Biosaintifika
Journal of Biology & Biology Education

Bird Communities In Seblat Nature Recreation Park (SNRP) North Bengkulu, Bengkulu

✉Eki Susanto[1,4], Yeni Aryati Mulyani[2], Bambang Suryobroto[3]

[1]Animals Biosciences, Graduates School, Bogor Agricultural University, Indonesia
[2]Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry
Bogor Agricultural University, Indonesia
[3]Department of Biology, Faculty of Mathematical and Science, Bogor Agricultural University, Indonesia
[4]Bencoolen Bird Watching, Indonesia

Abstract

Bird communities are the composition of several bird species that live together in the same place, time and interact with other birds. The diversity of birds in an area can be used as an indicator of stabilizing an area. Changes of vegetation structures due to logging practices can affect the availability of resources for bird communities. The objective of the research was to examine diversity, richness, bird species abundance and bird community similarity at HS1 (logged forest 1974), HS2 (logged forest 1989/1990) and HS3 (fully logged forest 1989/1990) in Seblat Nature Recreation Park (SNRP). The research was conducted in July – September 2013. Data collection was conducted by point count method (total 36 points) and mist net method (total 4752 nets hours). The Research showed 85 bird's species from 33 families were recorded. HS2 was highest value of diversity and richness (H '= 3.63, D_{MG} = 10.07). The highest relative abundance species in HS1 was Emerald Dove (*Chalcophaps indica*), while HS2 and HS3 were Slender-billed Crow (*Corvus enca*). The bird community similarity was highest in HS2 and HS3 (ISj = 0.58).

How to Cite

Susanto, E., Mulyani, Y. A., & Suryobroto, B. (2016). Bird Communities In Seblat Nature Recreation Park (SNRP) North Bengkulu, Bengkulu. *Biosaintifika: Journal of Biology & Biology Education*, 8(1), 25-32.

✉ Correspondence Author:
Jl. Raya Darmaga, Bogor, Jawa Barat
E-mail: eki010789@gmail.com

INTRODUCTION

Bird communities are the composition of several bird species that live together in same place, time and interact with other birds (Wiens, 1989). Bird communities can be observed by using parameters such as diversity, relative abundance, evenness and species composition (Magurran 2004; Novarino et al., 2008). The diversity of birds can be used as an indicator of stability in an area (Waltert et al., 2004; BirdLife International, 2013). Birds were an indicator of good or bad an ecosystem because the birds can live in all types of habitats and different altitudes (Sujatnika et al., 1995; Widodo, 2014).

Vegetation structure is very important for a bird life, because it can be used as a residence, foraging, life cycle, and shelter from predators. If plant communities in an area continue to decrease, the number of bird species can be reduced, resulting in the loss of bird species. Changes of vegetation structure due to logging practice can affect the availability of resources for bird communities (Manhaes & Dias, 2011). Limited resources can result in competition between species in a region.

Seblat Nature Recreation Park (SNRP) is one of the conservation area in North Bengkulu, Bengkulu Province. SNRP is a natural green area, available for bird communities in Sumatera. SNRP is an area of ± 7737 ha (56-113 m ASL), consisted of logged secondary forest, old shrubs and cultivation (Balai Konservasi Sumber Daya Alam, 2002). In the previous study on SNRP, Jarulis et al. (2010) recorded 105 birds species consisting of 14 orders, 34 families 73 genera with diversity index (H')= 3.9. However, they did not specify diversities of bird in each vegetation structures. The general aim of this research was to examine the relationship between bird communities and variation vegetation structure in SNRP. The specific purpose of this research was to study diversity, richness, bird species abundance and bird community similarity at logged forest 1974 (HS1), logged forest 1989/1990 (HS2) and full logged forest 1989/1990 (HS3) in Seblat Nature Recreation Park (SNRP).

This study will be useful for basic data provision, evaluation, and protection of the bird community. More over the study findings can be beneficial for education, because they improve the knowledge of wildlife, especially bird composition in Seblat Nature Recreation Park (SNRP).

