An assessment of birds and mammals in Wana Patra Lestari, PT Pertamina Refinery Unit V Balikpapan

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Abstract. Wana Patra Lestari (WPL) is a remaining forest in the center of Balikpapan City. It is located in the working area of PT Pertamina Refinery Unit (RU) V Balikpapan. Besides having cultural and historical value, the existence of the WPL area also has environmental service value as a habitat for birds and mammals. This study aims to analyze the diversity of bird and mammal species in the WPL area. We collected all related bird record by using a combination of point count and mist-netting methods. Furthermore, mammal was sampled by using a combination of line transect, live-trapping, camera-trapping, and also mist-netting survey. The results showed that in the WPL area 17 species of birds and 6 species of mammals were identified. There are 14 species of birds and 2 species of mammals added from previous studies. Of all the identified species, there is only one protected species in Indonesia, namely Elang Bondol (Haliastur indus).

Periodic monitoring is needed to find out more about population dynamics and diversity of wildlife in the WPL.

1. Introduction

Wana Patra Lestari (WPL) is a fragment forest of ± 45 Ha located in the working area of PT Pertamina Refinery Unit (RU) V Balikpapan. This forest is very unique and strategic, located between a dense industrial and residential area in the center of Balikpapan that directly faces the sea. This forest also has a high historical value, because they have “Mathilda”, the first location of oil well in Balikpapan. Furthermore, the date of its discovery was on February 8, 1897 and commemorated as the anniversary of Balikpapan City. Currently, Balikpapan is known as one of the developed cities in Borneo Island with economic growth supported by the petroleum industry sector [1].

Although not as a conservation forest, WPL has a high value of environmental services for the City of Balikpapan in the form of supporting environmental services, such as oxygen providers, carbon sinks, and also habitat for various species of wildlife, such as birds and mammals. The presence of birds and mammals in the forest area around industrial areas could be as an indicator of good environmental quality [2]. It has an important role in controlling insect population explosions, pollinating agents, and dispersing plant seeds [3-5], as well as having their own aesthetic value [6]. Vegetation in the WPL based on landscape perspective can also be a corridor or stepping stone that connects other habitat of various birds in Balikpapan City, such as Sungai Wain Protection Forest and the mangrove forest ecosystem in Balikpapan Bay.

The presence of birds and mammals in the WPL area need to be periodically monitored as a basis for the better future environmental management efforts. In this regard, a study on the diversity of birds and mammals in the WPL was conducted [7]. However, the study still needs to be continued to understand the dynamics of the wildlife species richness that exist in WPL and the mechanism of environmental
conditions that related to its presence. On a broader scale, studies on diversity of bird and mammal species in the administrative area of Balikpapan City have also been carried out in the Sungai Wain Protection Forest [3,8,9] and the Balikpapan Bay mangrove forest ecosystem [10].

To complete the biodiversity database information in WPL and Balikpapan City in general, further studies on the diversity of birds and mammals are needed. This study aims to investigate the diversity of bird and mammal species in WPL, PT Pertamina RU V Balikpapan. It is hoped that the results of this study will provide a complete data of the dynamics of bird and mammal species diversity in the WPL as well as recommendations for its management.

2. Materials and Methods

2.1. Study site
This research was conducted in the WPL, Balikpapan City, East Kalimantan Province, Indonesia at coordinates 1°16'14.0"S and 116°48'51.0"E (figure 1). WPL is a forest fragment that functions as a green space by PT Pertamina RU V with an area of 45 Ha. WPL is located among the oil refining industry areas which are very important in Balikpapan and has a role in supplying fuel needs for the Eastern Indonesia region. Geographically, the research location is in the front of Balikpapan Bay and directly faces the Makassar Strait with contours that tend to be hilly.

