BIRDS DISTRIBUTION IN PT EKOSISTEM KHATULISTIWA LESTARI, KUBU RAYA REGENCY, WEST KALIMANTAN PROVINCE

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ABSTRACT

IUPHHK-RE PT Ekosistem Khatulistiwa Lestari is the habitat of various wildlife species, comprises of a restoration forest area surrounded by production forest and oil palm plantations. The threats of damages from illegal logging and land clearing activities tend to threaten the wildlife existence. Therefore, this study aims to determine the distribution and diversity of bird species in PT Ekosistem Khatulistiwa Lestari. The study was conducted from January - February 2019, and data collection was conducted using the IPA (Index Ponctualle deAbondance) method. Furthermore, data analysis used diversity index, evenness index, and species similarity with dendrogram analysis using SPSS 21. The results showed that the highest bird species were found in mangroves (32 species), old swamp scrubs (26 species), young swamp scrubs (24 species), plantations (13 species), and settlement (15 species) habitats. Meanwhile, the diversity index of bird species in the five habitat types is classified as medium diversity. Species evenness with the highest value is settlement (E = 0.93). The dendrogram image of the settlement area showed bird species, which can be found in the other four habitats.

Keywords: diversity, bird distribution, West Borneo, dendrogram

INTRODUCTION

Birds diversity as an indicator of environmental quality, requires special attention because life is influenced by physical, chemical, and biological factors (Hidayat 2013). The widespread distribution of birds (found in almost every vegetated environment including natural and artificial ecosystems) makes birds as parts of Indonesia's biological wealth (Hadinoto *et al.* 2012).

According to Wisnubudi (2009), birds species distribution is strongly influenced by the suitability of bird's habitat, including environmental adaptation, competition, vegetation strata, food availability, and natural selection. However, when birds are removed from the food chain link, insects which are sources of wood will reproduce uncontrollably and become pests, which in turn will cause an imbalance in the chain of life (Wechsler and Wheeler 2012). Furthermore, plant existence is an important habitat used by birds for nesting, shelter, foraging for food, breeding, and other activities (Ridwan et al. 2015)

PT Ekosystem Khatulistiwa Lestari is one of the companies actively engaged in ecosystem restoration. To determine the success of restoration efforts, it is necessary to carry out regular monitoring for animals development and their habitat. Initial data collection was conducted in 2008 of which 26 birds species were recorded. The next data collection was conducted in 2016 and resulted in 59 being recorded. Monitoring should be regularly conducted to determine the potential of birds species usage as an indicator for the success of post-restoration area. Therefore, this study aims to determine the distribution and diversity of bird species in PT Ekosistem Khatulistiwa Lestari.

RESEARCH METHODS

This study was conducted from January to February 2019 on five types of habitats (young swamp scrubs, old swamp scrubs, plantations, mangroves, and settlements) in the IUPHHK-RE PT Ekosistem Khatulistiwa Lestari area, Kubu Raya Regency, West Kalimantan Province (Figure 1).

Data were collected along a one km line transect employing purposive sampling with a total of 11 transects in non-mangrove (plantations, settlements, young swamp scrubs, old swamp scrubs) and 15 transects in mangroves. The difference in the number of transects was due to the different topographic conditions and areas, thus were divided into two parts to allow higher accessibility. On each observation tract, an observation point (point count) or IPA (*Induces*

