Urban landscape for birdwatching activities

I Kurnia1, H Arief2, A Mardiastuti2 and R Hermawan2

1Ecotourism Management and Environmental Service Study Program, Faculty of Forestry and Environmental, IPB University, Bogor, Indonesia
2Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry and Environmental, IPB University, Bogor, Indonesia

Abstract. Urban landscapes are usually dominated by built spaces and human-made vegetation, which different from natural landscapes. This difference will affect the composition of birds that can be found in the urban landscape. For birdwatchers, birds are the main object in birdwatching activities. The objectives of this paper were to analyze the feasibility of urban landscapes for birdwatching activities and find out the characteristics of urban landscapes favored by birdwatchers in four cities in Java (Bogor, Sukabumi, Bandung, and Surabaya). Birdwatchers' site preference and perception were surveyed through online questionnaires in February through May 2020 (n=1,247 respondents). Surveyed data revealed that birdwatching sites' size varied between 0.05 and 76.82 ha, mainly urban forests and city parks. Most of the urban landscape was habitat to various bird species typical of the urban landscape (e.g., Eurasian tree-sparrow, Cave swiftlet, Black-headed Bulbul). Raptors (e.g., Black-thighed Falconet) are found in several locations. Among the respondents, 25 % (n=309) had previously conducted birdwatching activities in urban landscapes, while 72.0% (n=808) expressed their interest in birdwatching in urban landscapes, indicating that urban landscapes was feasible for birdwatching. The most favorite locations were the Bogor Botanical Gardens, Darmaga Research Forest (both in Bogor), Merdeka Field Park, Cikundul Agrotourism Area (Sukabumi), Bandung Zoo, Babakan Siliwangi City Forest (Bandung), Bungkul Park, and Flora Park (Surabaya). Characteristics of sites favored by birdwatchers were a shady area, not noisy location, and any facilities for birdwatching. The diversity of bird species did not become the main reason.

Keywords: birdwatchers, city parks, recreational activities, urban forest

1. Background

Urban landscapes are changing natural ecosystems in such extreme times that their natural forms have changed or disappeared completely [1]. Urban landscapes are characterized by the dominance of awakening space and the vegetation grown by humans as green open space. The dominance of socio-economic components over biotic and abiotic components impacts the composition of birds as part of the ecosystem. Only some species can adapt and survive in the urban landscape, while others are lost [2]. Urban landscapes, therefore, contain a lower variety of birds and are composed of generalist species with broad environmental tolerance [3] [4]. Nevertheless, urban landscapes become so important as birds' global habitat that many urban development will become interested in the birds' interests as part of the ecosystem [5] [6].

The presence of birds in the urban landscape became crucial concerning the birdwatching recreational object. For birdwatchers, birds are the principal objects in birdwatching recreational activities. Birdwatching is bird observational recreation type in the wild by naked eye surveys using aids such as telescopes and binoculars, or only listening the bird songs. Birdwatching is part of nature tourism focused on the bird observation [7] to be enjoyed through watching or listening [8]. This recreational activity is carried out in a very varied way from bird observation, discovery listing, until new species discovery competition;
therefore, the experts specifically distinguish birdwatching with twitching [9] to create a birdwatcher specialization [10].

Green open spaces in the urban landscape have been exploited by communities as one of the centers for physical activities [11] [12] and provide recreational satisfaction, which is close to the residence [13]. Like a bird's primary habitat in the urban landscape, green open spaces' existence has potential and opportunity as a birdwatching site [14]. While birds are the main objects in birdwatching, many factors influence the birdwatchers' choice of a location, especially in urban landscapes that are different from natural landscapes. The objectives of this paper were analyze the feasibility of urban landscapes for birdwatching activities and find out the characteristics of urban landscapes favored by birdwatchers in four cities in Java (Bogor, Sukabumi, Bandung and Surabaya).

2. Methodology
The research was carried out from February to May 2020 in four cities in Java (Bogor, Bandung, Surabaya and Sukabumi). Area data is taken by processing maps from google maps with the software Google Earth Pro. Habitat data are described. The vegetation strata refer to [15] with modifications, namely tree (A), shrub (B), bush (C), ground cover (D), and water plant (E). Bird data were collected using the presence-absence for five times each location. Observations of the birds were carried out during morning (05.30−11.00) or evening (14.00−18.00).

