Determination of birdwatching tourism locations for red-knobbed hornbill (*Rhyticeros cassidix*) around lake Lindu, Lore Lindu National park, central Sulawesi

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Abstract. Red-knobbed Hornbill (*Rhyticeros cassidix*) is a Sulawesi endemic hornbill. This bird is a species of bird that was used as a mascot by Lore Lindu National Park. Red-knobbed Hornbill population is spread in almost the entire Lore Lindu National Park area, especially around Lake Lindu. Lake Lindu is a lake located in the Enclave Lindu region, located in the utilization zone and the rehabilitation zone of the Lindu Resort, Lore Lindu National Park. The conditions around the lake are highland rainforest and settlement. Red-knobbed hornbills are generally easy to find in forest areas around lakes or settlements. Red-knobbed Hornbill has the potential as an object of natural tourist attraction, especially for special ecotourism or birdwatching, therefore it is necessary to know locations that have a high frequency of attendance. The purpose of this study was to determine the distribution of Red-knobbed Hornbills around Lake Lindu. Retrieval of data using the point count method combined in a transect line that is placed scattered around Lake Lindu. Data collection includes the number of Red-knobbed Hornbill individuals, habitat, time of attendance, and access from the settlement. Determination of birdwatching locations based on the results of scoring the number of individuals, habitats, and access from settlements. The results showed that there were eight Red-knobbed Hornbill monitoring locations around Lake Lindu. Red-knobbed Hornbill is active from 6:00 to 10:00 and 14:00 to 18:00. The presence of feed trees (*Ficus sp.*) Affects the level of the presence of Red-knobbed Hornbill. The research is expected to be used as input for management of birdwatching tours around Lake Lindu.

1. Introduction

Red-knobbed Hornbill (*Rhyticeros cassidix*) is a Sulawesi endemic hornbill. This bird is a type of bird that is protected by law and has a vulnerable status by the IUCN. Red-knobbed Hornbill is a type of hornbill that can be easily distinguished for males and females, where male birds and females have very different morphological characteristics. The difference lies in the color pattern. The color of feathers and knobs (horns) can be used as a differentiator. Male birds have red knobs and are large. The fur on the male's neck is brownish-white with a slight brown color at the top of his neck. Black body plumage and white tail feathers. Whereas in females, it is almost the same as males, except that the yellow knob is relatively smaller, with black neck feathers becoming one color with the body.
Red-knobbed Hornbill has habitat in tropical rain forests that have heights of up to 2000-m asl and are scattered throughout the island of Sulawesi and surrounding small islands [1]. One of the Red-knobbed Hornbill habitats is Lore Lindu National Park, Central Sulawesi.

Lore Lindu National Park is a national park in Indonesia located in the province of Central Sulawesi and one of Sulawesi’s biological protection sites. Lore Lindu National Park is located about 60 kilometers south of Palu City and is located between 119° 90’-120° 16’ in the east and 1° 8’-1° 3’ in the south. Compared to other national parks in Indonesia, of moderate size, this National Park officially covers an area of 217,991.18 ha (about 1.2% of Sulawesi, covering an area of 189,000 km² or 2.4% of Sulawesi’s remaining 90,000 km²) with varying heights between 200 and 2610 meters above sea level. The National Park consists mostly of the mountain and sub-mountain forests (± 90%) and a small portion of lowland forests (± 10%). Lore Lindu National Park has endemic fauna and flora of Sulawesi as well as an attractive natural panorama because it is located on the Wallace line which is a transitional area between the Asian and Australian zones.

The Lore Lindu National Park area has high potential as a habitat for various species of birds because the Lore Lindu National Park is one of the areas that is an important location for birds or IBA (Important Birds Areas) [2]. Important Birds Areas (IBA) is a program that seeks to designate a location as an important habitat for bird populations globally. The designated locations are mostly included in conservation areas in a country, but some are not conservation areas and are regulated according to the country concerned. Determination of an area in the IBA based on international agreements which is divided into four criteria, namely A1 (protection of species that have a high threat globally), A2 (protection for endemic species with limited populations), A3 (protection in areas that are a habitat for birds both settlers and migrants / migratory birds at a certain time) and A4 (protection of wetlands that serve as habitat for waterbirds and seabirds) [3]. The Lore Lindu National Park area is included in areas that have A1 and A2 criteria [2].