![Figure 1. Map of research site](image)

2.2. Procedure
Bird data was collected using a combination of point count and mist net methods [11,12]. In this study, we used a total of eight point counts with a distance of ± 200-300m. Every bird species observed in the point count was recorded in species and number of individual [11]. Bird watching was carried out in the morning (06.30-09.30) and in the afternoon (16.00-18.30). To complete the point count method, four mist nets were placed purposively at two observation points around the WPL Region.

Mammal data collection was carried out using small mammal traps, camera traps, and line transects. A total of 25 small mammal traps were placed systematically with the distance between traps was about
30-40m. The baits used were roasted coconut, peanut butter, and banana. Meanwhile, as many as 10 camera traps were placed proportionally at 10 points in the WPL area for one month. To complement the use of the trap and camera traps methods, we also explore around the WPL using the line transect approach. Every species of bird found during observation was recorded and documented.

2.3. Data analysis
Bird identification refers to MacKinnon et al. [13], whereas mammal identification refers to Payne et al. [14]. Bird and mammal data analysis was done by grouping each identified species into the family and its conservation status based on PermenLHK No.P.106/2018 [15], IUCN Red List [16], and CITES [17]. Furthermore, all species data identified as a result of a combination of several methods were recapitulated and displayed in tabular form (list of species).

For bird data, each species was grouped into feeding guild types [18] and calculated for the value of relative abundance and relative frequency with the following basic formula [19]. Additionally, bird data analysis was also carried out by calculating Shannon-Wiener species diversity index (H) and Evenness index (E) using PAST 3.1 software.

3. Result and Discussion

3.1 Bird diversity
We have recorded as many as 17 species of birds in the WPL which are divided into 12 families and 15 genera. Ecopedition [7] previously reported seven species of birds were identified in WPL. This study added 14 species of birds reported from this site. Recently, there are 21 species of birds found in the WPL. However, there are 4 species of birds that absent or not found referring to the checklist of bird species from previous studies (Lonchura leucogastroides, Streptopelia chinensis, Arachnothera longirostra, and Stachrys maculata).

![Figure 2. Relative abundance (left) and relative frequency (right) of bird species in WPL](image-url)
Shannon-Wiener diversity index (H) was 2.357, whereas Evenness index (E) was 0.621. Of the 17 identified species, only *Haliastur indus* was categorized as protected bird species by PermenLHK No.P.106/2018 and indexed in CITES as Appendix II. Based on the IUCN Red List, all bird species are mostly listed in the Least Concern category. The results of bird species identification in WPL are presented in Table 1. Meanwhile, relative abundance and relative frequency are presented in figure 2 and grouping of feeding guilds are shown in figure 3.