Ponctuel d'Abodance) was established with an interval of 200 metres (Figure 2). Each observation point was observed for 30 minutes to record the species encountered based on the need for travel time in the field, the number of birds, and the coordinates of the birds within the observation circle diameter with a radius of 50 metres (Bibby *et al.* 1998). On each observation point, the environmental conditions and the vertical height of all birds directly observed were classified based on canopy strata (A: 30 metres and above, B: 20-30 metres, C: 4-20 metres, D: 1-4 metres and E: 0-1 metres). In addition, bird watching was carried out in the morning at 05:30 - 9:00 am and at 03:00 - 06:00 pm in the afternoon.
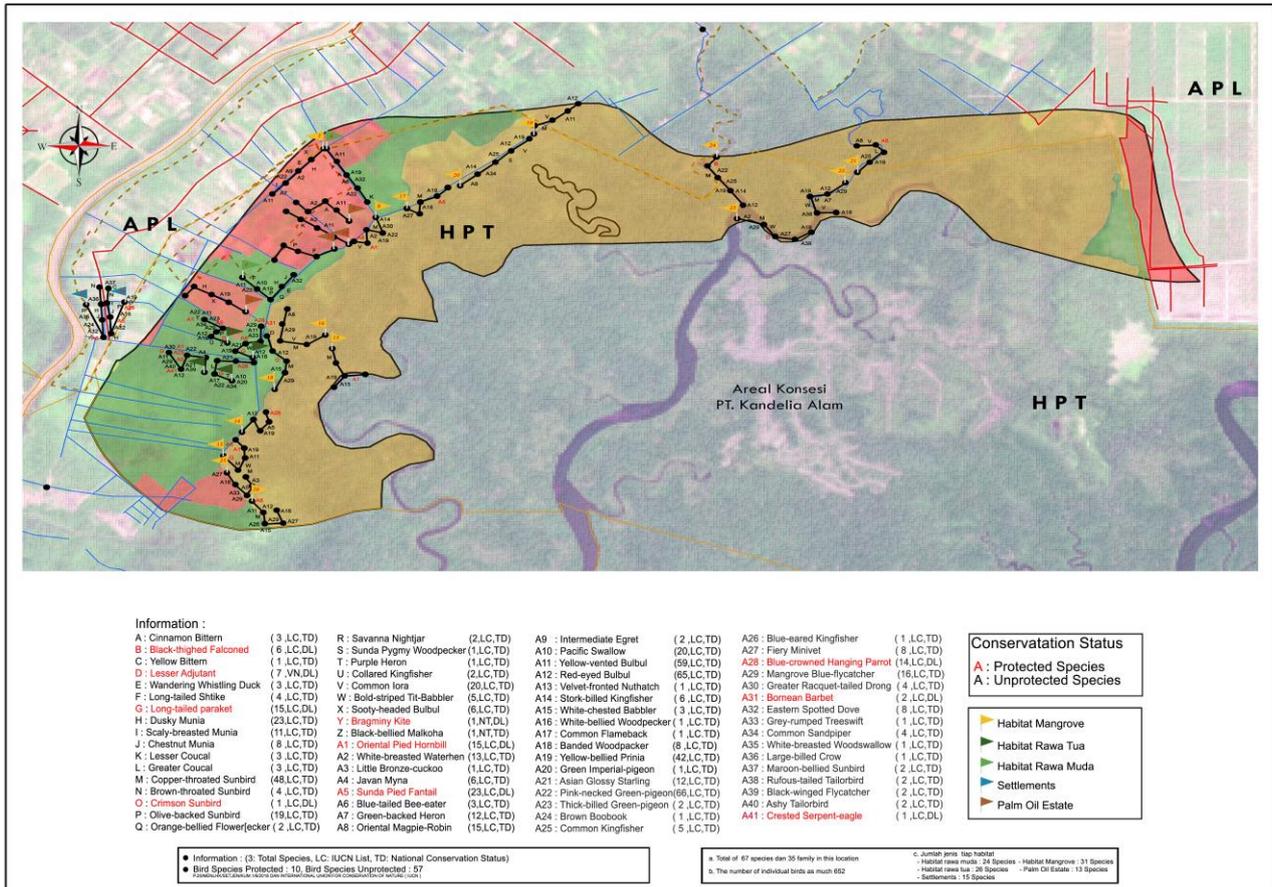

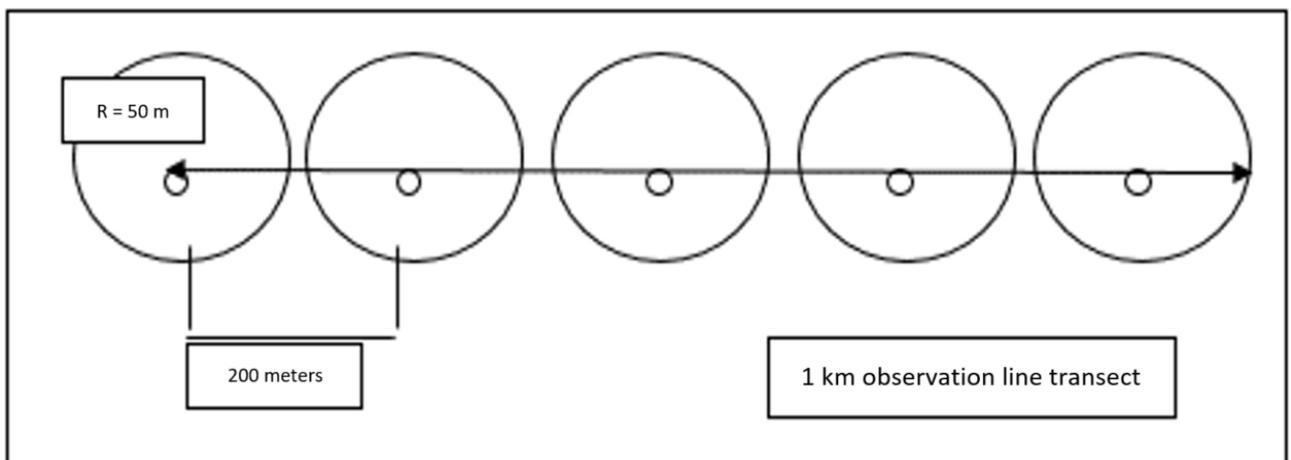Figure 1 Map of the IUPHHK-RE PT Ekosistem Khatulistiwa Lestari research location

Figure 2 Point Count method with line transect used to find bird distribution data

The distribution map of the birds was created using ArcGis, while SPSS 21 was used to process the data. Furthermore, data analysis used the following indices: Shannon-Wienner diversity index (Meffe and Carroll 1994) with the formula: H '= - Σ Pi ln Pi; evenness index to determine the evenness in each community encountered and calculated using the formula: E = H'/ln S, where: E = evenness index (value between 0-10), H' = bird species diversity, ln = natural logarithm, S = number of species; dominance, and species similarity in the five habitat types using SPSS 21 to produce dendrogram cluster analysis. The domination value functions was used to determine the dominant, sub-dominant, or non-dominant species in an observation path. In addition, the dominance index was calculated using the following formula:

$$Di = \frac{ni}{N} x 100\%$$

Where :

Di = dominance index of a bird species
ni = number of individuals from a bird species
Ni = number of individuals from all bird species.
The criteria for determining the domination level are as follows:
Di = 0 – 2 % is non-dominant species
Di = 2 – 5 % is sub-dominant species
Di = >5 % is dominant species.