Online questionnaires used for birdwatchers' site preference and perception which distributed via email, WhatsApp, and social media to 1500 people. The answers to the questionnaire are close-ended with a ranking scale of 1-4 (never at all), 2 (seldom), 3 (often), and 4 (always), or the answers agree/disagree. The ranking answers are made an average, while agree/disagree answers are made a percentage. The questionnaire contains questions regarding preferences for birdwatching (interest, priority, birds, habitat, and location) and perceptions about birdwatching in urban landscapes (conservation support, ability, and advantage). Data were analyzed using (i) a chi-square for interest and priority preference and (ii) an exploratory factor analysis (EFA) for bird and habitat preference. The significant value level used is 5% (<0.05). Data processing uses version 24 of IBM SPSS.

3. Result
3.1. Birdwatching sites
The size of birdwatching sites varied between 0.05 and 76.82 ha. The smallest area are Aspirasi Park Sukabumi and the largest are Bogor Botanical Garden. The majority location had four strata. Only three location has five strata. The dominant habitat type is a forest and garden. The forest habitat is dominated by trees from stratum A, while garden is dominated by shrub (statum B) and bush (stratum C). The field is dominated by ground cover vegetation (stratum D) or open space.

The dominant habitat type is a garden and the others habitat are forests, fields, ponds and rivers. The garden habitat is dominated by non-trees or trees with low height (stratum B and C), while the field is dominated by ground cover vegetation (stratum E) or open space. The ponds that were found were only in Bogor, namely the Bogor Botanical Garden (artificial pond) and Darmaga Research Forest (a natural pond). River habitats are found in the Bogor Botanical Garden and Sempur with the same river, namely the Ciliwung River. Other locations with rivers are Cikundul Agro Area, Kibitay Forest City, Maluku Park, Bandung Zoo, and Teras Cikapundung Park. The ponds found were only in Bogor and Bandung, namely the Bogor Botanical Garden and Bandung Zoo, both an artificial pond. The other are Darmaga Research Forest a natural pond. The field paddy habitat are only found in Cikundul Agrotourism Area, meanwhile the beach habitat found were only in Kenjeran Lama Park.
The number of bird species varied between three and 53 species. The bird species richness was highest in Bogor Botanical Garden (53 species) followed by Dramaga Research Forest (36 species). While the bird species richness was lowest in Aspirasi Park (three species). The species of birds encountered are generalists in the urban landscape; only a few specialists were found. Common types of generalists include the Eurasian tree-sparrow (31 locations), Cave swiftlet (30 locations), Black-headed Bulbul (29 locations), Plaintive cuckoo (26 locations), and Olive-backed Tailorbird (25 locations). As many as 29 bird species were only found in only one location, indicating that this species is not a generalist urban landscape but a specialist species but can survive or only visit in urban landscapes (e.g., Great Egret, Grey-cheeked Green Pigeon, Lesser coucal, and Hill Blue Flycatcher).

