Urban cemeteries as habitat for birds

A Meltriana[1*], A Mardiastuti[1], and Y A Mulyani[1]

[1] Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry, Bogor Agricultural University, Darmaga Campus, Bogor 16680, West Java, Indonesia

[*]E-mail: ipehaha610@gmail.com

Abstract. Cemeteries in an urban area may occupy a large area and harbor many bird species. The aim of this paper was to identify bird species found in cemeteries of urban area in Bogor, West Java. Three largest cemeteries were selected as study sites: Gunung gadung (36.0 ha), Dreded (6.5 ha), and Blender (6.7 ha). Point count method was used, followed by calculation of Shannon diversity indices, Jaccard similarity index, and species dominance. A total of 33 bird species were found in all sites, of which 21 species (H' 1.86) were found in Gununggadung, 20 species (H' 1.74) in Dreded, and 14 species (H'1.77) in Blender, all considered to have low species diversity. Similarity among sites were quite high (0.64-0.72), all showed typical urban bird species although the three sites are far apart. Dominant bird species were aerial insectivores (swiftlet) and granivores (especially munias). The low bird diversity in cemeteries was due to the poor tree species and coverage. Planting with more diverse tree plants might increase bird species in cemeteries, as well as increase their other ecological function in urban area.

Keywords: Birds, Habitat, Urban Area

1. Introduction

The growth of a city has resulted in the declining of available habitats for urban birds. The requirement to set aside an area for green open spaces in the city development has provided an opportunity for urban bird conservation; however, in general the size of urban green open spaces are relatively small. The model of island biogeography developed by MacArthur and Wilson [1] has shown that there is a positive correlation between size and bird species richness [1]. This relationship has also been shown in many studies, e.g [2, 3, 4]; therefore large green open spaces are needed to conserve birds in urban areas. One type of urban green spaces that may occupy a large area is cemetery. It is expected that urban cemeteries would harbor many bird species. Lussenhop [5] found that there was a positive correlation between urban birds with area size in cemetery and surrounding areas.

Most cemeteries in urban areas are also planted with vegetation, especially lush canopy trees such as rain tree (*Samanea saman*), and frangipani (*Plumeria accuminata*). The Regulation of Ministry of Public Works of Indonesia No. 5 Year 2008 gives guideline on the selection of plant species to be planted in cemeteries. In addition providing shades, the species should also capable in improving the ecological

roles of cemeteries. Identification of bird species inhabiting cemeteries and knowledge on the use of cemeteries by birds will be useful in encouraging bird conservation outside conservation areas. Therefore, the objective of this study was to identify bird diversity in three different cemeteries in Bogor City.

2. Study site and method

2.1. Description of the study site

There were eight public cemeteries managed by the City of Bogor, but only three were chosen as the study sites based on their size (> 50,000m^2): Gunung Gadung Public Cemetery, Dreded Public Cemetery, and Blender Public Cemetery (Figure 1). Gunung Gadung Public Cemetery is the largest public cemetery in Bogor (360,000m^2), and located in the Sub District of South Bogor (06°38'65''S 106°48'53"E). The tree species planted include frangipani, pine (*Pinus merkusii*), umbrella-tree (*Maesopsis eminii*), leucaena (*Leucaena leucocephala*), candle nut (*Aleurites moluccana*) and mahogany (*Swietenia macrophylla)*, with open canopy. Unlike the other two cemeteries, this cemetery is not surrounded by housings, but there is a quiet public road pass through this cemetery. Gununggadung public cemetery is also dominated by Chinese style tombs, which consists of buildings resembling small houses surrounded by miniature garden. Dreded Public Cemetery (64,8m^2) is located in Sub District of South Bogor (06°37'05''S 106°48'16"E) and planted with raintree (*Samanea saman*), frangipani (*Plumeria acuminata*) and figs (*Ficus* sp) with rather close canopy, giving an impression of shady cemetery. This cemetery is surrounded by human settlement, bordered by road, close to railway (120m) and Cisadane River (30m). Blender Public Cemetery (66,7m^2) is located in Sub District of Tanah Sareal (06°34'02''S 106°47'49"E) and planted with frangipani, Spanish cherry (*Mimusops elengi*), loquat (*Eriobotrya japonica*), figs and blackboard tree (*Alstonia scholaris*) with the overall heights varies between 8 and 20 m. The vegetation was dominated by palm lily (*Cordyline fructricosa*). This quite open cemetery is surrounded by housings, close to Pakancilan River (50m), has a busy road nearby, and about 800m from railway. Local community also uses the area in the cemetery for other activities, such as jogging and hanging out during weekend mornings.