RESULTS AND DISCUSSION

1. **Distribution of Birds in IUPHHK-RE PT Ekosistem Khatulistiwa Lestari**

As many as 67 bird species of 35 families were recorded in the IUPHHK-RE of PT Ekositem Khatulistiwa Lestari, distributed among five different habitats. Some species were found within one habitat type only, such as *Leptocoma calcostetha*, which is found only in mangroves.

The use of bird canopy strata in the five habitat types is shown in Figure 3. Within the young swamp scrub habitats, the highest number of birds observed were found in the C stratum, including long-tailed shrike (*Lanius schach*), olive-backed sunbird (*Cinnyris jugularis*), orange-bellied flowerpecker (*Dicaeum trigonostigma*), blue-tailed bee-eater (*Merops philippinus*), Yellow-vented Bulbul (*Pycnonotus goiavier*), Common Flameback (*Dinopium javanense*), banded woodpecker (*Chrysophlegma miniaceum*), Pink-necked Green-pigeon (*Treron vernans*), and Blue-crowned Hanging-parrot (*Loriculus galgulus*). Furthermore, in old swamp scrub habitats, many birds use the C-canopy strata, such as olive-backed sunbird (*Cinnyris jugularis*), Collared Kingfisher (*Todiramphus chloris*), Black-bellied Malkoha (*Rhopodytes diardi*), javan myna (*Acridotheres javanicus*), Yellow-vented bulbul (*Pycnonotus goiavier*), Asian red-eyed bulbul (*Pycnonotus brunneus*), banded woodpecker (*C. miniaceum*), Asian glossy starling (*Aplonis panayensi*s),

pink-necked green pigeon (*T.vernans*), thick-billed green pigeon (*T. curvirosta*), blue-crowned hanging-parrot (*L. galgulus*), and Bornean Barbet (*Megalaima exima*). Subsequently, in mangrove habitat, some birds are mostly found in the C-canopy strata, such as Black-thighed Falconet (*Microhierax fringillarius*), Copper-throated Sunbird (*L. calcostetha*), Olive-backed Sunbird (*C. jugularis*), Sunda Pygmy Woodpecker (*Picoides moluccensis*), Little Bronze-cuckoo (*Chrysococcyx minutillu*s), Pied Fantail (*Rhipidura javanica*), yellow-vented bulbul (*P. goiavier*), Asian red-eyed bulbul (*P. brunneus*), velvet-fronted nuthatch (*Sitta frontalis*), banded woodpecker (*C. miniaceum*), pink-necked green pigeon (*T. vernans*), blue-crowned hanging parrot (*L. galgulus*), and mangrove blue flycatcher (*Cyornis rufigrasta*). In settlement habitats, birds are also mostly found in the C-canopy strata, such as brown-throated sunbird (*Anthreptes malacensis*), purple-throated sunbird (*Leptocoma sperata*), crimson sunbird (*Aethopyga siparaja*), olive-backed sunbird (*C. jugularis*), white-breasted woodswallow (*Artamus leucorynchus*), white-bellied woodpecker (*Dryocopus javensis*), brown hawk-owl (*Ninox scutulata*), and blue-crowned hanging-parrot (*L. galgulus*).

Within the mangrove forest habitat, 32 species were found belonging to 23 families (Figure 4). The *Alcedinidae* family is closely associated with mangrove vegetation, including stork-billed kingfisher (*Pelargopsis capensis*), common kingfisher (*Alcedo atthis*), and blue-eared kingfisher (*Alcedo meninting*) which used the mangrove roots just above the water surface as a place to perch and observe the fish to catch. According to Darmawan (2006), some bird species used only one or several strata since they can only occupy certain areas or because they have an equally low population. The most dominant bird species found in mangroves is the copper-throated sunbird (*Leptocoma calcostetha*) in the C and D strata. Mangrove forests have the highest bird species diversity because of the intact habitat with abundant food availability and wide area.

Young swamp scrub habitat is a natural regeneration area after forest fires. In this habitat, 24 bird species from 18 families were found, and the most dominant species was Pasific Swallow (*Hirundo tahitica*) which occupies the C-canopy strata with perching activity on dry twigs for resting or sunbathing.

