Cultivated land (grassland, agricultural land, rice field, etc) | TNGHS; TNGP; Telaga Warna Nature Reserve; TWA Telaga Warna; TWA Jember. | [10]; [12]; [15]; [16] |
| 2    | Landform            | Mountainous                            | TNGP; Central Java and DIY; Ciamis, West Java. | [3]; [7]; [9]; [14]; [18] |
|      |                     | Hilly                                  | TNGP; TNGHS; Telaga Warna Nature Reserve; Ciamis, West Java. | [3]; [7]; [9]; [11]; [14]; [19] |
|      |                     | Flat                                   | TNAP; Banten and South Coast Java Island; Ciamis, West Java. | [8]; [9]; [15]; [16]; [17] |
| 3    | Slope               | Steep slope                            | TNGP; TNGHS; Central Java and DIY; Ciamis, West Java; Banten and South Coast Java Island. | [7]; [8]; [9]; [13]; [14]; [16]; [18]; [20] |
| 4    | Elevation           | 0-3000 masl                            | TNGP; TNGHS; Ciamis, West Java. | [3]; [9]; [13]; [15]; [20] |
|      |                     | Highland >1000 masl                    | TNGP; Telaga Warna Nature Reserve; TWA Telaga Warna; TWA Jember | [9]; [13]; [15]; [20]; [11]; [12]; [14] |
| 5    | Nest vegetation     | Emergent tree                          | TNGP; TNGHS; TNAP; Cibulao Nature Reserve; Ciamis, West Java; Central Java and DIY. | [8]; [9]; [13]; [17]; [18]; [19]; [21] |
|      |                     | Open canopy                            | Central Java and DIY. | [18] |
|      |                     | Model vegetation architecture “rauh”   | TNAP. | [17] |
### Table 4. Characteristic actual habitat of JHE in Banten Province

| No | Characteristic                  | Specification                             | Location                                                                 | Source          |
|----|---------------------------------|-------------------------------------------|-------------------------------------------------------------------------|-----------------|
| 5  | Nest vegetation                 | Dead or leafless                          | TNGP; TNGHS; Cibulao Nature Reserve; Central Java and DIY.              | [18]; [21]      |
| 6  | Corridor movement               | Tree corridor                             | Central Java and DIY.                                                  | [18]            |
|    |                                 | Non-Tree corridor                         |                                                                         |                 |
| 7  | Human activity intensity        | Hunting area, high human activity intensity | TNGHS; Ciamis, West Java.                                              | [9]; [20]       |
|    |                                 | Breeding area, low human activity intensity| TNGP; TNGHS.                                                           |                 |
| 8  | River                           | The nest near the river flow              | TNGHS; TNGP; Cibulao Nature Reserve; Ciamis, West Java; Banten and South Coast Java Island. | [8]; [12]; [21]|
| 9  | Home range                      | Primary forest                            | TNGP; TNGHS.                                                           |                 |
|    |                                 | Secondary forest                          |                                                                         |                 |

Note: Ujung Kulon National Park (TNUK), Mount Halimun Salak National Park (TNGHS), Gede Pangrango National Park (TNGP), Alas Purwo National Park (TNAP), Telaga Warna Nature Park (TWA Telaga Warna), Jember Nature Park (TWA Jember)

3.2. Landscape Characteristic of the JHE Potential Habitat. Based on ground truth checked, we found that patch 7 (Citorek in Mount Halimun Salak National Park) had been identified as an actual habitat patch for JHE in Banten Province. So, there were only six potential habitat patches were located in lowland rain forests on the hilly or mountainous with an elevation between 200 to 1800 masl. The slope on the six patches indicated that the patch was on a flat slope to a very steep slope. Then, there was nest vegetation in the six patches of potential habitat that was similar to the actual habitat. Landscape characteristics of potential habitat patches can be seen in Table 5 and Figure 2.