METHODS

Research was conducted in the Seblat Nature Recreation Park (101°39'18''-101°44'50''E and 03°03'12''- 03°09'24''S) North Bengkulu, Bengkulu from July-September 2013. Observations were carried out in three types of vegetation structures, they are HS1 (101°41.393'E and 03°07.434'S), HS2 (101°42.420'E and 03°08.263'S) and HS3 (101°42.233'E and 03°08.138'S) (Figure 1).
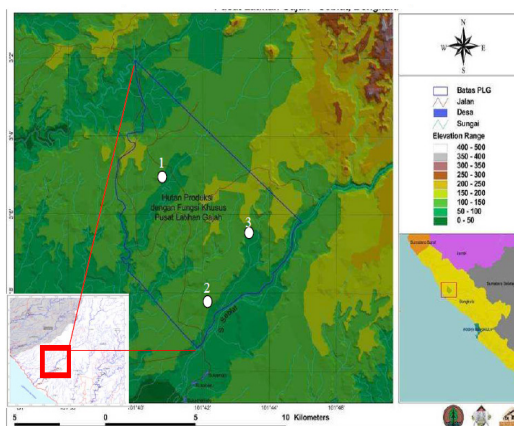

Figure 1. Study sites in the Seblat Nature Recreation Park (SNRP). 1). Logged forest 1974 (HS1), 2). Logged forest 1989/1990 (HS2), and 3). Fully logged forest 1989/1990 (HS3).

HS1 was a forest logged over in 1974. The trees in location had a height of ±15-22 m. HS2 was a forest logged over 1989/1990. HS2 was occupied by camp around and it was dominated by trees with a height of 15-20m. HS3 was a fully logged forest 1989/1990. HS3 was dominated by understorey, where the canopy conditions tended to be more open if compared with two locations. Sunlight could get to the forest floor in HS3.

Data collection was carried out by observation (Binocular, *Bushnell* 12 x 50) and trapping (mist nets, four units, HTX 12 x 2.5 m, 32-36 mm mesh and nylon). Rings (aluminum or incoloy) with a number from Indonesian Bird Banding Scheme (IBBS) were used to mark the birds caught. Global Positioning System (GPS) was used to get latitude and longitude of site observations. Identification of bird species used field guides by MacKinnon et al. (2010) and Robson (2000). The Bird naming is adjusted to Indonesian Bird List 2 (Sukmantoro et al., 2008). Sex and age were determined from morphological characters and other body parts referring to Robson (2000). Supporting data (habitat conditions,

technical implementation of the study, species identification) was documented by DSLR camera (Sony Alpha 37).

Bird community data was collected by using point counts method (Bibby et al., 2000). Sixteen observation points were placed in each of vegetation structures. Species and number of bird was seen or heard within a radius of 25 m for 10 minutes were recorded. Twenty-five meters radius was used with consideration of observers' ability to detect birds in forest habitats. Distances between the observation points were 50 m. Observations were undertaken in the morning (06.00 – 09.00 am) and afternoon (04.30 – 06.00 pm).

Mist nets were used to obtain information about bird species, not easily detected by point count method (Bibby et al., 2000). Mist nets were set up starting at 0500 am and it was opened at 0600 am – 0500 pm. Mist net checks were performed every 1 hour, whereas in hot weather mists net was checked every 30 minutes. When it rained, nets were closed earlier to prevent bird mortality. Total set up of mist nets were 4752 net hours (HS 1 = 1584 net hours, HS 2 = 1584 net hours, HS3 = 1584 net hours). Birds capture were carefully removed, put on cloth bag and brought to banding station. The ring was mounted on right tarsus (Novarino, 2008; Haryoko, 2011). After that, birds were released in the original habitat of trapping.

Data analysis was conducted to get parameters such as diversity, the richness of species, and similarity of bird communities. Diversity and richness of species were described by using Shannon diversity and Margalef index (Magurran, 2004). Relative abundance was analyzed by calculating abundance ratio of individual species refers to Fowler & Cohen (1986). The similarity of bird communities was examined by Jaccard similarity index (ISj) (Magurran, 2004).

RESULT AND DISCUSSION

A total of 85 bird species from 33 families were recorded (point count = 79 species and mist nets = 30 species) and 22% (85 species) all species of birds were found in Sumatra (MacKinnon et al., 2010). In his research Jarulis et al. (2010) recorded 105 species, whereas this study obtained 85 species. Differences in the number of species recorded in this research were compared with the previous research under the different time of the research (July - August) and method (method transect). Different time of observation, methods and research location were recorded as factors that influence the number of species in a region (Esdates, 1997; Haselmayer & Quinn, 2000; Azhar et al., 2013).

Each study sites had different diversity (H'), Margalef richness (D_{Mg}) indices and a number of species (Table 1). In HS1, there were 152 individuals, 42 species, and 24 families recorded (point count and mist net). In HS2, there were 162 individuals, 54 species, and 24 families recorded (point count and mist net). In HS3, there were 168 individuals, 54 species, and 26 families recorded (point count and mist net).