Lake Lindu is a lake located in the Enclave Lindu region, the utilization zone, and the rehabilitation zone of the Lindu Resort, Lore Lindu National Park. This lake has an area of 3488 ha with an altitude of 986 asl. Lake Lindu is located in the enclave and Lore Lindu National Park area. The conditions around the lake are highland rainforest and settlement. Lake Lindu is an important area for various species of birds in the Lore Lindu National Park. Lake Lindu has the potential to be developed as a special interest tourism location, birdwatching. Birdwatching is a form of nature tourism which since the 2000s has continued to be developed in Indonesia [4]. The development of birdwatching tourism in Indonesia is a breakthrough for regions that are continuing to improve their tourism assets. The area around Lake Lindu is largely an enclave, which is an area within the national park area, where the area is not a conservation area. In general, enclaves are pockets of settlements within the national park area. The existence of the community inside the national park needs to get attention and assistance in conservation activities. The community needs to be involved and participate in efforts to manage conservation areas (protection, use, and preservation). One such effort is the development of natural tourism. The development of natural tourism requires the support of many parties. Community as residents (native) has the role and potential to support it. An example is in birdwatching tours that require a guide to enter dense forest areas such as in the area around Lake Lindu, Lore Lindu National Park.

Red-knobbed Hornbill is one of the endemic birds in Lore Lindu National Park. Red-knobbed Hornbill is a species of bird that was used as a mascot by Lore Lindu National Park. Its population is spread in almost the entire Lore Lindu National Park area, especially around Lake Lindu. Red-knobbed Hornbill has the potential as an object of natural tourist attraction, especially for special ecotourism or birdwatching, therefore it is necessary to know locations that have a high frequency of attendance as observation locations. Determination of the location of observations of Red-knobbed Hornbill needs to be known and determined to monitor the population. The purpose of this study was to determine the distribution of Red-knobbed Hornbills around Lake Lindu and to determine the feasibility of the location as a place for birdwatching activities and monitoring of Red-knobbed
Hornbill populations. The research is expected to be used as input for management of birdwatching tours around Lake Lindu.

2. Methods

2.1. Study site
This research was conducted on May 2014 in the area around Lake Lindu, Lore Lindu National Park. Lake Lindu is a lake located in the Enclave Lindu region, the utilization zone, and the rehabilitation zone of the Lindu Resort, Lore Lindu National Park. This lake has an area of 3488 ha with an altitude of 986-m asl. Lake Lindu is located in the enclave and Lore Lindu National Park area. The conditions around the lake are highland rainforest and settlement. On the west side of the lake is a fairly dominant settlement. There are four villages in the western part of the lake, namely Puroo Village, Langko Village, Tomado Village, and Anca Village. On the east side, there is a village resulting from the division of Tomado Yatiu Village, Kalawu Village. The southern part of the lake is widely used by the community for rice fields. Rice fields are on the edge of the lake and the land is still flat, the hill or ridge is used as a coffee and cocoa plantation. The rice fields of the community are spread out in almost every part of the lake. Especially for plantations only on the west side of the lake. The northern part of the lake is the Lindu Lake National Park area. Precisely is the utilization zone, rehabilitation zone, and jungle zone. Vegetation in this place is dense highland rainforest. The north side of the lake is one of the Lindu Lake outlets, the Rawa River. The river flows and forms rapids that are very swift even found with large waterfalls. This is due to the condition of Lake Lindu at a higher location. Lake Lindu's catchment area is bounded by mountains, among which the highest is Mount Nokilelaki (2357-m asl) to the northeast of the lake, Mount Lantawungu (2270-m asl) to the southeast, and Mount Tumawu (2192-m asl) to the south. Rainforest is the largest part of Lake Lindu's catchment area, while other areas are fields, coffee and cocoa plantations, rice fields, and settlements.