### Table 1 Birdwatching sites condition

| Birdwatching site                      | Area (ha) | Habitat type | Strata | Number of bird species |
|----------------------------------------|-----------|--------------|--------|------------------------|
| **Bogor**                              |           |              |        |                        |
| 1. Bogor Botanical Garden              | 76.82     | Fo, Ga, Fi, Rv, Po | A-B-C-D-E | 53                     |
| 2. Dramaga Research Forest             | 70.11     | Fo, Po       | A-B-C-D | 36                     |
| 3. Sempur Park                        | 2.53      | Ga, Fi, Rv   | A-B-C-D | 16                     |
| 4. Heulang Park                       | 2.25      | Ga, Fi       | A-B-C-D | 9                      |
| 5. Ahmad Yani City Forest             | 1.58      | Fo           | A-B-C-D | 8                      |
| 6. Malabar Park                      | 0.70      | Ga           | A-B-C-D | 15                     |
| 7. Kencana Park                       | 0.64      | Ga           | A-B-C-D | 10                     |
| 8. Peranginan Park                    | 0.39      | Fo           | A-B-C-D | 6                      |
| **Sukabumi**                          |           |              |        |                        |
| 9. Cikundul Agrotourism Area           | 6.00      | Fo, Fi, Rv, Fp | A-B-C-D-E | 18                     |
| 10. Kibitay City Forest               | 4.16      | Fo, Rv       | A-B-C-D | 13                     |
| 11. Kerkof City Forest                | 1.87      | Fo           | A-B-C-D | 16                     |
| 12. Merdeka Field                     | 1.78      | Fo, Fi       | A-B-C-D | 9                      |
| 13. Sugema Park                       | 0.82      | Ga           | A-B-C-D | 5                      |
| 14. Digital Park                      | 0.58      | Ga           | A-B-C-D | 11                     |
| 15. Aspirasi Park                     | 0.05      | Fo           | A-B     | 3                      |
| **Bandung**                           |           |              |        |                        |
| 16. Tegalega Park                     | 17.23     | Fo, Ga, Fi   | A-B-C-D | 11                     |
| 17. Bandung Zoo                       | 13.57     | Fo, Ga, Fi, Rv, Po | A-B-C-D-E | 21                     |
| 18. Balai Kota Park                   | 6.12      | Fo, Ga       | A-B-C-D | 14                     |
| 19. Maluku Park                       | 5.48      | Fo, Ga, Fi, Rv | A-B-C-D | 19                     |
| 20. Babakan Siliwangi City Forest     | 4.61      | Fo, Ga       | A-B-C-D | 14                     |
| 21. Teras Cikapundung Park            | 2.69      | Fo, Ga, Rv   | A-B-C-D | 11                     |
| 22. Lansiya Park                      | 1.85      | Fo, Ga       | A-B-C-D | 13                     |
| 23. Pramuka Park                      | 1.42      | Fo, Ga       | A-B-C-D | 10                     |
| 24. Ganesha Park                      | 1.49      | Fo, Ga, Fi   | A-B-C-D | 13                     |
| 25. Cibeunying Park                   | 1.00      | Fo, Ga       | A-B-C-D | 10                     |
| 26. Pustaka Bunga Park                | 0.83      | Fo, Ga       | A-B-C-D | 5                      |
| **Surabaya**                          |           |              |        |                        |
| 27. Harmoni Park                      | 8.58      | Fo, Ga       | A-B-C-D | 12                     |
| 28. Pakal City Forest                 | 7.27      | Fo, Ga       | A-B-C-D | 18                     |
| 29. Flora Park                        | 3.98      | Fo, Ga       | A-B-C-D | 16                     |
| 30. Kenjeran Lama Park                | 2.75      | Fo, Ga, Fi, Bc | A-B-C-D | 10                     |
| 31. Bungkul Park                      | 1.68      | Fo, Ga       | A-B-C-D | 10                     |

Note: Habitat (Fo: forest; Ga: garden; Fi: field; Rv: river; Po: pond; Fp: field paddy; Bc: beach)

The raptor that was found also indicated that it was not a generalist species, because it was only found in few locations, namely Crested Goshawk and Black-thighed Falconet. Only a few species of birds made nests at the site, namely Black-crowned Night Heron (Bogor Botanical Garden and Bandung Zoo), Red-breasted Parakeet (Ganesha Park), Javan Munia
Sugema Park), White-headed Munia (Digital Park), Scarlet-headed flowerpecker (Pakal Forest City), Black-headed Bulbul (Pakal Forest City and Flora Park), and Zebra doves made use of artificial nests (Harmoni Park).