Table 1. Number of Species, diversity, and richness in each location

Variable	Location		
	HS1	HS2	HS3
Number of Species	42 (49.4%)	54 (63.5%)	50 (58.8%)
Diversity (H')	3.28	3.63	3.52
Richness (D_{Mg})	7.87	10.07	9.29

Description: HS1 (logged forest 1974), HS2 (logged forest 1989/1990) and HS3 (full logged forest 1989/1990)

Vegetation structure is an important determinant of bird communities in each habitat. Vegetation structure is a source of food for birds. Vegetation composition in HS1 was dominated by Sapat (*Macaranga tanarius*), Meranti (*Shorea leprosula*), Kayu laban (*Vitex pubescens*) and Sibalik (*Mallotus* sp). The height of trees in location was ±15-22 m. Canopy conditions of trees were higher, denser than that of another sites and distance of each plant tended to be very closed. HS2 was used as a camp, dominated by trees of 15-20 m in height. The composition of vegetation structure was dominated by Kekerang (*Macaranga tanarius*), Kayu laban (*Vitex pubescens*), Ara (*Ficus* sp) and Jambu hutan (*Syzygium* sp). Different from HS1, HS2 canopy conditions of trees were rare, and the distance of each plant was not that dense. As a result, sunlight achieved the forest floor and understory plants, namely: Alang-alang (*Imperata cylindrica*), Jahean (*Alpinia malaccensis*), Senggani (*Melastoma candidum*), and Putri Malu (*Mimosa pudica*). HS3 was dominated by understory plant, i.e. Alang-alang (*Imperata cylindrica*), Jahean (*Alpinia malaccensis*), Senggani (*Melastoma candidum*), Putri Malu (*Mimosa pudica*), Secang (*Caesalpinia sappan*), Petai-petaian (*Parkia* sp), and herbage (*Cyperus* spp.). Trees found were only Kayu laban (*Vitex pubescens*), Meranti (*Shorea leprosula*), and Ara (*Ficus* sp). Canopy conditions in HS3 were likely to be more opened if compared

to the two locations, and sunlight directly went to the forest floor.

Vegetation provides feed on stems, leaves, fruits, flowers and nectar. Bird can use one type of feed or combination several types of feed. Vegetation as food resources is very important to the life of various birds' species (Widodo, 2015). Various studies demonstrated that bird diversity was different in regions from different vegetation structure (Chettri et al., 2005; Waltert et al., 2005; Zakaria et al., 2005). This study indicated the bird communities were greater in the HS2 than one in HS1 and HS3. HS2 had complex vegetation, offering more niches and higher levels of plant. It contributed to more bird species diversity (Pearman, 2002; Miller et al., 2004; Ferger et al., 2014). Fewer species were found in HS1 and HS3 because these habitats were structurally simpler that gave fewer niches for birds.

The Pycnonotidae (bulbuls) had the highest number of individuals captured and observed by 117 individuals (20.63%) (Table 2). It consisted of ten species, .i.e. *Pycnonotus simplex* 29 individuals, *Pycnonotus goiavier* 12 individuals, *Pycnonotus melanicterus* 33 individuals, *Pycnonotus brunneus* 30 individuals, *Pycnonotus aurigaster* two individuals, *Pycnonotus cyaniventris* four individuals, *Pycnonotus erythropthalmos* one individual, *Criniger phaeocephalus* four individuals, *Ixos malaccensis* one individual and *Tricholestes criniger* 1 individual.

In Indonesia, Pycnonotidae is fairly widespread in Sumatera, because it has high adaptation ability to environment and feed. They are active in all parts of the tree strata such as under, middle or top of the canopy (MacKinnon et al., 2010), so species were easily caught or seen in large quantities in all types of vegetation structures. Another factor affects abundance of Pycnonotidae is locations. Locations (HS1, HS2, and HS3) are secondary forests, and it has higher richness than primary forests. Secondary forests were caused by the effect of higher diversity habitat so it can accommodate more species (Novarino, 2008).

The comparison bird species found in all types of vegetation structures with the highest relative abundance in HS 1 were *Chalcophaps indica* 2.99% (17 individuals; point count = 13 individuals, mist net = 4 individuals), while in HS2 and HS3 were *Corvus enca* 2.64% (15 individuals; point count = 15 individuals, mist net = 0 individuals) and 2.99% (17 individuals; point count = 17 individuals, mist net = 0 individuals) (Table 3).

Table 2. The abundance of family, the number of species and individual same caught and observed in all locations.