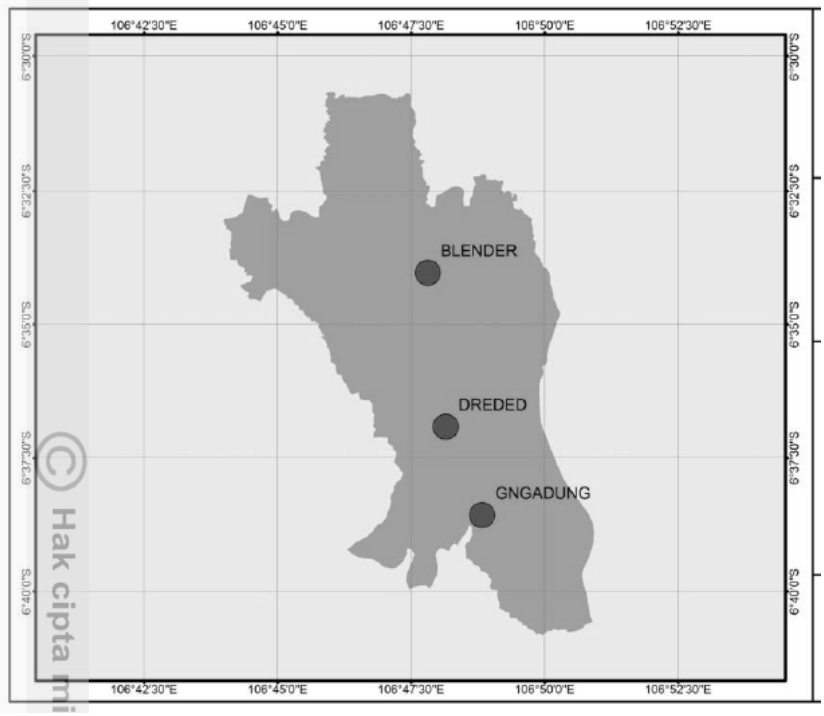

Figure 1. Location of the study sites in Bogor City

2.2. Method

2.2.1. Data collection

Bird observations were done in March and May 2015 during morning (06.00-09.00) and afternoon (16.00-18.00). Bird observations were conducted for six days in each site. Observation in Dreded Public Cemetery was conducted in March 2015, while observations in Blender and Gunung Gadung Cemeteries were conducted in May 2015. Point counts with a radius of 50m [6] were conducted to calculate diversity indices of the birds in all sites. The number of points varied due to different size of the cemeteries; there were 6 points in Dreded, 4 in Blender and 10 in Gunung Gadung. All birds seen or heard during 20 minutes observation period at each point were recorded. A binocular (8X42), a camera and a field guide were used to help in bird identification.

2.2.2. Data analysis

Total species diversity was expressed by the number of species (*S*). Shannon indices of diversity following Magurran [7] was calculated based on data obtained from point count method. Birds observed outside the radius of 50m were also recorded but were not taken into calculation for abundance and indices. Jaccard similarity index was also calculated to describe the difference in bird communities among sites [8]. Species dominance in each site was expressed as the proportion of the number of a certain species to the total bird number of all species. A species is categorized as dominant in one location if the dominance value is more than 5% [6].

3. Results

A total of 33 species from 19 families were observed during the study, while point count method recorded only 30 species of 17 families. The three species that were not found during point count were Purple Heron *(Ardea purpurea),* Rusty-breasted Cuckoo *(Cacomantis sepulcralis)*, and White-vented Myna *(Acridotheres javanicus)*. The highest species richness was found in Gunung Gadung Public Cemetery, although the number of families was highest in Dreded Public Cemetery (Table 1). Shannon diversity indices showed that the diversity in the study sites are generally low (ranged between 1.74 – 1.86), with moderate evenness indices (ranged between 0.59 – 0.69). The number of species in each family varied between 1 to 3 species. Families with highest number of species were Cuculidae (cuckoos), Columbidae (pigeon and doves), Sylviidae (prinia and tailorbirds), and Estrildidae (munias).