3.2. Birdwatching preference

Preference for birdwatching is linked with (a) respondent interest, (b) priority of activities, (c) birds’ uniqueness, (d) bird characteristics, (e) birdwatching activities, (f) bird habitat, and (f) birdwatching sites in each city. A total of 1,296 citizens responded to the survey, though not all questions were answered (full complete 96%; n=1,247). A 72% of the total respondent was interested for birdwatching in the urban landscape, and of the total respondents 25% had previously birdwatched in the urban landscape. The interest respondents in urban landscape did differ significantly ($\chi^2 = 241.70; df=1; P<0.05$) and as well as birdwatching experience ($\chi^2 = 317.27; df=1; P<0.05$). Most respondents chose a balanced activity between looking for birds and other leisure activities (e.g., jogging and sport) (Figure1).

![Figure 1](image_url)

**Figure 1** Percentage of respondents interest (left), respondent experience (center), and activities priority (right) for birdwatching in the urban landscape

The preference for the uniqueness of birds and the characteristics of birds to be seen presents only one factor. While the preference for birdwatching activities and the preference for birdwatching types of habitats make up two factors (Table 2). The first factor of birdwatching activities are the most severe activities in birdwatching (e.g., draw, song record, white the second factor of birdwatching activities are common activities during birdwatching (e.g., to see and to listen).

| Preference                    | Cumulative initial eigenvalues | Variable of factor                                      | EFA Indicator | Cronbach’s α | Eigenvalues |
|-------------------------------|--------------------------------|----------------------------------------------------------|---------------|--------------|-------------|
| Bird uniqueness               | 68.96%                         | All species, feather, song, behavior, habitat, distribution, new species | 8             | 0.932        | 5.516       |
| Bird characteristics          | 78.77%                         | Easy to see, easy to hear, many individuals              | 3             | 0.864        | 2.363       |
| Birdwatching activities       | 73.47%                         | Draw, song record, video record, encounter record, discuss| 5             | 0.844        | 4.836       |
|                               |                                | To see, to listen, to take a photo                       | 3             | 0.844        | 1.042       |
| Bird habitats                 | 74.16%                         | City forest, city park, green roadside, river, pond, field paddy, farm, other green open space | 8             | 0.938        | 6.621       |
|                               |                                | Backyard, housing, office ground                         | 3             | 0.893        | 1.536       |
Generally, the most popular location is Bogor Botanical Garden and Dramaga Research Forest, both in Bogor. The other’s location are Merdeka Field and Cikundul Agrotourism Area (Sukabumi), Bandung Zoo and Babakan Siliwangi City Forest (Bandung), and Bungkul Park and Flora Park (Surabaya). All locations that are most desirable in each city are those near the city center, excluding Dramaga Research Forest in Bogor. However, they have low bird diversity (e.g., Sempur Park, Merdeka Field, and Bungkul Park) (Figure 2).

![Figure 2 The birdwatching sites preference](image2)

The main reason of respondents for choosing the birdwatching sites is a shady area. These patterns are taking place all over the city. Bird diversity is not the main reason for choosing a preferred location for birdwatching. Even locations with high bird diversity get a poor choice. However, respondents gave a higher reason score for the birdwatching facilities (Figure 3).

![Figure 3 The reason choice of birdwatching sites preference](image3)
3.3. Birdwatching perception of the urban landscape
The birdwatching perception of the urban landscape is connected with (a) the birdwatching for conservation support, (b) the urban landscape’s ability to birdwatching, and (c) the birdwatching advantage. Most of the responders responded to their support if birdwatching in the urban landscape can support conservation (Figure 4).

![Figure 4 Percentage of support for birdwatching in urban landscape](image)

The urban landscape is a positive reflection of the birdwatching landscape. The most dominant reason is accessibility ease, followed by reason as easy and cheap inexpensive recreation, this same value pattern for an entire city. The highest perception of birdwatching gains in the urban landscape is that children and students are learn media and are then followed by a perception of green or green cities (Figure 5).

![Figure 5 Perception score of the reason (left) and advantage (right) urban landscape utilization for birdwatching](image)

4. Discussion
Birdwatching sites demonstrate the urban landscape's ability as a habitat for birds. Though it widens to influence bird attendance [16] [17], large is not the only factor affecting the presence of birds in a particular habitat, but many other factors that support the presence of birds, such as vegetation and landscape structure [18] [19] [20] [21] [22]. The range that the birdwatching is a nature trip to enjoy birds in the wild, making birds on the birdwatching sites vital as it is the main object of the birdwatching. Generally speaking, bird species encountered in urban landscapes are generalist species found in many habitats, though some specialists in urban landscape. Raptor presence on urban landscape became something of interest. The raptor, as the top predator in an ecosystem, is an indicator of biodiversity in an ecosystem [23] [24].