![Figure 1. Sampling Map](image)
2.2. Habitat description

Description of habitat is done by describing the character of the habitat in the habitat type under study. This habitat character data consists of biotic and abiotic factors. Biotic factors are vegetation data and abiotic factors are physical environment data. Vegetation data taken is the number of Red-knobbed Hornbill feed trees and vegetation cover consisting of canopy closure and horizontal closure (vegetation density). Vegetation cover is taken by a circular plot method. Vegetation cover horizontally measured by density board and vegetation cover vertically measured with ocular tubes. The circular plot is made with a radius of 11.3 m or diameter 22.6 m. Horizontal canopy cover and undergrowth are taken in the four cardinal directions (north, south, west-east), taking every 3.7 m distance from the center point to the four cardinal directions. Observations are made with the help of an ocular tube, if a part of the vegetation is caught in the tube then it is given a sign (+), if it does not touch the tube then it is marked (-).

Horizontal closure measurements at shrub, shrub, pole and tree levels were carried out in each cardinal direction at a distance of 11.3 m from the center of the circular plot. Physical environmental data consist of temperature, altitude, slope, and distance from settlements. The temperature is measured using a thermometer by hanging it from a tree branch, waiting a few moments, then recording the temperature value. The height of the place is measured by GPS and the slope is measured using a clinometer. Data Physical environment is measured in each observation plot of the Red-knobbed Hornbill. Determination of the distance between observation points and settlements is measured based on flat distance using GPS.

2.3. Red-knobbed Hornbill population

Red-knobbed Hornbill data collection at the study site was carried out by the point count method combined with the transect line. Sampling was placed purposively in the area around Lake Lindu, with the distance between the point counts being 200 meters. The observation radius of the bird plot is 50 meters. Bird observations were carried out for 10 minutes in each plot [5]. Inventory is carried out 5 minutes after reaching the observation point. Retrieval of bird data is carried out from 06.00-18.00 (Middle Indonesian Time). Red-knobbed Hornbill is calculated by observing its presence directly or indirectly (by listening to its voice) in the circle plot. The assumptions used in this method are:

a. Birds do not approach the observer or fly.
b. Birds in the sample can be detected at 100%.
c. Birds do not move during calculations.
d. Birds behave freely (not dependent on each other).
e. Violations of these assumptions do not affect habitat or study design.
f. Accurate distance estimation.
g. Birds can be fully identified.

Birds outside the point are not counted and observations are recorded in the tally sheet. Data recorded in the form of the number of individuals Red-knobbed Hornbill and time of encounter with Red-knobbed Hornbill.

2.4. Habitat analysis

The habitat description is used to describe the condition of the Red-knobbed Hornbill habitat around Lake Lindu. Red-knobbed Hornbill habitat data including biotic and abiotic factors were analyzed descriptively.

2.5. Determination of Red-knobbed Hornbill distribution

The spatial distribution of Red-knobbed Hornbills is obtained from the coordinates of the locations where Red-knobbed Hornbills are found which are then overlaid onto the map so that the positions
where the birds are found can be identified. To process the data, ArcGis 10.1 for Windows software is used. Spatial distribution patterns of the population of the Red-knobbed Hornbill were analyzed by spatial distribution patterns. Determination of species distribution is done by Variance-Mean Ratio analysis [6,7], this method is the oldest and simplest method for determining the spatial pattern of an organism. The ratio between sample variance values and sample mean values is called the Dispersion Index.

\[
\text{Dispersion Index} = \frac{s^2}{\bar{x}}
\]

If the sample follows the Poisson distribution, the sample variance will be proportional to the sample average and then the expected ID value is always 1, which indicates that the population follows a random distribution pattern; if a ratio <1 (close to 0) indicates regular distribution; and if >1 indicates cluster distribution.