Family	Number of			
	Species	%	Individual	%
Accipitridae	2	2.35	3	0.53
Columbidae	2	2.35	28	4.94
Trogonidae	1	1.18	1	0.18
Cuculidae	6	7.06	11	1.94
Apodidae	1	118	10	1.76
Phasianidae	1	1.18	1	0.18
Picidae	7	8.24	10	1.76
Capitonidae	2	2.35	7	124
Bucerotidae	4	4.71	47	8.29
Alcedinidae	4	4.71	12	2.12
Meropidae	2	2.35	28	4.94
Hirundinidae	1	1.18	3	0.53
Corvidae	1	1.18	43	7.58
Campephagidae	1	1.18	4	0.71
Oriolidae	1	1.18	1	0.18
Irenide	1	1.18	6	1.06
Laniidae	1	1.18	9	1.59
Pittidae	1	1.18	1	0.18
Eurylaimidae	1	1.18	1	0.18
Sittidae	1	1.18	4	0.71
Aegithinidae	2	2.35	20	3.53
Dicruridae	2	2.35	23	4.06
Muscicapidae	2	2.35	8	1.41
Turdidae	2	2.35	7	1.24
Monarchidae	2	2.35	6	1.06
Chloropseidae	2	2.35	19	3.35
Pycnonotidae	10	11.76	117	20.63
Timaliidae	7	8.24	24	4.23
Nectarinidae	3	3.53	25	4.41
Dicaidae	4	4.71	25	4.41
Syllvidae	5	5.88	54	9.53
Zosteropidae	1	1.18	3	0.53
Estrildidae	1	1.18	5	0.88
Ploceidae	1	1.18	1	0.18
Total	**85**	**100**	**567**	**100**

Description: HS1 (logged forest 1974), HS2 (logged forest 1989/1990) and HS3 (full logged forest 1989/1990)

**Table 3**. The abundance (%) of dominant species in each location.

Species	Location		
	HS1	HS2	HS3
Chalcophaps indica	2.99	1.23	0.18
Buceros rhinoceros	0.35	1.06	1.94
Buceros bicornis	0.18	1.41	0.70
Ceyx rufidorsa	0.70	0.18	0.18
Merops viridis	1.59	0.35	2.82
Corvus enca	1.94	2.64	2.99
Lanius tigrinus	0.35	0.70	0.88
Dicrurus paradiseus	0.70	2.11	0.88
Enicurus leschenaulti.	0.18	0.35	0.18
Pycnonotus simplex	2.82	0.88	1.41
Pycnonotus goiavier	0.35	1.06	0.70
Pycnonotus melanicterus	1.76	1.94	1.94
Pycnonotus brunneus	2.11	1.76	1.41
Trichastoma rostratum	0.35	0.53	0.53
Anthreptes simplex	0.53	0.18	0.35
Arachnothera longirostra	0.35	1.59	0.35
Dicaeum cruentatum	0.18	0.53	0.88
Prionochilus percussus	0.53	0.88	0.35
Prionochilus maculatus	0.35	0.18	0.18
Prinia familiaris	1.94	1.41	0.53
Orthotomus ruficeps	0.35	0.88	1.06

Description: HS1 (logged forest 1974), HS2 (logged forest 1989/1990) and HS3 (full logged forest 1989/1990)

Chalcophaps indica (Figure 2) dominated the HS1, because there were plants bearing fruits. *Chalcophaps indica* belonged to the family of Columbidae and frugivorous (Styring et al. 2011; British Trust of Ornithologist 2014 (2014). This group of birds was adaptable to the season of fruits. Frugivorous feed on a variety of fruits was widely available for the secondary forest. Frugivorous birds had the ability to select preferred fruit based on color detection, seed size, nutrient content and fruiting arrangement (Herrera, 1982; Levey et al., 1984; Gautier-Hion et al., 1985; Levey, 1987).

Figure 2. Emerald Dove (*Chalcophaps indica*).