Respondent interest in birdwatching, which is shown by a higher percentage of interest than an uninterested one, indicates that birdwatching is a form of recreation that has an interest in the community. The respondent interest is similar to people in the USA for birdwatching and hunting [25]. The aesthetic value of birds provides the hope of satisfaction for society in recreation [26]. These conditions of bird’s value are similar to those found by [8] about the positive perceive of Chicago’s birds around their home to aesthetic aspects and the role of birds in the ecosystem. The same is true in Sweden that people provide a positively perceive of birds in open green space [27].
The birdwatching experience shows that the birdwatching has been done by people in Indonesia even though it is not as popular as recreational activities. Birdwatchers' experience shows that birdwatching has existed and continues to unfold as a hobby to this day [28] [29]. Bird's diversity research for birdwatching in the urban landscape is also conducted by [30] [31] [32]. This research implies that the urban landscape is also part of a bird's habitat that can be enjoyed for birdwatching [33].

The preference for birdwatching activities with a dominant value, not birdwatching, as a priority is very likely to occur because the respondent's main activity is outdoor recreation, so birdwatching is considered an additional activity while doing other recreational activities. Urban parks are generally used by the community for recreational activities [13]. Other activities outside of birdwatching are also common for birdwatchers when making birdwatching trips but are generally performed by beginner and intermediate birdwatcher groups, not expert birdwatchers [34]. Despite positive perceptions of birds and birdwatching, appreciation for birds may not yet fully emerge. Park visitor knowledge in Chile was not related to bird species richness in city parks, but they tended to only know about species that were abundant, widespread, and exotic [35]. In general, almost no research has examined visitor preferences for bird choices and various aspects related to them. The formation of a preference factor for the uniqueness of birds and the nature of the birds they want to see shows that the respondents' pattern is similar for all variables. A preference for seeing as many bird species as possible suggests that most birdwatchers are generalists, while a minorities are specialists or twitchers. Generalists refer to birdwatchers who generally study entire groups of birds. In contrast, specialists are groups of birdwatchers who specifically target a specific species [10]. This condition is different from what found that birdwatchers in Australia are dominated by specialist groups, compared to generalists [36].

Birdwatching' activity preferences form two factors, general activity factors and specific activity factors. Activities that include general factor (seeing, listening, and taking photos) are everyday activities that stick to the definition of birdwatching [28], while other activities require more specific equipment. Equipment can provide a picture of strong or weak motivation. The birdwatcher's motivation for recreation reflected by equipments and skills possessed, that high motivation is indicated by high quality equipment and expert skills [37]. The first factor is common for all birdwatchers, while the second factor is generally used by expert birdwatchers [34, 38]. The beginner birdwatchers can be distinguished from expert birdwatchers by the frequency and the motivation of birdwatching. The beginner birdwatcher less frequently than expert. The beginner birdwatcher has a variety of motivations, while expert birdwatcher, only focus on birds [38].

Birdwatching habitat preference forms a general green open space factor and a green open space factor around a residential or working building. The first factor has a higher value than the second factor. This condition illustrates; although, birdwatching is done in urban landscapes, respondents expect a more natural atmosphere than those around where they live or work. This condition is similar to what was found in Australia that natural habitat is more desirable than backyard [36]. Although sometimes, the type of habitat that is preferred is not related to the type of bird you are interested in seeing. Even though it gets a lower choice score, the backyard is a site that can be used for birdwatching every day [14].