The old swamp scrub habitat consisted of peat soil and a more complex stand composition than the young swamp scrub. The most dominant species is the Asian red-eyed bulbul (*Pycnonotus brunneus*), which occupies the C-canopy stratum with activities like perching or foraging on small fruits of the common fig tree (*Ficus carica L*). Meanwhile, the bold-striped tit-babbler (*Macronus bornensis*) showed preference for the deer fern (*Stenochlaena palustris Burm.f.*) occupying the D-canopy stratum.
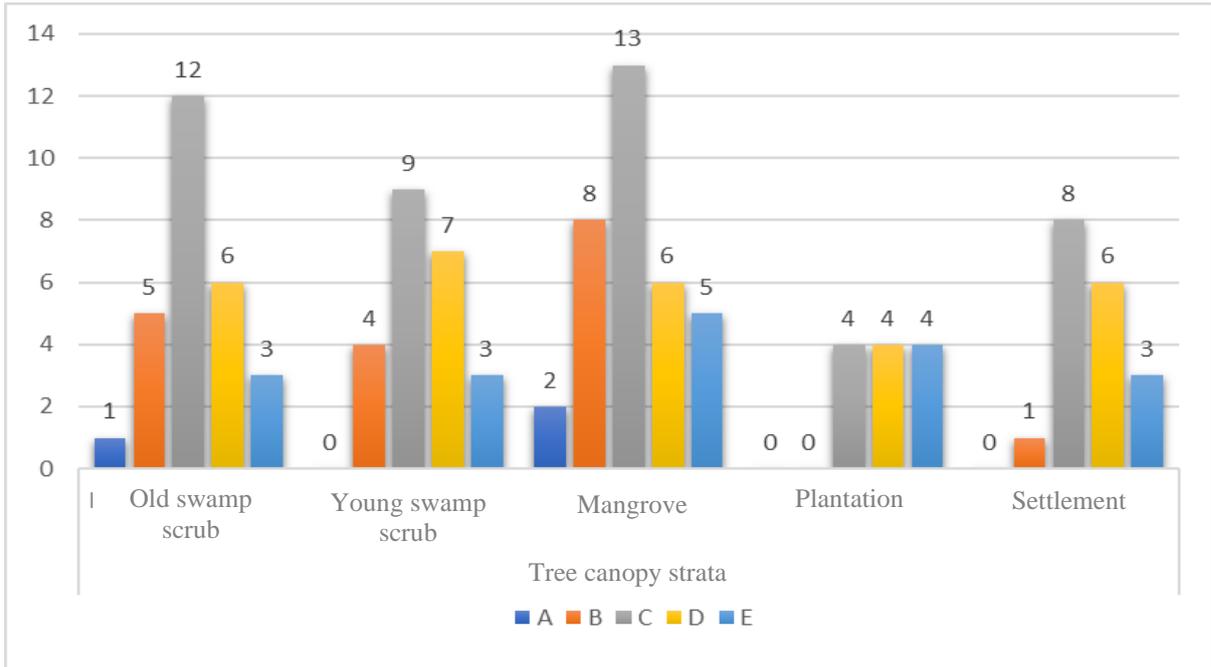
Figure 3 The use of tree canopy strata for each bird species in five habitat types in the PT Ekosistem Khatulistiwa Lestari area
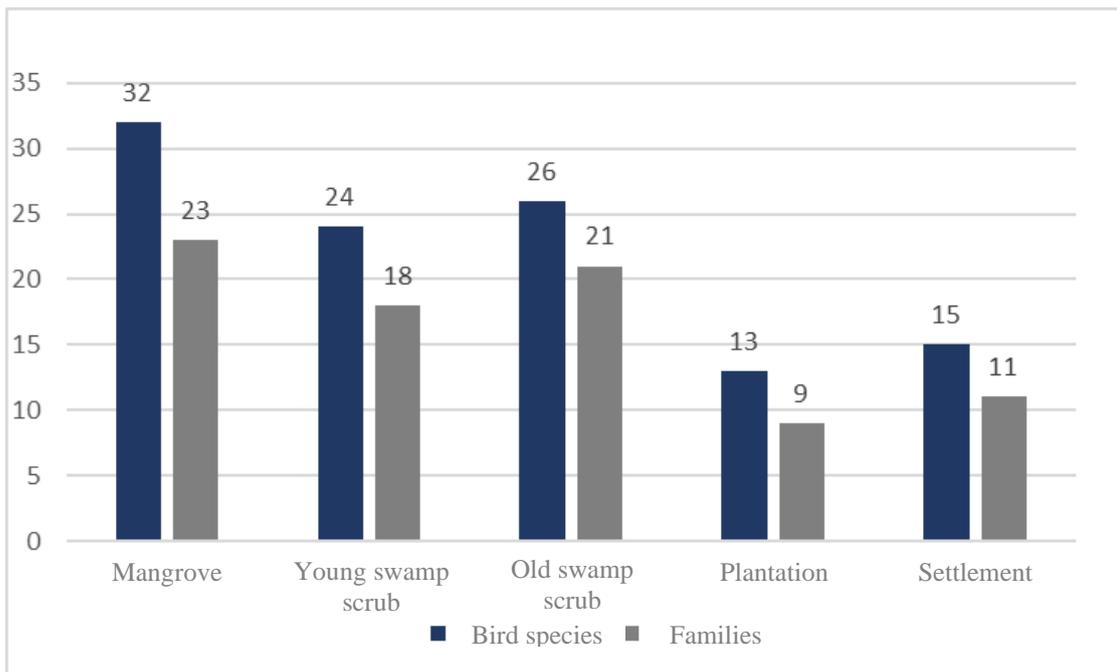