**Table 1.** List of bird species in WPL

| No | Family          | Local Name       | Scientific Name | Conservation Status | This study (2017) | Previous study (2015)* |
|----|----------------|------------------|-----------------|---------------------|-------------------|------------------------|
| 1  | Accipitridae   | Elang Bondol     | *Haliastur indus* | √  | LC | App.II + + |
| 2  | Cisticolidae   | Cinemen Kelabu   | *Orthotomus ruficeps* | -  | LC | - + - |
| 3  | Columbidae     | Perkutut Jawa    | *Geopelia striata* | -  | LC | - + - |
| 4  | Columbidae     | Punai Gading     | *Treason vernans* | -  | LC | - + - |
| 5  | Columbidae     | Tekukur          | *Streptopelia chinensis* | -  | LC | - - + |
| 6  | Columbidae     | Delimukan Zamrud |                 | -  | LC | - + - |
| 7  | Dicaeidae      | Cabai Bunga Api  | *Dicaeum trigonostigma* | -  | LC | - + - |
| 8  | Dicaeidae      | Cabai Panggul Hitam | *Dicaeum monticolum* | -  | LC | - + - |
| 9  | Estrildidae    | Bondol Rawa      | *Lonchura malacca* | -  | LC | - + - |
| 10 | Estrildidae    | Bondol Jawa      | *Lonchura leucogastroides* | -  | LC | - - + |
| 11 | Hirundinidae   | Layang-Layang Batu | *Hirundo tahitica* | -  | LC | - + - |
| 12 | Hirundinidae   | Layang-Layang Rumah | *Delichon dasypus* | -  | LC | - + - |
| 13 | Nectariniidae  | Pijantung Kecil  | *Arachnothera longirostra* | -  | LC | - + |
| 14 | Passeridae     | Burung Gereja Erasia | *Passer montanus* | -  | LC | - + - |
| 15 | Pellorneidae   | Pelanduk Semak   | *Turdinus sepia* | -  | LC | - + - |
| 16 | Pycnonotidae   | Cucak Kutilang   | *Pycnonotus aurigaster* | -  | LC | - + + |
| 17 | Pycnonotidae   | Merbah Belukar   | *Pycnonotus plumosus* | -  | LC | - + - |
| 18 | Rallidae       | Kareo Padi       | *Amaurornis phoenicurus* | -  | LC | - + - |
| 19 | Sturnidae      | Kerak Kerbau     | *Acridotheres javanicus* | -  | LC | - + + |
| 20 | Strigidae      | Celepuk Reban    | *Otus lempijii* | -  | LC | - + - |
| 21 | Timaliidae     | Tepus Tunggir Merah | *Stachrys maculata* | -  | NT | - + + |

Remarks: RA = Relative Abundance; RF = Relative Frequency; (+) = present; (-) = absent; LC = Least Concern; NT = Near Threatened; (*)Ecopedition [7]
3.2 Mammal diversity

The species of mammals that identified in this study were six species or total of eight species if combined with the previous studies. This study also added two species to the previous checklist of mammal species from this locality, namely *Tupaia minor* (Scandentia) and *Cynopterus brachyotis* (Chiroptera). *Macaca fascicularis* is the only primate species recorded in this study. Of all the mammals recorded in this study, none were categorized as protected wildlife species in Indonesia. Based on the IUCN Red List, all mammal species in the WPL are also still in the Least Concern category. However, previous studies have managed to record one protected mammal, namely *Arctictis binturong* which in the IUCN Red List is included in the Vulnerable category.

Table 2. List of mammal species in WPL

| No | Family                  | Local Name | Scientific Name             | Method | Conservation Status | This study (2017) | Previous study (2015)* |
|----|-------------------------|------------|-----------------------------|--------|---------------------|-------------------|------------------------|
| 1  | Pteropodidae            | Codot Krawar | *Cynopterus brachyotis*     | MN     | LC                  | +                 | +                      |
| 2  | Sciuridae               | Bajing Kelapa | *Callosciurus notatus*      | LT     | LC                  | +                 | +                      |
| 3  | Tupaiidae               | Tupai Kecil | *Tupaia minor*              | T      | LC                  | -                 | +                      |
| 4  | Tupaiidae               | Tupai Bergaris | *Tupaia dorsalis*            | LT     | LC                  | -                 | +                      |
| 5  | Muridae                 | Tikus Belukar | *Rattus tiomanicus*         | LT     | LC                  | -                 | +                      |
| 6  | Cercopithecidae         | Monyet Ekor Panjang | *Macaca fascicularis*       | T      | VU                  | App. II           | +                      |
| 7  | Viveridae               | Musang Pandan Binturung | *Paradoxurus hermaphroditus* | CT     | LC                  | +                 | +                      |
| 8  | Viveridae               |              | *Arctictis binturong*       | CT     | √ VU                | App.II            | -                      |

Remarks: + = Present; - = Absent; MN = Mist Net; LT = Live Trap; T = Transect; CT = Camera Trap; LC = Least Concern; VU = Vulnerable; (*)Ecopedition [7]

Figure 3. Feeding guild of bird species in WPL. Data compiled from Ecopedition [7].