### Table 5. Potential habitat patches (validation)

| Patch Number | Location               | Area (km²) | Status | Validation Result | Type of Threats |
|--------------|------------------------|------------|--------|-------------------|-----------------|
| 1            | Gunung Tukung Gede     | 54.53      | CF     | 200-400 masl      | A2/B            |
|              | Nature Reserve         |            |        | 25 until > 45%    |                 |
|              |                        |            |        | Schima wallichii  |                 |
| 2            | Mount Pulosari         | 19.52      | PF/PPF | 200-1800 masl     | B               |
|              |                        |            |        | 15 until > 45%    |                 |
|              |                        |            |        | Schima wallichii  |                 |
| 3            | Mount Aseupan          | 87.01      | PF/CF/LPF/PPF | 200-1800 masl   | B               |
|              |                        |            |        | 15 until > 45%    |                 |
|              |                        |            |        | Schima wallichii  |                 |
|              |                        |            |        | and Altingia excelsa |               |
Table 5. Potential habitat patches (validation)

| Patch Number | Location          | Area (km²) | Status     | Validation Result | Type of Threats |
|--------------|-------------------|------------|------------|-------------------|-----------------|
| 4            | Mount Karang      | 38.19      | PF/LPF/PPF | 200 until >180 0 masl, 15 until >45% | Schima wallichii and Altingia excelsa, B |
| 5            | Mount Honje (TNUK) | 143.22     | CF         | 200-800 masl, 8 until >45% | Schima wallichii, B |
| 6            | South Coast       | 18.49      | LPF        | 200-400 masl, 0 until 25% | Schima wallichii, A1/B |

Note: Protected Forest (PF), Limited Production Forest (LPF), Permanent Production Forest (PPF), Conservation Forest (CF), A1 (illegal logging), A2 (land conversion), A3 (facility development), B (trade), C (natural disaster)

Figure 2. Landscape characteristic of potential habitat patches (a) Gunung Tukung Gede Nature Reserve, (b) Mount Pulosari, (c) Mount Aseupan, (d) Mount Karang, (e) Mount Honje (Ujung Kulon National Park), (f) South Coast

An overlay between potential habitat patches of JHE in Banten Province [8] with a protected forest map, three habitat patches were located in a protected forest. Three potential habitat patches that were in a protected forest, there were patch 2 (Mount Pulosari), patch 3 (Mount Aseupan), and patch 4 (Mount Karang) in Pandeglang. Habitat patches that were in the protected forest were 20.84 km² (9.54%), while 197.58 km² (90.46%) in the outside. The result of overlaying a potential habitat patch with a land cover map obtained JHE potential habitat patches that dominated by forest with an area of 136.35 km² (71.09%).

Threats in JHE potential habitat patches were caused by the development of road infrastructure, illegal mining, and animal hunting. Then, some of JHE's potential habitat patches have another problem, its location which was isolated from the actual habitat patch due to landcover between patches that were already dominated by plantations, paddy fields or developed areas. There were patch 1 (Gunung Tukung
Gede Nature Reserve) in Serang, patch 2 (Mount Pulosari), patch 3 (Mount Aseupan), patch 4 (Mount Karang), and patch 5 (Mount Honje) in Pandeglang.

JHE habitat is in primary forest, secondary forest and production forest with hunting areas on cultivated land ([3], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17]). This proves that the habitat of JHE is in the forest cover. The result of overlaying a potential habitat patch with a land cover map obtained JHE potential habitat patches that were on a forest land cover with an area of 136.35 km$^2$ (71.09%), fields with an area of 17.16 km$^2$ (8.95%), plantations with an area of 6.34 km$^2$ (3.30%). This proves that the most important characteristic of JHE habitat was the presence of forests, both upland and lowland forests. Vegetation that was suitable to meet the needs of JHE in survival and breeding was vegetation with characteristics emergent tree and model vegetation architecture “rauh”. For example in nest vegetation of JHE in Mount Halimun Salak National Park was Rasamala (*Altingia excelsa*), Puspa (*Schima wallichii*) dan Tungurut (*Castanopsis tungurut*) [22]. Therefore, it can be said that JHE choose forests with diverse or heterogeneous vegetation types to survive and to breed. Three potential habitat patches that were in a protected forest, there were patch 2 (Mount Pulosari), patch 3 (Mount Aseupan), and patch 4 (Mount Karang) in Pandeglang. Habitat patches that were in the protected forest was 20.84 km$^2$ (9.54%), while 197.58 km$^2$ (90.46%) was in the outside.