The similarity of the bird community was highest in HS2 and HS3. Results of analysis generated similarity index (ISj) 0.58 (Table 4). Thirty-five bird species were found in HS2 and HS3 too. The high similarity of the bird community (0.58) was caused in two locations have similar shrubs, and understorey is habitat for bird species. Adhikerana (1997) suggested that bird distribution in
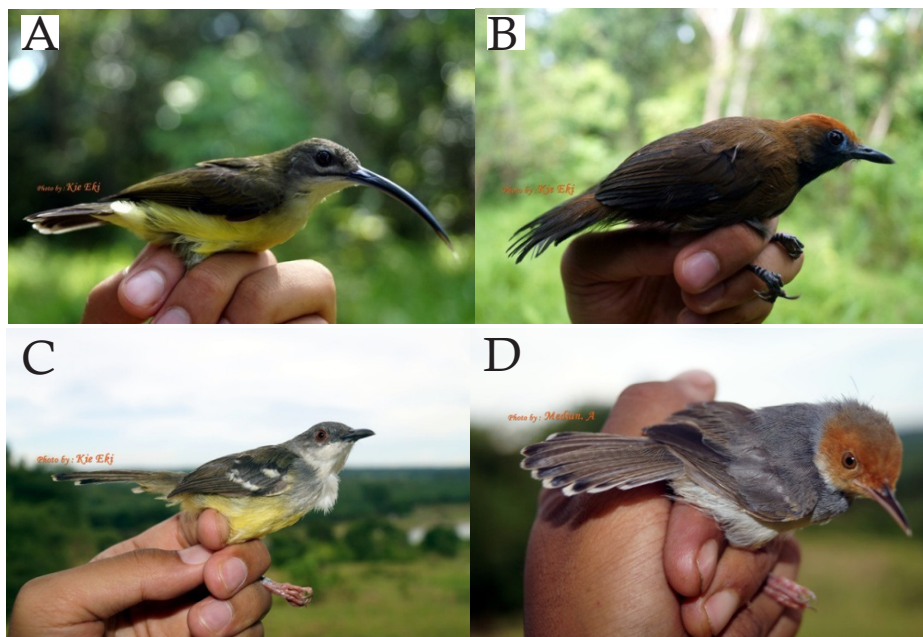
Figure 3. (A) Little Spiderhunter (*Arachnothera longirostra*), (B) Striped Tit-Babbler (*Macronous gularis*), (C) Bar-winged Prinia (*Prinia familiaris*), and (D) Ashy Tailordbird (*Orthothomus ruficeps*).
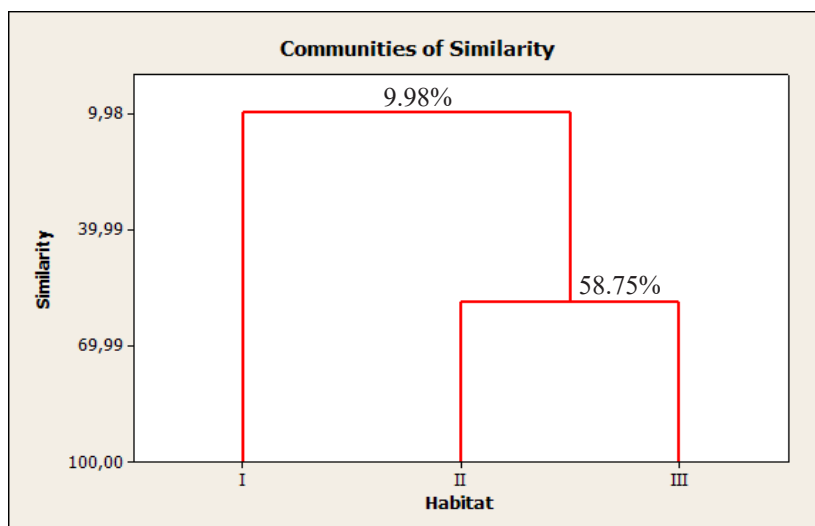
Figure 4. Dendrogram of similarity index bird species at three locations (I: HS1, II: HS2, and III: HS3) in Seblat Nature Recreation Park, North Bengkulu, Bengkulu.

an area have a close relationship with each type of habitat. Selection of bird habitat based on vegetation and factors that influence presence of bird species in a habitat were caused by selection results, so habitats were appropriate for bird life (Blake & Hoppes, 1986). The same understorey plant in HS2 and HS3 were Alang-alang (*Imperata cylindrica*), Jahean (*Alpinia malaccensis*), Senggani (*Melastoma candidum*) and Putri Malu (*Mimosa pudica*). The similarity of open area was shrubs and understorey plants, unseparated from the increase in canopy opening, it caused bird individual like open areas. The open canopy could result in the rapid growth of understorey plant and habitat for birds bush, so and insensitive to disturbances (Arriaga-Weiss et al. 2008; Moradi & Mohammed, 2010). Besides that, shrubs and understorey plants had very appropriate to the needs of understorey birds (Partasasmita et al., 2009; Widodo, 2014). Bird species that like the open areas i.e. Little Spiderhunter (*Arachnothera longirostra*) (Figure 3A), Striped Tit-Babbler (*Macronous gularis*) (Figure 3B), Bar-winged Prinia (*Prinia familiaris*) (Figure 3C), Yellow-bellied Prinia (*Prinia flaviventris*) and Ashy Tailorbird (*Orthothomus ruficeps*) (Figure 3D) utilizing the area for activities (MacKinnon et al., 2010).