Table 1. Bird species richness and diversity indices in the study sites

Public Cemetery	Number of Families	Number of Species	H'	E'
Gunung gadung	10	21	1.86	0.62
Dreded	14	20	1.74	0.59
Blender	9	14	1.77	0.69

Jaccard similarity indices showed that all sites had high similarities (Table 2) with the highest similarity found between Blender and Dreded Cemeteries.

Table 2. Bird similarity indices among sites

	Gununggadung	Dreded	Blender
Gununggadung	1	0.64	0.71
Dreded	-	1	0.72
Blender	-	-	1

Based on the dominance criteria, there were six species that were dominant in Gunung Gadung Public Cemetery, whilst in each of the the other sites only four species were dominant. Dominant bird species in all sites were granivores (especially munias) and aerial insectivores (insectivores), but bulbuls were

also dominant in Gununggadung and Blender (Table 3). Eurasian tree sparrow was dominant only in Dreded Public Cemetery.

Table 3. Dominance value (%) of bird species in the study sites

No	Bird Species	Common Name	Gununggadung Public Cemetery	Dreded Public Cemetery	Blender Public Cemetery
1	*Streptopelia chinensis*	Spotted Dove	1.97	0.25	2.25
2	*Streptopeliabitorquata*	Sunda Collared Dove		0.06	
3	*Geopeliastriata*	Zebra Dove	0.20		
4	*Cacomantis merulinus*	Plaintive Cuckoo	1.38	1.00	
5	*Centropus bengalensis*	Lesser Coucal	0.30		
6	*Collocalialinchi*	Linchi Swiftlet	11.32	19.60	24.08
7	*Apus affinis*	Little Swift	5.61		2.52
8	*Halcyon cyanoventris*	Javan Kingfisher	0.79		0.36
9	*Halcyon chloris*	Collared Kingfisher	2.66	0.69	
10	*Megalaima haemacephala*	Coppersmith Barbet		0.62	
11	*Dendrocoposmacei*	Fulvous-breasted Woodpecker	0.20		
12	*Dendrocoposmoluccensis*	Sunda Woodpecker	0.10	0.06	0.09
13	*Hirundotahitica*	Pacific Swallow			0.72
14	*Hirundostriolata*	Striated Swallow	3.05		
15	*Pericrocotuscinnamomeus*	Small Minivet		0.12	
16	*Pycnonotusaurigaster*	Sooty-headed Bulbul	8.96	4.24	8.84
17	*Pycnonotusgoiavier*	Yellow-vented Bulbul	0.89	4.68	7.30
18	*Pellorneumcapistratum*	Black-capped Babbler	0.20		
19	*Orthotomussutorius*	Common Tailorbird		0.06	0.36
20	*Orthotomussepium*	Olive-backed Tailorbird	0.59	0.19	
21	*Priniafamiliaris*	Bar-winged Prinia	0.10		
22	*Muscicapadauurica*	Asian Brown Flycatcher		0.06	
23	*Anthreptesmalacensis*	Plain-thoroated Sunbird		0.06	
24	*Cinnyrisjugularis*	Olive-backed Sunbird	0.49	0.81	
25	*Dicaeumtrochileum*	Scarlet-headed Flowerpecker	0.20	1.19	3.16

No	Bird Species	Common Name	Gununggadung Public Cemetery	Dreded Public Cemetery	Blender Public Cemetery
26	*Zosteropspalpebrosus*	Oriental White-eye		0.19	
27	*Passer montanus*	Eurasian Tree Sparrow	4.33	10.61	4.15
28	*Lonchuraleucogastroides*	Javan Munia	48.92	13.17	2.80
29	*Lonchurapunctulata*	Scaly-breasted Munia	7.78	42.32	42.20
30	*Lonchuramaja*	White-headed Munia			1.17

There were four species that are protected by the Indonesian Government Regulation recorded during the study; those are Javan Kingfisher (*Halcyon cyanoventris)*, Collared Kingfisher (*Halcyon chloris*), Brown-throated Sunbird (*Anthreptes malacensis*), and Olive-backed Sunbird (*Cinnyris jugularis*).

4. Discussion

Gunung Gadung Public Cemetery had the highest diversity index although the number of species was almost similar to those in Dreded Public Cemetery. Larger area in Gunung Gadung provides more varied resources for different bird species that occupy the habitat. Furthermore, open canopy in Gunung Gadung area allowed the observer to detect birds more easily than in habitat with close canopy. Similar result in the tropical rain forest were reported by Wisubudi [9] and Ahmadi [10].