3.3. Comparison of the JHE Potential and Actual Habitats

Landscape comparison of JHE potential habitats in Banten Province with actual habitat was carried out in six potential habitat patches. Nine characteristics of actual habitat were used in this analysis. Characteristics of the actual habitat for JHE based on previous researches include landcover, landform, slope, elevation, nest vegetation, corridor movement, human activity intensity, rivers, and home range. Assessment of characteristic potential habitat of JHE can be seen in Table 6, while the map can be seen in Figure 3.

| Patch                          | Characteristic$^a$ | Total Score$^b$ | Potential Level |
|-------------------------------|-------------------|-----------------|----------------|
| Patch 1 (Gunung Tukung Gede Nature Reserve) | X1 X2 X3 X4 X5 X6 X7 X8 X9 | 36 | High |
| Patch 2 (Mount Pulosari)      | 3 3 5 4 5 4 4 5 3 | 37 | High |
| Patch 3 (Mount Aseupan)       | 3 3 5 5 4 4 5 5 3 | 39 | Highest |
| Patch 4 (Mount Karang)        | 3 3 5 5 4 5 5 5 3 | 40 | Highest |
| Patch 5 (Mount Honje)         | 3 3 4 4 5 4 5 3 3 | 35 | High |
| Patch 6 (South Coast)         | 3 3 2 3 3 3 4 3 3 | 35 | Moderate |

$^a$ Characteristic (X1 = Land cover; X2 = Landform; X3 = Slope; X4 = Elevation; X5 = Nest vegetation; X6 = Corridor movement; X7 = Human activity intensity; X8 = River; and X9 = Home range)

$^b$ Total Score (9 – 16.1 = lowest potential; 16.2 – 23.3 = low potential; 23.4 – 30.5 = moderate potential; 30.6 – 37.7 = high potential; 37.8 - 45 = highest potential)
Figure 3. Assessment of JHE potential habitat patches in Banten Province

Potential habitat patches in this study basically was the continuation of JHE researches that started in 2008 [14] until 2017 [8]. Then we found out that the actual habitat patches in Banten province beside patch 7 (Citorek in Mount Halimun Salak National Park) was Ujung Kulon National Park especially near Cigenter river [23]. JHE potential habitat in Banten Province consisted of patch 1 (Gunung Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), patch 3 (Mount Aseupan), patch 4 (Mount Karang), patch 5 (Mount Honje), and patch 6 (South Coast). JHE habitat in Banten Province was in Ujung Kulon National Park, Mount Aseupan, Mount Karang, and Mount Halimun Salak National Park ([1], [7], [8], [16]). Based on the results of a survey in 1980-1999 in Mount Karang and Mount Aseupan there were 1-2 pairs of JHE [7]. Based on the results of assessments that had been carried out on JHE potential habitat patches in Banten Province, patch 3 (Mount Aseupan) and patch 4 (Mount Karang) were the highest potential with the actual habitat of JHE. Based on ground truth checked, the landscape characteristics on patch 3 (Mount Aseupan) and patch 4 (Mount Karang) had already resembled the actual habitat of the JHE. The actual habitat of JHE was located in the highland forest, such as Cikaniki in Mount Halimun Salak National Park Region III Sukabumi, West Java.