Variance according to Ridho (2011) is the square of the standard deviation calculated using the formula [8]:

\[
s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}
\]

Remarks: \(s^2\): sample variance; s: standard deviation; n: number of samples according to Ludwig & Reynolds (1988) to test the Dispersion Index obtained, another simple statistical test is used that is chi-square (\(x^2\)).

\[
x^2 = ID(n - 1)
\]

Remarks:

- chi-square value with free degrees: n-1
- ID: Dispersion Index
- n: Number of squares used

The Dispersion Index Test is a two-part test because there are two possible directions of deviation: If the organism is spread out regularly, the variance will be less than the average value and the dispersion index is close to 0. If the organism spreads in groups (clumped), the observed variance will be greater than the average value and the index value will be greater than 1. After the Dispersion Index values are obtained, further tests are done using the Green Coefficient. This coefficient value is based on the value of the variance-mean ratio with a simple calculation:

\[
\text{Green equation} = \frac{ID - 1}{n-1}
\]

Remarks: ID = dispersion index and n = number of plots If the negative Green coefficient shows a uniform pattern, and a positive value indicates a clustered pattern.

2.6. Determination of the suitability of birdwatching site

The suitability of birdwatching site is determined by scoring individual numbers, habitats (number of feed trees, canopy cover, and vegetation density, slope), time of attendance, and access from settlements. An assessment of the condition of the birdwatching site is carried out following table 1:


| Aspect           | Variable                                      | Criteria          | Remarks                                                                 | Score |
|------------------|-----------------------------------------------|-------------------|-------------------------------------------------------------------------|-------|
| Site Condition   | Number of Red-knobbed Hornbill Individuals    | 0 - 2 individuals | Generally, Red-knobbed Hornbills are found in the form of flocks and/or pairs. | 1     |
|                  |                                               | 3 - 6 individuals |                                                                        | 2     |
|                  |                                               | 7 - 10 individuals|                                                                        | 3     |
|                  |                                               | > 10 individuals  |                                                                        | 4     |
| Number of Feed Trees | Number of Feed trees at the observation site (ex: Ficus spp.) | None             |                                                                        | 1     |
| Crown Cover      |                                               | There are 1       |                                                                        | 2     |
|                  |                                               | There are 2       |                                                                        | 3     |
|                  |                                               | There are > 2     |                                                                        | 4     |
| Vegetation Density |                                               | 0 - 25%          | Less dense                                                              | 1     |
|                  |                                               | 26 - 50%         | Moderate                                                                | 2     |
|                  |                                               | 51 - 75%         | Dense                                                                   | 3     |
|                  |                                               | 76 - 100%        | Very Dense                                                              | 4     |
|                  |                                               | 0 - 25%          | Less dense                                                              | 1     |
|                  |                                               | 25 - 50%         | Moderate                                                                | 2     |
|                  |                                               | 50 - 75%         | Dense                                                                   | 3     |
|                  |                                               | 75 - 100%        | Very Dense                                                              | 4     |
|                  |                                               | > 25%            | Steep                                                                   | 1     |
|                  |                                               | 15 - 25%         | Rather Steep                                                            | 2     |
|                  |                                               | 8 - 15%          | Sloping                                                                 | 3     |
|                  |                                               | 0 - 8%           | Flat                                                                    | 4     |
|                  |                                               | < 0.5 km and > 1.6 km | Distance too short and too long | 1     |
| Slope            |                                               | 0.51 km – 0.75 km | Short distance                                                          | 2     |
|                  |                                               | 0.76 - 1 km      | Not Ideal                                                               | 3     |
|                  |                                               | 1 – 1.5 km       | Ideal                                                                   | 4     |

The scores obtained for each aspect of the assessment are multiplied by the weight of each aspect, then summed to the total value generated for each point. Furthermore, to determine the suitability of the scoring results, the total score is calculated using the formula \( \Sigma \) (score of each variable * weight). Then the four eligibility criteria are determined namely very suitable, suitable, inadequate, and not suitable. Determination of the interval used for the interval class score of wealth, uniqueness, and the total calculation score assessment based on the calculation as follows:

\[
S = \frac{(S_{\text{max}} - S_{\text{min}})}{K}
\]