Figure 4 The encounter for the number of bird species and families in five habitat types in the PT Ekosistem Khatulistiwa Lestari area

The plantation habitat of PT Ekosistem Khatulistiwa Lestari comprised of smallholder plantations, coconut plantations (*Cocos nucifera L*) and oil palm plantations (*Elaeis guineensis Jacq*). The most dominant bird species was the pink-necked green pigeons (*Treron vernans*), occupying the C-canopy stratum.

In settlement areas, 15 species of 11 families were recorded. The most dominant was the olive-backed sunbird (*Cinnyris jugularis*) from the Nectariniidae family, which was observed using the C stratum and forages on *C. nucifera* coconut flower nectar. Various bird species in general, preferred the C stratum due to the abundance of food.

2. **Diversity, Evenness and Frequency of birds in IUPHHK-RE PT Ekosistem Khatulistiwa Lestari**

PT Ekosistem Khatulistiwa Lestari area has a diversity index value within the medium category (Figure 5). The Shannon-Wiener diversity index value is classified into several categories; value of 0 <H '<1.5 is categorised as having low diversity, 1.5 <H' <3.5 is moderate, and H '> 3.5 is high (Magurran 1988). Therefore, the bird species diversity for settlements, young swamp scrub, old swamp scrub, mangroves, and plantations indicated moderate diversities with H' values of 2.5, 2.75, 2.7, 2.8, and 2.2 respectively. Such category suggested that PT Ekosistem Khatulistiwa Lestari still provides adequate habitat for bird cmmunities. According to Arbi (2012), the high or low diversity indices can be influenced by various factors, including the abundance of the species. The evenness index of the five habitat types indicated high similarities (Figure 5), with values for settlement (E=0.93), young swamp scrub (E=0.88), old swamp scrub (E=0.83), mangroves (E=0.84), and settlements (E=0.85). According to Odum (1971), the evenness index value is stated to be high when it has a value > 0.60. Also, Rahman *et al.* (2008) stated that the Species Evenness Index (E) value can be used as an indicator of dominance among each species within the community (Rahman *et al*. 2008). This value describes a community's stability in an ecosystem (Ariza *et al.* 2014).

Asian red-eyed bulbul (*Pycnonotus brunneus*) was found in two types of habitat mangroves and old swamp scrubs with a total of 65 individuals. Meanwhile, 66 pink-necked green pigeons (*Treron Vernans*) were found in young swamp scrubs, old swamp scrubs, mangroves, and plantations with the highest frequency of 10% (Figure 6). The four habitat types consisted of varied fruit tree species. Fruits comprised the primary diets for the pink-necked green pigeons. These birds were absent in settlement habitat since most of the plant species is coconut, and the local people collected the sap water. According to Sawitri and Garsetiasih (2015), the primary food types for pink-necked green pigeons are seeds and fruits, in addition to insects, shellfish, worms, leaves, shoots, and flowers. The birds performed activities in groups (eat, fly or perch), hence often found abundant.

This study found that the dominant species is different for each habitat type. The olive-backed sunbird (*Cinnyris jugularis*) is the dominant species in the settlement habitat. This habitat is dominated by coconut trees and allow the birds to forage the nectars in the coconut tree inflorescences. Pacific swallow (*Hirundo tahitica*) is the most dominant species found in the young swamp scrubs since this habitat is rarely overgrown by large trees and is dominated by small trees and dry branches. According to MacKinnon *et al.* (1998), Pacific swallows are insectivorous birds which forage while flying. Meanwhile, the old swamp scrubs is dominated by Asian red-eyed bulbul with 25 individuals. The habitat is dominated by various fruit trees that are the sources of food for this species. While in mangroves, the copper-throated sunbird is the dominating species because they forage on nectars of trees and small insects.
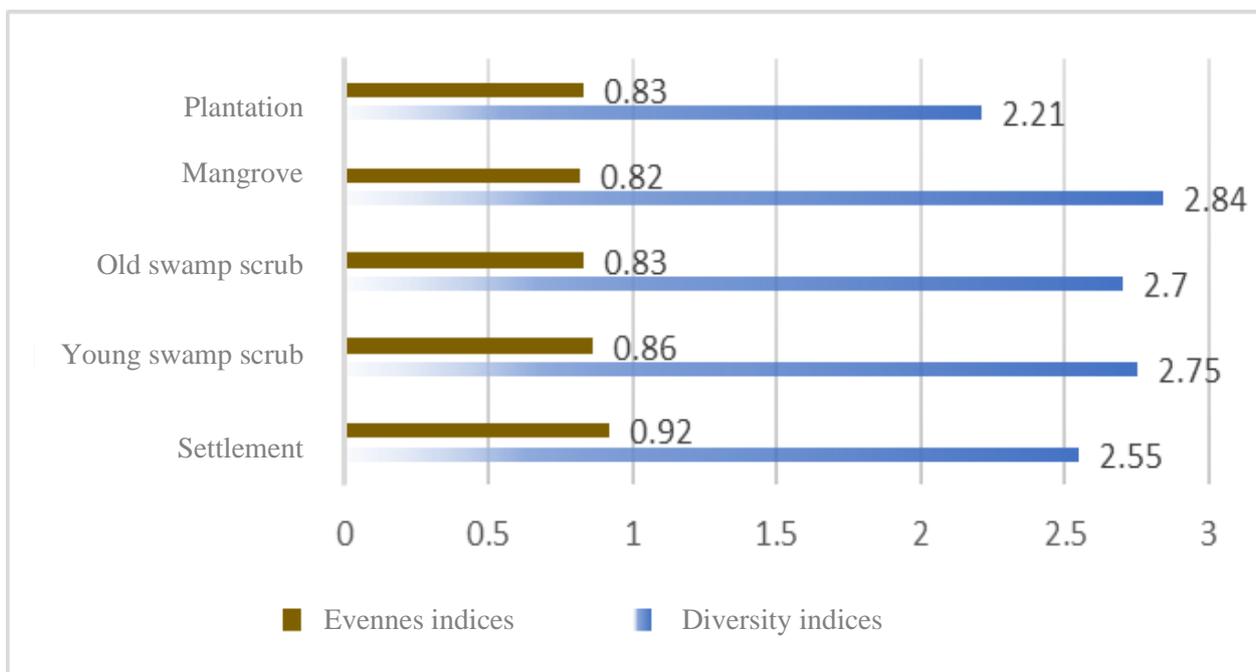