![Figure 3](image-url)
3.3 Discussion

WPL is one of the last remaining forest fragments in the center of Balikpapan City. It is a secondary forest type with an area of 45 Ha. This area has an important ecological function as a habitat for various species of birds and mammals that live in urban areas. WPL supports not only viability for generalist species, but also several protected species that have experienced global population decline, such as H. indus and S. maculata. Furthermore, Soga et al. [20] explained that remnant forest among human-modified landscapes also provides benefits as refugia for wildlife. The surrounding habitat that has been degraded causes migration of birds and mammals to the remaining forest, such as in WPL. Additionally, the presence of birds and mammals are also supported by the better quality of forest stand compared to the surrounding habitat. Adman [21] reported that vegetation in WPL was dominated by the Myrtaceae family with 128 identified plant species, Syzygium sp. and Cotylelobium melanoxyllum were found to be the most abundant in each strata of vegetation.

As a forest fragment in the city center, the addition of 14 new reported species of bird are very informative. Several studies conducted in big cities in Southeast Asia reported that the bird species diversity was not very high, such as in Kuala Lumpur with 11 species [22], Bangkok 26 species [23], and Bandung 28 species [24]. Meanwhile as comparisons, 194 species of bird in several dipterocarps forest areas near Balikpapan City were recorded [3], while Putera et al. [10] reported 34 species in mangrove forest ecosystem close to the Balikpapan Bay. Bird diversity in urban area can be affected by various factors. However, anthropogenic factor are more influential than non-anthropogenic factor such as topography, microclimates, and geographical position [25]. Bird habitat in WPL is strongly affected by the history of the establishment of the Balikpapan City as a location for oil drilling since the 20th century. Most of birds in WPL are adaptive species in disturbed forests or secondary forest. In recent years, expansion of oil refineries has changed the land cover used as habitat for birds.

We found that P. aurigaster is a species of bird that has the highest relative abundance and relative frequency compared to other identified bird species. This bird species can be easily found at various points in WPL with distinctive singing (figure 4). This high abundance is in line with the results of several studies conducted in Java, such as Krisanti et al. [26] in Gunung Lawu, and Kurnianto and Kurniawan [27] in agroforestry area, Malang District. This finding is not too surprising because the bird species from the family Pycnonotidae are known to have high adaptability, scattered in various types of habitat but rarely to the interior of the forest. One of the causes of the abundance of P. aurigaster is because this species are generalist in feeding guild (insectivore-frugivore), so that it can live in various habitat conditions. In the area of oil palm plantations, it reported to have preyed on 20 species of insects [28], as well as documented eating large amounts of grain in shrubs and secondary forests in West Java [4]. Our observations show that P. aurigaster in WPL was often seen eating fruit of Macaranga sp., and insects on the Casuarina equisetifolia tree on the roadside. Conversely, birds with very low abundance such as C. indica and T. sepiarius are species that are sensitive, less tolerant of forest disturbance, and tend to live in forest interior. For example, the abundance of T. sepiarius will show a significant decrease in disturbed forest [18,29].