Remarks:
- \( S \) = interval used to determine eligibility criteria
- \( S_{\text{max}} \) = Maximum score (400)
- \( S_{\text{min}} \) = Minimum score (100)
- \( K \) = Number of classifications (4)

Calculations obtained for the total interval calculation of the score assessment are:
7

\[
S = \frac{(400 - 100)}{4} \\
S = 75
\]

So that the interval used is 75. Determination of the eligibility criteria in this study are:

100 < x < 175 : Not suitable
175 < x < 250 : Inadequate
250 < x < 325: Suitable
325 < x < 400: Very suitable

3. Results

3.1. Habitat Description

Determination of Red-knobbed Hornbill habitat data in this study included the number of feed trees \((Ficus\, spp.)\), The percentage of canopy cover, vegetation density, slope, and distance from settlements table 2.

**Table 2. Character Descriptions of Red-knobbed Hornbill Habitats around Lake Lindu**

| Habitat Components* | Total |
|---------------------|-------|
| Feed Tree           | 14    |
| Crown Cover (%)     | 25 - 100% |
| Vegetation Density (%) | 25 - 100% |
| Slope (%)           | 8 - > 45% |
| Distance From Settlemets (km) | 0.8 - 5.8 |
| Settlements (km)    | km    |

* data taken at the point of observation

The number of feed trees at the observation point was 14 individuals. Not all Red-knobbed Hornbill feed trees are scattered at the point of safety. The condition of the forage trees during the study was still in a fruitful state which attracted the attention of the Red-knobbed Hornbill. Red-Knobbed Hornbill feed tree in this study was \(Ficus\) sp. and \(Arthocarpus\) elasticus. The forest around Lake Lindu still has large and tall trees, which are used as a place to find food, activities, and nesting for these birds. This red-knobbed hornbill is a hornbill family (Bucerotidae) which is commonly found in tall tree canopies. Trees such as around Lake Lindu, for example, are of the type Moraceae \((Ficus\, spp.)\) Which is quite dominating. The frequency of the presence of Red-knobbed Hornbills around Lake Lindu is many if the tree has been fruitful and has matured. Because it is one of the feed trees. Red-knobbed hornbill has an important role in the ecosystem because the bird is a seed-dispersing agent. Red-Knobbed Hornbill are frugivory [9], they are the major component of frugivores in Sulawesi, although they prefer ripe figs \((Ficus\, spp.)\), They eat the fruit and spread the seeds very far from the original tree [10,11]. Therefore, its existence is very important as a dispersal agent for the fig seeds. Bucerotidae is birds that generally have large home ranges. For example, \(Anorbinus\) nipalensis has a home range of 6.19 km² during mating season and 11.16 km² when not mating season [12]. Seeds that come out through these impurities can be spread widely to all places and grow into new individuals. Cover canopy and vegetation density on average in the range of 25-100%, in general, Red-knobbed Hornbill is found at locations having 80% percent cover canopy % Observation sites around Lake Lindu vary in slope (flat - steep). The distance between observation sites and settlements in the range 0.8 - 5.8 km, Red-knobbed Hornbill is found at the observation points that are near residential settlements. The condition of the Red-knobbed Hornbill Habitats around Lake Lindu is a lowland tropical rain forest that feels in the hills which has a slope of 8 - > 45%. This shows that the habitat has a steep, steep and very steep slope.

3.2. Red-knobbed Hornbill Distribution

Red-Knobbed Hornbills are found at several observation points where transects are placed figure 2. There are eight observation points recorded with the Red-knobbed Hornbill. The observations
obtained as many as 46 individuals Red-knobbed Hornbill were recorded. Red-Knobbed Hornbill was observed in the form of a flock or pairs (male and female), not found Red-knobbed Hornbill individually.

Based on the results of the dispersion index analysis, the distribution pattern of Red-knobbed Hornbill in the area around Lake Lindu is clumped table 3. Grouping shows that individuals gather in several beneficial habitats, these events can be caused by group behavior, heterogeneous environments, reproductive models, and so on [13]. This can be caused because in natural forests many individuals who come to certain points only in groups. *Ficus* sp. and *Arthocarpus heterophyllus*, thought to be the tree most frequently visited by these species of birds. The three trees at the time of data collection were at the time of fruiting, which certainly provides plenty of food for many species of birds, especially the Red-knobbed Hornbill.