The community similarity between two locations with HS1 was only 9.98% (Figure 4). Thirteen bird species were recorded only in HS1 and not found in two locations. The low community similarity was caused by different composition and vegetation structure. Some studies showed the composition and vegetation structure affected the diversity of bird species (Aleixo, 1999; Chettri et al., 2005; Garcia & Martinez, 2012). Vegeta-

tion condition in HS1 were trees of 15-20 m in height, and canopy dense, and the little open area was overgrown shrubs, when the observation was conducted, many birds activity was seen in the upper canopy tree. One characteristic of species that like this condition, only in HS1 was Dark-throated Oriole (*Oriolus xanthonotus*). It was active in the upper canopy trees (MacKinnon et al., 2010).

Table 4. Similarity index bird species based on Jaccard similarity index (ISj).

Similarity index bird species	HS 1	HS 2	HS3
HS1	1	0.34	0.31
HS2		1	0.58
HS3			1

Description: HS1 (logged forest 1974), HS2 (logged forest 1989/1990) and HS3 (full logged forest 1989/1990)

Vegetation structure influences the composition distribution of birds in each habitat. All types of vegetation structures were dominated by insectivorous birds because insects were continuously available while fruit and nectar were influenced by seasons. Insect abundance is stable if compared to the abundance of fruit and nectar (Wong, 1986). Also, plants were bloomed at the time of research, so insects wheedled to come on flowers. Insectivorous bird domination were also found on bird communities in Sumatera (Novarino et al., 2008; Fujita et al., 2014), Java (Sodhi et al., 2005; Rahayuningsih et al., 2010), Wong, 1986; Lambert & Collar, 2002; Posa, 2011; Az-

man et al., 2011) and Sulawesi (Waltert et al., 2005).

The height diversity of bird species in Seblat Nature Recreation Park indicated that SNRP area had a high conservation value if managed properly, and if conserved wisely. Monitoring bird community needs to be done sustainably from each location. The participant of local government and managers of Seblat Nature Recreation Park were improved via socialization to people from surrounding area, about importance of vegetation for wildlife, especially bird life in Seblat Nature Recreation Park, North Bengkulu, Bengkulu.

CONCLUSION

Different vegetation structures affected diversity, richness, bird species relative abundance, and bird community similarity at HS1 (logged forest 1974), HS2 (logged forest 1989/1990) and HS3 (full logged forest 1989/1990) in Seblat Nature Recreation Park (SNRP). Logged forest in 1989/1990 (HS2) showed the highest diversity and richness than that of logged forest 1974 (HS1) and fully logged forest 1989/199 (HS3). The Pycnonotidae (bulbuls) was a group that dominated all sites. The highest abundance of species in HS1 was Emerald Dove (*Chalcophaps indica*) while HS2 and HS3 were Slender-billed Crow (*Corvus enca*). The bird community similarity was highest in HS2 and HS3 (ISj = 0.58).

ACKNOWLEDGMENT

REFERENCES

Adhikerana, A. S. (1997). Komunitas burung di delapan tipe habitat di Pulau Siberut, Indonesia. *Berita Biologi*, 4(1), 1-6.

Aleixo, A. (1999). Effect of selecting logging on a bird community in the Bazilian Atlantic forest. *Condor*, 101, 537-548.

Arriaga-Weiss, S. L., Calme, S., & Kamampichler, C. (2008). Bird communities in rainforest fragments: guild responses to habitat variables in Tabasco, Mexico. *Biodiversity and Conservation*, 17, 173–190.

Azhar, B., Lindenmayer, D. B., Wood, J., Fischer, J., Manning, A., McElhinny, C., & Zakaria, M. (2013). The influence of agricultural system, stand structural complexity and landscape context on foraging birdsin oil palm landscapes. *Ibis*, 155(1), 297–312.

Azman, M. A., Latif, N. S. A., Sah, S.A.M., Akil, M. A. M. M., Shafie, N. J. S., & Khairuddin, N.L. (2011). Avian diversity and feeding guilds in a secondary forest, an oil palm plantation and a paddy field in riparian areas of the Kerian River Basin, Perak, Malaysia. *Tropical Life Sciences Research*, 22(2), 45–64.