Bird diversity are not a consideration for respondents in choosing a location, because, respondents' preference are shady location, followed by not noisy conditions and passing visitors. Conditions in open green space are generally more relaxed than other environments, attracting people to come [39]. Not noisy locations are often the reason people take advantage of green urban space [11]. Most of the respondents are beginner birdwatchers, so that there is no motivation to see birds as the main activity or even the only activity. The landscape quality, in this case, bird diversity, is not yet the main reason for
visitor choice, similar to what was found in China in that the relationship between selected activities in urban landscapes [40]. Urban landscapes are perceived positively as a location for birdwatching. The most dominant reason is the ease of accessibility, followed by reasons as easy and cheap recreation. Birdwatching in urban landscapes will save a lot of expenses. This condition different with birdwatching in natural landscapes, which are generally high cost [28]. Both accessibility and distance influenced on visits to green open spaces [12] [41].

Birdwatching in urban landscapes is perceived as a learning medium, especially for children and students, in line with the research in England, which made birds an object of study related to school students’ awareness [42]. There is a positive perception that birdwatching is related to environmentally friendly cities or green cities because it is related to the concept of green open space as an indicator of green city [43]. Understanding this perception is important because perceptions uses the basis for management. Many motivations and perceptions studies produce a good recommendations for park management [8] [29].

5. Conclusion Possible to do birdwatching activities in urban landscapes because of the existence of birds as their primary resource. The species diversity found in each location was generally low; only a few locations had high species diversity of birds. The types of birds encountered are generally generalist. The majority of respondents are interested in and support birdwatching in urban landscapes. A popular location is desirable for its coolness and minimal disturbance, but does not require that it be rich in bird species.

6. Recommendation It is necessary to build a green open space that can become a bird’s habitat and preferred by birdwatchers with enrichment of feed vegetation and shady vegetation. The development of birdwatching in the urban landscape can be done to conserve biodiversity to form a sustainable city.

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References
[1] Silva C P, García C E, Estay S A and Barbosa O 2015 Bird richness and abundance in response to urban form in a Latin American City: Valdivia, Chile J. PLoS ONE 10(9): 1-16
[2] Martin P R and Bonier F 2018 Species interactions limit the occurrence of urban adapted birds in cities PNAS 115(49): 11495-11504
[3] Bonier F, Martin P R and Wingfield J C 2007 Urban birds have broader environmental tolerance Biol. Lett. 3: 670–673
[4] Palomino D and Carrascal L M 2006 Urban influence on birds at a regional scale: A case study with the avifauna of northern Madrid Province Landsc. Urban Plan. 77: 276–290
[5] Jokimäki J, Suohon J and Marja-Liisa J K 2018 Urban core areas are important for species conservation: A European-level analysis of breeding bird species Landsc. Urban Plan. 178: 73–81
[6] Snep R P H, Kooijmans J L, Kwak R G M, Poppen R P B, Parsons H, Awashty M, Sierdsema H L K, Marzluff J M, Fernandez-Juricic E, de Laet J, van Heezik Y M 2016 Urban bird conservation: presenting stakeholder-specific arguments for the development of bird-friendly cities Urban Ecosyst. 10: 1535-1550
[7] Biggs D, Turpie J, Fabricius C and Spacecley A 2011 The value of avitourism for conservation and job creation-An analysis from South Africa Conserv. Soc. 9(1): 80-90
[8] Belaire J A, Westphal L M, Whelan C J and Minor E S 2015 Urban residents’ perceptions of birds in the neighborhood: Biodiversity, cultural ecosystem services, and disservices The Condor 117: 192-202
[9] Connell J 2009 Birdwatching, twitching and tourism: towards an Australian perspective *Aus. Geogr.* **40**(2): 203-217

[10] Hvenegaard G T 2002 Birder specialization differences in conservation involvement, demographics, and motivations *Hum. Dimens. Wildl.* **7**: 21-36

[11] Burrows E, O’Mahony M and Geraghty D 2018 How urban parks offer opportunities for physical activity in Dublin, Ireland *Int. J. Environ. Res. Public Health* **15**: 1-11

[12] Cohen D A, McKenzie T L, Sehgal A, Williamson S, Golinelli D and Lurie N 2007 Contribution of public parks to physical activity *Am. J. Public Health* **97**(3): 509-514