Landscape characteristics of JHE potential habitats such as altitude, slope, and vegetation on patch 3 (Mount Aseupan) and patch 4 (Mount Karang) had already resembled the actual habitat of JHE. The elevation of the two patches reached an altitude of more than 1800 masl with a slope of more than 45%. Puspa (Schima wallichii) and Rasamala (Altingia excelsa) were also found on these two patches. This proves that potential habitats in patch 3 (Mount Aseupan) and patch 4 (Mount Karang) the landscape characteristics were very suitable but information on the existence of JHE on this patch is still unknown. However, based on the results of interviews with forest rangers, it has been known that there was eagle species that resembled JHE but the truth was uncertain.

Then, patch 1 (Gunung Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), and patch 5 (Mount Honje) were high potential with actual habitat of JHE. This showed that patch 1 (Gunung Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), and patch 5 (Mount Honje) had characteristics that almost resembled the actual habitat of the JHE. The survey locations from 1980 to 1999 included Mount Pulosari but the survey results showed that there was no JHE was found at that location [7]. JHE habitat
in Banten Province was in the Ujung Kulon National Park ([1], [7], [8], [16]). The number of pairs of JHE was around 3 to 4 pairs in Mount Honje, Ujung Kulon National Park ([7], [16]).

Patch 1 (Gunung Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), and patch 5 (Mount Honje) had characteristics that almost resembled the actual habitat of the JHE. Landscape characteristics of JHE potential habitats such as altitude, slope, and vegetation on patch 1 (Gunung Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), and patch 5 (Mount Honje). The elevation of the three patches reached an altitude of more than 1800 masl with a slope of more than 45%. Puspa (Schima wallichii) was found on these three patches. This proves that in patch 1 (Gunung Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), and patch 5 (Mount Honje) the landscape characteristics were suitable. But in reality, the existence of JHE in all three patches is still unknown. This can occur because of the reduced quality of the landscape in the three patches caused by human activities, such as gardening, farming or collecting wood for fuel. Besides, the location of these patches that were not connected with other patches could also be a factor in the presence of JHE on the patch.

The results of the assessment that have been carried out on JHE's potential habitat patches in Banten Province have the benefit of being basic information about suitable locations for JHE release activities, although these patches still need more management program before release activities implementations. JHE release activity in potential habitat patches aims to expand the distribution of JHE in habitat patches on Java and as an effort to prevent the overpopulation of JHE in several habitat patches. Besides, this is also the effort to increase the JHE population following SK Dirjen PHKA No. 200 / IV / KKH / 2015 which establishes the JHE as one of the endangered animals that are prioritized to increase its population by 10% in 2015-2019 according to biological conditions and habitat availability.

4. Conclusion
This study succeeded in obtaining basic information about the landscape characteristics of the JHE's actual habitat from study literature related to the JHE from 1998 to 2017, there were land cover, landform, slope, elevation, nest vegetation, corridor movement, human activity intensity, rivers, and home range. Banten Province has 6 potential habitat patches. These patches were patch 1 (Mount Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), patch 3 (Mount Aseupan), patch 4 (Mount Karang), patch 5 (Mount Honje), patch 6 (South Coast). Two patches were the highest potential (patch 3 (Mount Aseupan) and patch 4 (Mount Karang)), three patches were high potential (patch 1 (Gunung Tukung Gede Nature Reserve), patch 2 (Mount Pulosari), and patch 5 (Mount Honje)), then one patch was moderately potential (patch 6 (South Coast)). JHE potential habitat patches land cover was 71.09% (136.35 km²) forest, 8.95% (17.16 km²) fields, and 3.30% (6.34 km²) plantations. Then, three habitat patches (patch 2 (Mount Pulosari), patch 3 (Mount Aseupan), and patch 4 (Mount Karang)) that were in the protected forest were 20.84 km² (9.54%), while 197.58 km² (90.46%) in the outside. This study recommends for intense future survey in the six potential habitat patches in order to facilitate the JHE release activities in Banten Province. Then, forest conservation and program activities based on SK Dirjen PHKA No. 200 / IV / KKH / 2015 to support JHE conservation has also been recommended to be conducted on six potential habitat patches.