Balai Konservasi Sumber Daya Alam Bengkulu. (2002). *Profil Kawasan Konservasi di Bengkulu*. Bengkulu: BKSDA Bengkulu.

British Trust of Ornitologist. (2014). *Columbidae Family*. Retrieved from http://www.bto.org/about-birds/birdfacts/bird-families/pigeons.

Bibby, C. J., Burgess, N. D., Hill, D. A., & Mustoe, S. H. (2000). *Bird Census Techniques*. 2nd Ed. Tokyo: Academic Press.

Birdlife International. (2013). *Asian birds save the endangered guide to government and civil society*. Retrieved from http://www.birdlife.org/.

Blake, J. G., & Hoppes, W. G. (1986). Influence of resource abundance on use of treefall gaps by birds in an isolated woodlot. *Auk*, 103, 328-340.

Chettri, N., Deb, D.C., Sharma, E. & Jackson, R. (2005). The relationship between bird communities and habitat a study along a Trekking Corridor in The Sikkim Himalaya. *Mountain Research and Development*, 25(3), 235-243.

Estades, C. F. (1997). Bird-habitat relationships in a vegetational gradient in the Andes of Central Chile. *The Condor* 99(1), 719-727.

Ferger, S. W., Schleuning, M., Hemp, A., Howell, K. M., & Gaese, K. B. (2014). Food resources and vegetation structure mediate climatic effects on species richness of birds. *Global Ecol. Biogeogr*, 23(5), 541–549.

Fowler, J. & Cohen, L. (1986). *Statistics for Ornithologist*. England: British Trust for Ornithology.

Fujita, M. S., Prawiladilaga, D. M., & Yoshimura, T. (2014). Roles of fragmented and logged forests for bird communities in industrial *Acacia mangium* plantations in Indonesia. *Ecological Research,* 29(4), 741-755.

García, D., & Martínez, D. (2012). Species richness matters for the quality of ecosystem services: a test using seed dispersal by frugivorous birds. *Proc. R. Soc. B,* 279, 3106–3113.

Gautier-Hion, A., Duplantier, J. M., Quris, R., Feer, F., Sourd, C., Decaux, J. P., Dubost, G., Emmons, L., Erard, C., Hecketsweiler, P., Moungazi, A., Roussilhon, C., & Thiollay, J.M. (1985). Fruit characters as a basic of fruit choice and seed dis-

persal in a tropical forest vertebrate community. *Oecologia,* 65(3), 324–337.

Haryoko, T. (2011). Keragaman jenis burung di Bunguran Utara, Pulau Bunguran, Natuna. *Zoo Indonesia*, 20(2), 17-25.

Haselmayer, J., & Quinn, J. S. (2000). A comparison of point count and sound recording as bird survey methods in Amazonian Southeast Peru. *Condor,* 102(4), 887-893.

Herrera, C. M. (1982). Seasonal variation in the quality of fruits and diffuse coevolution between pants and avian dispersers. *Ecology*, 63(3), 773–785.

Jarulis, Roso, C., & Rizwar. (2010). Komposisi aves di kawasan hutan Pusat Latihan Gajah (PLG) Seblat Kabupaten Bengkulu Utara. *Konservasi Hayati,* 6(1), 25-37.

Lambert, F. R. & Collar, N. J. (2002). The future for Sundaic lowland forest birds: long-term effect commercial logging and fragmentation. *Forktail*, 18(1), 127-146.

Levey, D. J. (1987). Seed size and fruit-handling techniques of avian Frugivorouss. *The American Naturalist*, 129(4), 471–485.

Levey, D. J., Moermond, T. C., & Denslow, J. S. (1984). Fruit choice in neotropical birds: The effect of distance between fruits on preference patterns. *Ecology*, 65(3), 844–850.

MacKinnon, J. K., Phillips, K., & Van Balen, S. (2010). *Burung-burung di Sumatera, Jawa, Bali, dan Kalimantan (Termasuk Sabah, Sarawak, dan Brunei Darussalam).* Bogor: Puslitbang Biologi LIPI BirdLife International Indonesia Programme.

Magurran, A.E. 2004. *Measuring Biological Diversity*. New Jersey: Blackwell Scientific.

Manhaes, M. A., & Dias, M. M. (2011). Spatial dynamics of understorey insectivorous birds and arthropods in a southeastern Brazilian Atlantic woodlot. *Braz. J. Biol*, 71(1), 1-7.