Insectivorous and Insectivore-Frugivorous birds are two groups of feeding guilds that dominate WPL area. The high percentage of this both feeding guild groups are similar to the previous studies conducted in Borneo Island [18,30]. This phenomenon is possibly related to the food resources in secondary forest such as in the WPL area. Insect populations and seeds/fruits tend to be higher found among shrubs in secondary forest. H. indus is the only raptor found in this study (Figure 3). This bird has a very close correlation with the presence of vegetation in the WPL area as a nesting place. H. indus was found nesting on the tops of tree that were taller than the surrounding trees. Nests were built in the middle of the canopy which tends to be shady. C. equisetifolia is a tree used as nesting sites in WPL. Active nest tree generally had diameter > 30cm at breast height and height of trees was >20m. However, according to H. indus observations, they tend to hunt more prey in such as fish and crustaceans around the coast, but not in the WPL forest area. Raptor birds are top predators that are also sensitive to changes in forest conditions, so they are often used as indicator of environmental quality [31].
Several bird species that have been recorded in the 2015 study, but not found again in this study do not necessarily mean that the species has completely disappeared. Periodic monitoring is needed in the future to re-ensure its existence. The report on the discovery of *L. leucogastroides* in a previous study by Ecopedition [7] is an interesting case. Prawira and Iqbal [32] reported the occurrence of this species in several forest fragments of Balikpapan in 2015 as a first record for Borneo. The natural distribution of this species is generally only found in Java, Bali, Lombok, and parts of Sumatra [13]. Furthermore, Kurnianto and Kurniawan [27] explained that this species has fast reproduction, and very adaptive because it can utilize palm fiber and waste paper as a nest material. However, a record of feral population that was introduced in Singapore in 1922 has now declined due to rural development [33]. Besides *L. leucogastroides*, there are actually three other bird species that have been introduced to Borneo from Java since more than a century ago, namely *G. striata*, *P. aurigaster*, and *A. javanicus* [13]. Besides living freely in nature, all bird species are also often used as pets by the community.

Like birds, most of mammals found in WPL are the species that have a good adaptation to the various habitat conditions, such as secondary forests, shrubs, plantations, and around settlements. These findings supported by previous studies for mammals from other localities [9,34-38]. Mammal studies in urban areas, secondary forests and plantations also reported the presence of small mammals with wider distribution, such as the family Tupaiidae, Sciuridae, Muridae, and Pteropodidae [34-36]. *M. fascicularis* is also commonly found in various urban areas in Asia, and even indicates a population explosion and have the potential to cause conflicts with humans [37] (figure 5). We suspect that the WPL forest is not at all a habitat for big terrestrial mammals. This is confirmed by the results of the installation of 10 camera trap units which failed to record any of these species. This is actually very reasonable, because the habitat conditions in the WPL forest have a small area, in which there is no water source in the form of river flow, and the habitat is not connected to pristine intact forests. Previous notes made by Ecopedition [7] regarding the occurrence of *A. binturong* may be due to inaccurate identification based on imperfect images quality of camera trap.
Figure 5. Macaca fascicularis (A) and Cynopterus brachyotis (B) that can be found in WPL

*C. brachyotis* is a new record for group of bats in the WPL forest (figure 5). This species is always found in a fairly large number of groups. It is widespread in South Asia and Southeast Asia and commonly found in Borneo. They have 21-32 g of weights, occupy various habitats, but generally in disturbed forest, such as coastal forests, mangroves, agricultural areas, dipterocarp forests, and lower mountain forest up to 1500m asl [14]. Additionally, it helps in the process of pollinating tree species from the Anacardiaceae and Apocynaceae families, preferences for the food types are strongly influenced by the morphology of flowers and fruits [38]. In addition to the mammal species as recorded in this study, we also found interesting phenomena related to the presence of wild dog populations (feral dogs) in the WPL forest recorded by camera traps. This condition indicates that there has been an interaction between feral dogs with wildlife in the WPL forest in the form of predation. The interaction between feral dogs and wildlife in the form of predation by feral dogs in natural habitats is very possible, but in urban areas this behaviour has become an important note in several studies [39,40]. If predation occurs, the small mammals especially from the family Sciuridae, Tupaiidae, and Muridae also have the potential to become one of the preys for the feral dog.

4. Conclusion
Most of birds and mammals in WPL are species commonly found in secondary forest. They are adaptive to disturbed forest conditions. In general, we found that the diversity of birds and mammals in the WPL forest has increased since the first survey conducted in 2015. For bird species, there have been an increase in baseline data of 14 species, while mammals are two species. However, there were four species of birds and two species of mammals that were absent from previous studies. To get a more complete picture of biodiversity, monitoring activities still need to be done periodically in the future and also by involving other fauna, such as invertebrates.

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