Figure 5 Evenness and diversity indices of bird species

Furthermore, the plantation habitat is dominated by pink-necked green pigeons because they often perch in the morning on dry trees, and the presence of food abundance in the form of sengganen (*Melastoma candidum D. Don*) often feed by this species.

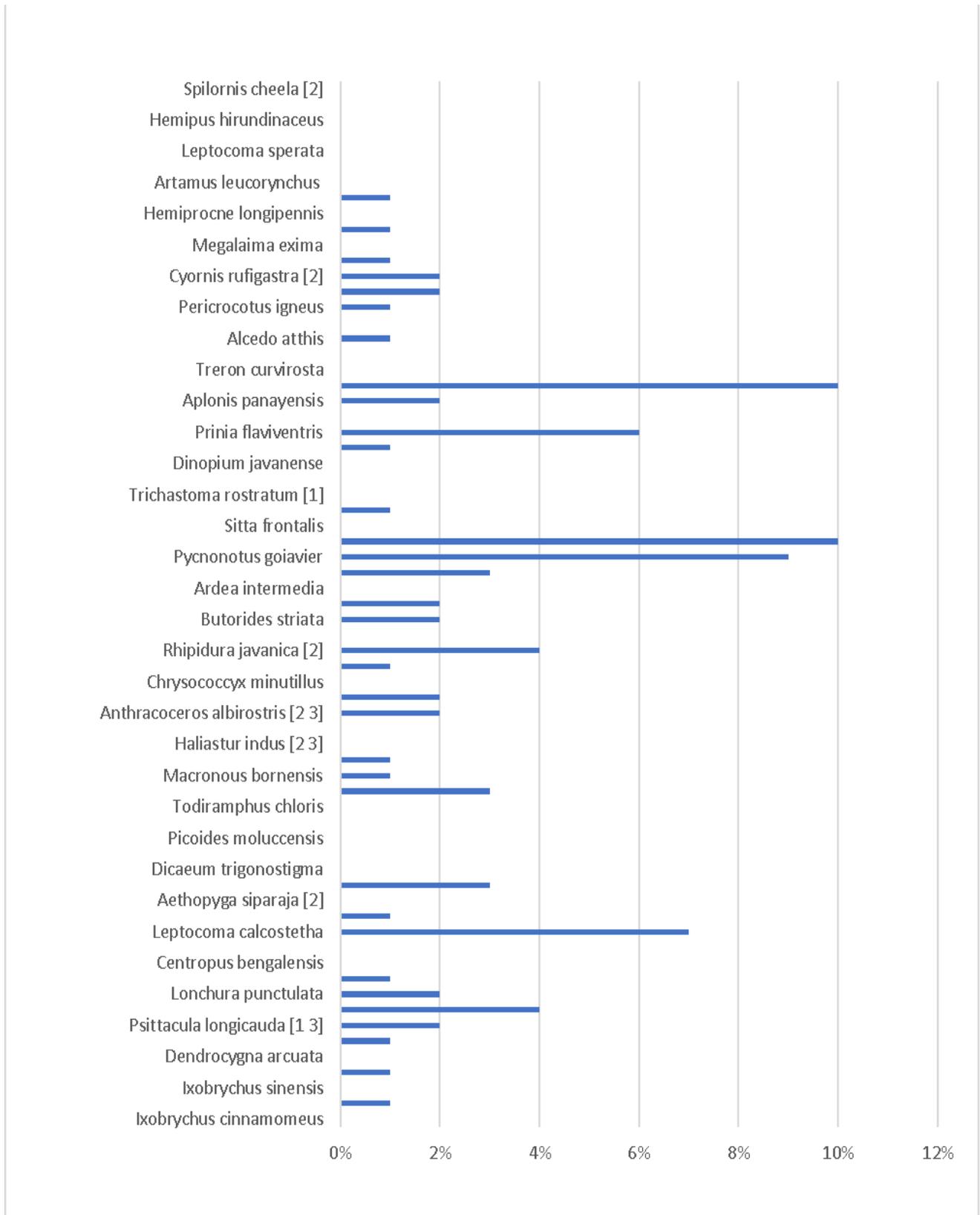### 3. Similarity of Bird Species in IUPHHK-RE PT Ekosistem Khatulistiwa Lestari