3.3. Birdwatching Site Suitability

Based on the results of the birdwatching location assessment, eight points were suitable to be developed as a Red-knobbed Hornbill observation location. This is supported by the Red-knobbed Hornbill factor and the number of feed trees at the observation points. All of these locations lie in natural forests that have high and natural vegetation densities table 4. Sites were suitable for birdwatching or monitoring sites. Red-Knobbed Hornbill is a location that has a distance from the settlement (1 - 1.5 km). The assaults on the eight locations are categorized as sloping to very steep. Not found a decent location with a flat slope. Generally, Red-knobbed Hornbills are found in sites that have vegetation cover in the form of natural forests with steep slopes. This bird can also be found around settlements that border directly with natural forests figure 3.

![Figure 2. Red-Knobbed Hornbill (*Rhyticeros cassidix*) distribution map](image-url)
| Species                        | Individuals | Mean  | Variance | Dispersion Index | Chi Square | Green Index | Pattern   |
|-------------------------------|-------------|-------|----------|------------------|------------|-------------|-----------|
| Red-Knobbed Hornbill          | 46          | 1.533 | 3.2242   | 6.779610195      | 189.8291   | 0.1992969   | Clumped   |

**Table 4. Birdwatching Site Assessment**

| Point No. | Red-Knobbed Individuals | Total Feed Tree | Crown Cover | Vegetation Density | Distance From Settlement | Slope | Average | Result |
|-----------|-------------------------|-----------------|-------------|--------------------|-------------------------|-------|---------|--------|
| Point 1   | 200                     | 400             | 400         | 400                | 100                     | 300   | 300.00  | Suitable |
| Point 10  | 400                     | 200             | 400         | 400                | 100                     | 300   | 300.00  | Suitable |
| Point 16  | 100                     | 100             | 400         | 400                | 400                     | 100   | 250.00  | Suitable |
| Point 2   | 200                     | 400             | 400         | 400                | 100                     | 300   | 300.00  | Suitable |
| Point 27  | 100                     | 100             | 400         | 400                | 300                     | 200   | 250.00  | Suitable |
| Point 28  | 400                     | 300             | 400         | 400                | 400                     | 100   | 333.33  | Very Suitable |
| Point 29  | 300                     | 100             | 400         | 400                | 400                     | 100   | 283.33  | Suitable |
| Point 30  | 100                     | 100             | 400         | 400                | 400                     | 300   | 283.33  | Suitable |

**Figure 3. Suitable Sites for Birdwatching**
4. Discussion
Observing the Red-knobbed Hornbill directly in its natural habitat is a separate satisfaction. Complex wildlife behavior is a very interesting moment to be documented. Because it only happens at certain times and not much is documented. Documenting it when they eat, socialize, breed, care for their children, etc. is important information for the conservation of these animals. We can learn from nature about the ecology of the animals we observe.

In observing the Red-knobbed Hornbill requires equipment, techniques, bird ecology and knowledge of the location that is often visited by the Red-knobbed Hornbill. Red-knobbed Hornbill is a bird that is slightly sensitive to human presence. Red-knobbed Hornbill can often be observed in the rainforest around the lake but occasionally flies near settlements. Here are some things that need to be prepared or considered in observing Red-knobbed Hornbill:

4.1. Clothes
Wear clothes that are not flashy; comfortable and absorb sweat material; long arms can avoid insect bites, thorns, and retain heat; pocket clothing makes it easy to store notebooks and stationery; use safe and comfortable footwear (shoes) (Keep in mind that Lake Lindu has a liver worm (*Schistosoma japonica*) which lives in mud or stagnant water, therefore the use of booth shoes is highly recommended); The hat can protect the head from heat.