Acknowledgements
The authors would like to thank Mr. Toru Yamazaki as President of Asian Raptor Research and Conservation Network for the opportunity to receive International Student Grant in the 11th ARRCN International Symposium. 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] Syartinilia, Tsuyuki S and Lee J S 2009 Gis-Based Habitat Model of Javan Hawk-Eagle (Spizaetus bartelsi) using Inductive Approach in Java Island, Indonesia Wildlife: Destruction, Conservation and Biodiversity (New York: Nova Publisher) 302-311
[2] Beck T 2013 Principal of Ecological Landscape Design (Washington: Island Press)
[3] Nijman V and SÖzer R 1998 Forktail. 14 13 – 16
[4] Rakhman Z 2012 Garuda Mitos dan Faktanya di Indonesia (Jakarta: Raptor Indonesia)
[5] Birdlife International 2001 Threatened Birds of Asia: The Birdlife International Red Data Book (Cambridge: Birdlife International Cambridge)
[6] Ribai, Alikodra H S, Masu’ud B and Rahmat U M 2015 Media Konservasi 20 108
[7] van Balen S, Nijman V and Prins H T 2000 Biol. Conserv. 96 297
[8] Syartinilia, Makalew A D N and Mulyani Y A 2017 Kajian ekologi lanskap pada habitat Sikep-madu asia dan Elang Jawa untuk menunjang pelestarian spesies prioritas dan indikator lingkungan International Strategic Research Report (Bogor: IPB University)
[9] Cahyana A N 2009 Pemodelan spasial habitat elang jawa (Spizaetus bartelsi Stresemann, 1924), elang hitam (Ictinaetus malayanus Temminck, 1822) dan elang-ular bido (Spilornis cheela Latham, 1790) dengan menggunakan sistem informasi geografis di kabupaten Ciamis bagian Utara Bachelor Thesis (Bogor: IPB University)
[10] Gjershaug J O, Røv N, Nygåd T, Prawiradilaga D M, Afianto M Y, Hapsoro and Supriatna A 2004 J. Raptor. Res. 38 343
[11] Kaneda H, Prawiradiyaga D M and Yamagishi S 2007 J. Raptor. Res. 41 68
[12] Kuswandono 2010 Analisis kesenjangan dalam pelestarian elang jawa (Spizaetus bartelsi) MSc Thesis (Bogor: IPB University)
[13] Nijman V, van Balen S and SÖzer R 2000 100 125
[14] Syartinilia and Tsuyuki S 2008 Biol. Conserv. 141 756
[15] Nijman V and van Balen S 2003 J. Ornithol. 144 451
[16] van Balen, S, Nijman V and SÖzer R 2001 Contrib. Zool. 70 161
[17] Sitorus D N and Herwono J B 2016 Media Konservasi 21 278
[18] Nurfatimah C 2017 Pengelolaan lanskap terintegrasi pada jejaring koridor habitat elang jawa (Nisaetus bartelsi) di Jawa bagian Tengah MSc Thesis (Bogor: IPB University)
[19] Widodo T 2004 Populasi dan wilayah jelajah elang jawa (Spizaetus bartelsi Stresemann, 1924) di Gunung Kendeng resort Cikaniki Taman Nasional Gunung Halimun Bachelor Thesis (Bogor: IPB University)
[20] Cahyana A N 2015 Pemodelan spasial kesesuaian habitat elang jawa (Nisaetus bartelsi Stresemann, 1924) di Taman Nasional Gunung Halimun-Salak MSc Thesis (Bogor: IPB University)
[21] Prawiradilaga D M 2006 Ornithol. Sci. 5 177-186
[22] Murad A R P 2017 Evaluasi distribusi habitat elang jawa (Nisaetus bartelsi) di Jawa Timur Bachelor Thesis (Bogor: IPB University)
[23] Fahmi I 2019 Studi karakteristik lanskap dan preferensi habitat elang jawa (Nisaetus bartelsi) pada hutan dataran rendah di Taman Nasional Ujung Kulon Bachelor Thesis (Bogor: IPB University)