Results of similarity analysis showed that the highest similarity index (Figure 7) was found in settlements with a value of 25. This indicated that species found in settlements had high similarities with other vegetation types. In other words, the species at the research location can generally be found in settlement areas. Similarly, habitats having the same species were generally found in young swamp scrubs and settlements with an average value of 25. The similarity in the two habitats was due to the similar characteristics of the study locations. Furthermore, young swamp scrubs and settlements have a fairly homogeneous vegetation composition with minimum canopy cover dominated by coconut, acacia, and oil palm plantations. The species similarity in different habitats is related to the birds' distribution which is influenced by their habitat suitability, including adaptation, vegetation, food availability, natural selection, and other natural factors (Alikodra 2002).

The differences found within the five habitat types were due to the habitat restriction of the birds, such as species that were confined in one habitat only, such as the copper-throated sunbird of the Nectariniidae family found only in mangroves. The Alcedinidae family is closely related to the presence of mangrove vegetation, including the stork-billed kingfisher (*Pelargopsis capensis*), common kingfisher (*Alcedo atthis*), and the blue-eared kingfisher (*Alcedo meninting*) which used mangrove roots above the water surface as a place to perch and observe the fish in the water for food. In addition, the frequency level of wild birds using plant species is one of the criteria to show their dependence level in using habitat for activities (Forestry *et al.* 2017).

As many as 8 species found in PT Ekosistem Khatulistiwa Lestari area are protected according to P.106/MENLHK/SETJEN/KUM.1/6/2018, namely the black-thighed falconet (*Microhierax fringillarius*), lesser adjutant (*Leptoptilos javanicus*), crimson sunbird (*Aethopyga siparaja*), brahminy kite (*Haliastur indus*), oriental pied hornbill (*Anthracoceros albirostris*), Malaysian pied fantail (*Rhipidura javanica*), blue-crowned hanging parrot (*Loriculus galgalus*), and crested serpent-eagle (*Spilornis cheela*). Furthermore, several species are protected by the IUCN, namely the lesser adjutant (*Leptoptilos javanicus*), long-tailed parakeet (*Psitacula longicauda*), black-bellied malcoha (*Rhopodytes diardi*), and white-chested babbler (*Trichastoma rostratum*). In addition, seven bird species are protected according to CITES and they are all included in the Appendix II category, that is, species not necessarily threatened with extinction, but the trade must be controlled in order to avoid utilization incompatible with their survival. These species are lesser adjutant (*Leptoptilos javanicus*), savanna nightjar (*Camprimulgus affinis*), brahminy kite (*Haliastur indus*), brown hawk-owl (*Ninox scutulata*), blue-crowned hanging parrot (*Loriculus galgalus*), and crested serpent-eagle (*Spilornis cheela*) (Figure 6).

The direction for conservation measures that can be taken by PT Ekosistem Khatulistiwa Lestari using the bird distribution data (Appendix 1) is community participation-based conservation efforts, which can be packaged through bird watching as a special interest eco-tourism activity. Bird watching activity among the Indonesian society began in the 1990s (Ambarwati 2011). In line with the increased community's understanding of wildlife ecological functions, their perspectives have shifted to enjoying free-live animals (not kept in cages).

(Note: [1]: IUCN; [2]: P.106/MENLHK/SETJEN/KUM.1/6/2018; [3]: CITES)
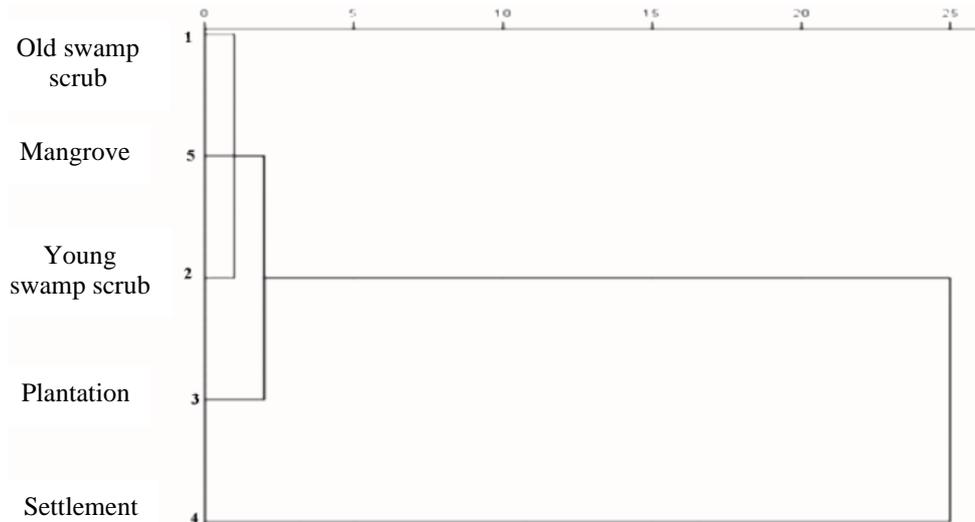Figure 6 Frequency of bird species in the PT Ekosistem Khatulistiwa Lestari area