4.2. Documentation tools
In general, the documentation equipment in our minds is the camera. The camera has an important function to document the moment. A camera that has a high zoom is highly recommended because Red-knobbed Hornbill often move in the canopy of trees, and stay away from when approached. The use of camcorders is used to make videos, but now the camera is also equipped with a video recorder so that we can document photos and videos. Field notebooks and recorders are equipment that needs to be carried. Notebooks are selected that are practical and easy to carry. This book will be a record of the moments that we have encountered. Notes that need to be present are the time that concerns the day/hour/ date of observation, number of individuals, behavior, weather, and other information. If you do not bring a camera, it would be better if you make a sketch/picture of the Red-knobbed Hornbill being observed. The recorder can be used for those Red-knobbed Hornbill’s sounds. The sound of this bird is quite loud, “hoank hoank” like that sound. They sound when perched and fly. When flying the sound issued from the flutter of its large wings, when flying sounds very noisy like a helicopter. In addition, equipment that needs to be carried to support field observations is binocular/monocular, field guide books, navigation tools (GPS, Compass, Maps, Protractors), Logistics (adequate food and water), shelter tools (if observations are made for a long time (daily), and security equipment.

4.3. Number of group members
Form groups that are not too many, about 3 - 5 people. Large group members tend to be noisier so they can repel birds. Communication is done in moderation, many voices will disturb and repel birds). Also keep in mind that, do not do the observation alone because the forest around Lake Lindu has the potential to cause people to get lost because the forest is still tight.

4.4. Observation technique
Walk slowly, walk fast but not noisy, wait quietly, and be patient. Observing Red-knobbed Hornbill can be done by waiting for it in the feed tree or nest (Ficus spp.). If the tree is fruiting and ripe, the frequency of the presence of Red-knobbed Hornbill will increase. Imitating the sound of Red-knobbed Hornbill is not recommended because it will interfere with territorial behavior. Imitating the sound of Red-knobbed Hornbill that has a different tone to the original will not make this bird come, it will farther away.
time of observation

Red-Knobbed Hornbill is a diurnal type of bird which is a species of bird that is active on sing day. The observations show that this bird is active in the morning from 6:00 to 10:00 and in the afternoon from 14:00 to 18:00.

Local guide

Local guides can provide precise observation spot information about the Red-knobbed Hornbill, which has not been known before.

Conclusion

The result shows that the Red-knobbed Hornbill is spread in the area around Lake Lindu. This bird has a clumped distribution pattern where the presence of feed trees affect the level of its presence. There are eight locations that are suitable to be developed as a Red-knobbed Hornbill monitoring site around Lake Lindu.

Suggestion from this research is to remember that Red-knobbed Hornbill is categorized as a vulnerable bird status by the IUCN Red-List and protected by PP No. 7 of 1999, so the need for conservation efforts that involve many parties, especially the people. The community needs to be involved and participate in efforts to manage conservation areas (protection, use, and preservation). One such effort is the development of natural tourism. The development of natural tourism requires the support of many parties. The community as local (native) people have a role and potential to support this. An example is in bird watching tours that require a guide to enter dense forest areas such as in the area around Lake Lindu, Lore Lindu National Park. Preservation of Red-knobbed Hornbill habitat is by conserving trees that are used as a source of food and nests. Because of the tree species are cut down or reduced it will affect the declining population of this animal. Forest loss and degradation will make it even more vulnerable. Red-knobbed Hornbill is a natural seed-dispersing agent that is very important for the forest ecosystem. Plants that produce fruit and seeds in large quantities may be more vulnerable to extinction if they lose their natural spreaders [14]. It has also been hypothesized that the extinction of large frugivores can also cause the extinction of various species of trees, which can only be done on these animals [15]. Hunting is also a serious threat to the Red-knobbed Hornbill. Preserving it is our shared responsibility. This research is expected to be used as input for management of birdwatching tours around Lake Lindu. To support future birdwatching activities, research is needed that raises the topic of determining interpretation pathways for birdwatching around Lake Lindu, research on feed tree phenology, visitor satisfaction surveys, and social research on animals related to animals around Lake Lindu.

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