Miller, J. R., Dixon, M. D., & Turner, M. G. (2004). Response of avian communities in large river floodplains to environmental variation at multiple scales. *Ecological Applications*, 14(5), 1394–1410.

Moradi, H. V., & Mohamed, Z. 2010. Response of babblers (Timaliidae) to the forest edge-interior gradient in an isolated tropical rainforest in Peninsular Malaysia. *Journal of Tropical Forest Science*, 22(1), 36–48.

Novarino, W., Mardiastuti, A.. Prasetyo. L. B., Widjakusuma, R., Mulyani, Y. A., Kobayashi, H., Salsabilah, A., Jarulis, & Janra, M. N. (2008). The composition of guild and niche width understorey bird in Sipisang West Sumatra. *Biota*, 13(3), 155-162.

Novarino, W. (2008). Dinamika jangka panjang komunitas burung strata bawah di Sipisang, Sumatera Barat. *Disertasi*. Bogor. Sekolah Pascasarjana, Institut Pertanian Bogor.

Partasasmita, R., Mardiastuti, A., Solihin, D. D., Widjajakusuma, R., Prijono, S. N., & Ueda, K. (2009). Komunitas Burung Pemakan Buah di Habitat Suksesi. *Biosfera*, 26(2), 90-99.

Pearman, P. B. (2002). The scale of community structure: Habitat variation and avian guilds in tropical forest understory. *Ecological Monographs,* 72(1), 19–39.

Posa, M. R. C. (2011). Peat swamp forest avifauna of Central Kalimantan, Indonesia: Effects of habitat loss and degradation. *Biological Conservation*, 144(10), 2548-2556.

Rahayuningsih, M., Purnomo, F. A., & Priyono, B. (2010). Keanekaragaman burung di Desa Karangasem Kecamatan Wirosari Kabupaten Grobogan Jawa Tengah. *Biosaintifika : Journal of Biology & Biology Education,* 2(2), 82-89.

Robson, C. (2000). *A field guide to the birds of South East Asia*. Massachusetts: New Holland Publisher.

Sodhi, N. S., Soh, M. C. K., Prawiladilaga, D. M., Darjono, & Brook, B. W. (2005). Persistence of lowland rainforest birds in a recently logged area in Central Java. *Bird Concervation International*, 15(2), 173-191.

Sujatnika, Jepson, P., Suhartono, T. R., Crosby, M. J. & Mardiastuti, A. (1995). *Melestarikan Keanekaragaman Hayati Indonesia: Pendekatan Daerah Burung Endemik*. PHPA/BirdLife International-Indonesia Programme, Bogor. Hal.: 18-19.

Sukmantoro, W., Irham, M., Novarino, W., Hasudungan, F., Kemp, N. & Muchtar, M. (2008). *Daftar Burung Indonesia No.2*. Bogor: Indonesian Ornithologists' Union.

Styring, A. R., Ragai, R., Unggang, J., Stuebing, R., Hosner, P. A., & Sheldon, F. H. (2011). Bird community assembly in Bornean industrial tree plantations: effects of forest age and structure. *Forest Ecology and Management*, 261(3), 531-544.

Waltert, M., Mardiastuti, A., & Mühlenberg, M. (2004). Effect of land use on bird species richness in Sulawesi, Indonesia. *Conservation Biology*, 18(5), 1339-1346.

Waltert, M., Mardiastuti, A., & Mühlenberg, M. (2005). Effects of deforestation and forest modification on understorey birds in Central Sulawesi, Indonesia. *Bird Conservation International,* 15(3), 257-273.

Widodo, W. (2014). Populasi dan Pola Sebaran Burung di Hutan Wanawisata Galunggung, Tasikmalaya, Jawa Barat. *Biosaintifika: Journal of Biology & Biology Education*, 6(1), 29-38.

Widodo, W. (2015). Kajian Kulaitatif Kemelimpahan Spesies Burung di Hutan Pegunungan Telaga Bodas, Garut, Jawa Barat. *Biosaintifika: Journal of Biology & Biology Education*, 7(1), 37-47.

Wiens, J. A. (1989). *The Ecology of Bird Communities Volume1*. Cambrige: Cambridge University Press.

Wong, M. (1986). Trophic organization of birds in Malaysian dipterocarp forest. *Auk*, 103, 100-116.

Zakaria, M., Leong, P. C., & Yusuf, M. E. (2005). Comparison of species composition in three forest types: towards using birds as indicator of forest ecosystem health. *Journal of Biological Sciences*, 5(6), 734-737.