Figure 7 Dendogram of bird species similarity
Description: 1) Old swamp scrub, 2) Young swamp scrub, 3) Plantation, 4) Settlement, 5) Mangrove

CONCLUSION

There were 67 bird species of 35 families were recorded in PT Ekosistem Khatulistiwa Lestari, with the highest number of species found in mangroves (32 species) followed by old swamp scrubs (26 species), young swamp scrubs (24 species), settlements (15 species), and the least in plantation areas (13 species), and. The diversity index indicated a moderate diversity with values of the five habitats between 1.5 <H '<3.5. Furthermore, the highest species evenness was found in settlements (E = 0.92) indicating the highest similarities with the other habitat types. Therefore, it can be concluded that the birds'distribution in the five habitats of PT Ekosistem Khatuliswa Lestari were evenly distributed.

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Appendix 1. Bird species encounters per habitat type

No.	Bird species	Checklist of bird species per land use				
		Settlement	Young swamp scrub	Old swamp scrub	Mangrove	Plantation
1	*Ixobrychus cinnanomeus*		√			√
2	*Microhierax fringillarius*		√		√	
3	*Ixobrychus sinensis*	√				
4	*Leptoptilos javanicus*			√	√	
5	*Dendrocygna arcuata*		√			√
6	*Lanius schach*		√			
7	*Psitacula longicauda*		√	√	√	
8	*Lonchura fuscans*	√	√			√
9	*Lonchura punctulata*	√				√
10	*Lonchura atricapilla*	√	√			
11	*Centropus bengalensis*		√			√
12	*Centropus sinensis*		√		√	
13	*Leptocoma calcostetha*				√	
14	*Anthreptes malacensis*	√				
15	*Aethopyga siparaja*	√				
16	*Cinnyris jugularis*	√	√	√	√	√
17	*Dicaeum trigonostigma*		√			
18	*Caprimulgus affinis*	√				
19	*Picoides moluccensis*				√	
20	*Lacedo pulchella*			√		
21	*Todiramphus chloris*			√		
22	*Aegithina tiphia*				√	
23	*Macronus bornensis*			√	√	
24	*Pycnonotus aurigaster*					√
25	*Haliastur indus*					√
26	*Rhopodytes diardi*			√		
27	*Anthracoceros albirostris*			√	√	
28	*Amaurornis phoenicurus*			√	√	√
29	*Chrysococcyx minutillus*				√	
30	*Acridotheres javanicus*			√		
31	*Rhipidura javanica*	√		√	√	
32	*Merops philippinus*		√			
33	*Butorides striata*				√	√

No.	Bird species	Checklist of bird species per land use				
		Settlement	Young swamp scrub	Old swamp scrub	Mangrove	Plantation
34	*Copsychus saularis*				√	
35	*Ardea intermedia*		√			
36	*Hirundo tahitica*		√			
37	*Pycnonotus goiavier*		√	√	√	√
38	*Pycnonotus brunneus*			√	√	
39	*Sitta frontalis*				√	
40	*Pelargopsis capensis*				√	
41	*Trichastoma rostratum*				√	
42	*Dryocopus javensis*	√				
43	*Dinopium javanese*		√			
44	*Chrysophlegma miniaceum*		√	√	√	
45	*Prinia plaviventris*	√	√	√	√	√
46	*Ducula aenea*		√			
47	*Aplonis panayensis*		√	√		
48	*Treron vernans*		√	√	√	√
49	*Treron curvirosta*			√		
50	*Ninox scutulata*	√				
51	*Alcedo atthis*				√	
52	*Alcedo meninting*				√	
53	*Pericrocotus igneus*				√	
54	*Loriculus galgulus*	√	√	√	√	
55	*Cyornis rufigrasta*			√	√	
56	*Dicrucus paradiseus*			√	√	
57	*Megalaima exima*			√		
58	*Streptopelia chinensis*	√	√			
59	*Hemiprocne longipennis*				√	
60	*Actitis hypoleucos*		√	√	√	
61	*Artamus leucorynchus*	√				
62	*Corvus macrorhynchos*	√				
63	*Leptocoma sperata*					√
64	*Orthotomus sericeus*				√	
65	*Hemipus hirundinaceus*			√		
66	*Orthotomus ruficeps*			√		
67	*Spilornis cheela*			√		