Cemeteries as public open green spaces have been reported to harbor a high diversity of birds [11]. However, this study showed that bird diversity in three cemeteries was relatively low. These sites also had lower bird diversity compared to other studies on birds in green open spaces in Bogor and the surroundings. At least 63 species were reported in various urban habitats of Bogor by Ontario *et al*.[12], 42 species in housing complex by Asmoro [13], and 41 species in orchard by Nurfaizah [14]. However, lower result was reported from Cinangsi Public Cemetery in Bandung where only 14 species of birds were recorded [15]. The vegetation in the cemeteries in the study sites is more homogeneous than those in the other studies. Bird diversity has been reported to be higher in more heterogeneous habitats [16], [17]. Tews [18] reviewed studies on the relationships between animal diversity and habitat heterogeneity and reported that habitat heterogeneity may have different impact on different groups.

5. Conclusion

The low bird diversity in cemeteries was due to the poor tree species and coverage. Planting with more diverse tree plants might increase bird species in cemeteries, as well as increase their other ecological function in urban area.

Acknowledgments

The authors wish to thank the Agency for Sanitazion and Parks of Bogor City for permit to use the public cemeteries as study sites. We also would like to extend our thanks to Karim, Ilham, Sukri, Imam and Richsy who had helped in data collection.

References

[1] MacArthur RH and Wilson EO 1967 *The Theory of Island Biogeography*. (NewJersey: Princeton University Press)
[2] Kim J, Chae J, Koo T 2007 *Acta Ornithol*. 42:39-42
[3] Rahayuningsih M 2009*Komunitas Burung di Kepulauan Karimunjawa Jawa Tengah: Aplikasi Teori Biogeografi Pulau*PhD Dissertation (Bogor: Institut Pertanian Bogor)
[4] Schütz C, Schulze CH 2015*Ecology and Evolution* 5(22):5230–39 doi: 10.1002/ece3.1778

[5] Lussenhop J 1977 Condor 79: 456-61
[6] van Helvoort B 1981 *Bird Population in the Rural Ecosystem of West Java* (The Netherlands: Nature Conservation Department)
[7] Magurran AE 2004 *Measuring Biological Diversity* (USA: Blackwell Publishing Company)
[8] Krebs CJ 1978 *Ecology: The Experimental Analysis of Distribution and Abundance.* 2nd Ed (New York: Harper and Row Pub)
[9] Wisnubudi G 2009 *Vis Vitalis* 2(2): 41-49
[10] Ahmadi R. 2014.*Komunitas Burung pada Beberapa Habitat dengan Gangguan Berbeda di Hutan Lambusango, Pulau Buton, Sulawesi Tenggara.* BS Thesis (Bogor: Institut Pertanian Bogor)
[11] Chamberlain DE, Gough S, Vaughan H, Vickery JA and Appleton GF 2007 *Bird Study* 54(1): 87-97 DOI:10.1080/00063650709461460
[12] Ontario J, Hernowo JB, Haryanto and Ekarelawan 1990 *Media Konservasi*3(1) 15-28
[13] Asmoro AWT 2012 *Keanekaragaman Jenis Burung pada Beberapa Cluster Perumahan di SentulCity, Bogor Jawa Barat* BS Thesis (Bogor: Departemen Konservasi Sumber Daya Hutan Fakultas Kehutanan Institut Pertanian Bogor)
[14] Nurfaizah I 2017 *Keanekaragaman Burung di Area Kebun Buah, Taman Buah Mekarsari* BS Thesis (Bogor: Departemen Biologi, Fakultas Matematika dan Ilmu Pengetahuan Alam Institut Pertanian Bogor)
[15] Nur'aini 2012 *Keanekaragaman Jenis Burung dalam Pemanfaatan Areal Pemakaman sebagai Habitat Hidupnya* BS Thesis (Bandung: Biologi Fakultas Sains dan Teknologi) geri. Bandung.
[16] Katayama N, Amano T, Naoe S, Yamakita T, Komatsu I et al 2014 *PLoSONE* 9(3):e93359 doi:10.1371/journal.pone.0093359
[17] Mohd-Azlan J, Noske RA and Lewis MJ 2015 *Diversity* 7:118-36 doi:10.3390/d7020118
[18] Tews J, Brose U, Grimm V, Tielbo K, Wichmann MC, Schwageri M and Jeltsch 2004 *J. Biogeogr.* 31:79-92