[13] Zhu J, Lu H, Zheng T, Rong Y, Wang C, Yan Y and Tang L 2020 Vitality of urban parks and its influencing factors from the perspective of recreational service supply, demand, and spatial links *Int. J. Environ. Res. Public Health* **17**(1615): 1-17

[14] Cammack P J, Convery I and Prince H 2011 Gardens and birdwatching: recreation, environmental management and human–nature interaction in an everyday location *Area* **43**(3): 314-319

[15] Lembaga Ilmu Pengetahuan Indonesia 2013 3500 Plant Species of The Botanic Gardens of Indonesia (Jakarta: Lembaga Ilmu Pengetahuan Indonesia)

[16] Chamberlain D E, Gough S, Vaughan H, Vickery J A and Appleton GF 2007 Determinants of bird species richness in public green spaces *Bird Study* **54**(1): 87-97

[17] Kim J, Chae J and Koo T H 2007 Variation in bird diversity in relation to habitat size in the urban landscape of Seoul, South Korea *Acta Oecol.* **42**(1): 39-44

[18] Leveau I M 2019 Primary productivity and habitat diversity predict bird species richness and composition along urban-rural gradients of central Argentina *Urban For. Urban Green.* **43**: 1-11

[19] Kaban A, Mardiastuti A and Prasetyo L 2018 Landscape structure affects bird community in Bogor, West Java *Jurnal Penelitian Kehutanan Wallacea* **7**(2): 109-118

[20] Aronson M F J, Lepczyk C A, Evans K L, Goddard M A, Lerman S B, MacIvor J S, Nilon C H and Vargo T 2019 Biodiversity in the city: Key challenges for urban green space management *Front. Ecol. Environ.* **17**(5): 159-169

[21] Schutz C and Schulze C H 2015 Functional diversity of urban bird communities: Effects of landscape composition, green space area, and vegetation cover *Ecol. Evol.* **5**(22): 5230-5239

[22] Sulaiman M, Mohamad N H N and Idiliftri S 2013 Contribution of vegetation in urban parks as habitat for selective bird community *Procedia - Social and Behavioral Sciences* **85**: 267-281

[23] Tinajero R, Barragan F and Chapa-Vargas L 2017 Raptor functional diversity in scrubland-agricultural landscapes of Northern-Central-Mexican dryland environments *Trop. Conserv. Sci.* **10**: 1-18

[24] Roth T and Weber D 2008 Top predators as indicators for species richness? Prey species are just as useful *J. Appl. Ecol.* **45**(3): 987-991

[25] Wilkins E J, Cole N W, Miller H M, Schuster R M, Dayer A A, Duberstein J N, Fulton D C, Harshaw H W and Raedeke A H 2019 Rural-urban differences in hunting and birdwatching attitudes and participation intent *Hum. Dimens. Wildl.* **24**(6): 530-547

[26] Clucas B, Rabotyagov S and Marzluff J M 2015 How much is that birdie in my backyard? A cross-continental economic valuation of native urban songbirds *Urban Ecosyst.* **18**: 251-266

[27] Gunnarsson B, Knez I, Hedblom M and Sang A O 2017 Effects of biodiversity and environment-related attitude on perception of urban green space *Urban Ecosyst.* **20**: 37-49

[28] Cordell H K and Herbert N G 2002 The popularity of birding is still growing *Birding* **34**: 54-61

[29] Sekercioglu C H 2002 Impact of birdwatching on human and bird communities *Environ. Conserv.* **29**(3): 282-289

[30] Agita A, Nurcahyani N, Kanedi M and Busman H 2020 Study of birds and plant types for birdwatching tourism development in The Liwa Botanical Garden, West Lampung *Jurnal Ilmiah Biologi Ekspimen dan Keanekaragaman Hayati* **7**(1): 6-10

[31] Janra M N 2019 Birding backyard: birdwatching in Andalas University *Earth and Environmental Science* **327**: 1-12 *IOP Conf. Ser.: Earth Environ. Sci.* **327**: 012025

[32] Hasibuan R S, Nithibaskara T U and Mahardika R 2018 Birdwatching Interpretation in Bogor Botanical Garden *Media Konservasi* **XXXIII**(1):28-36

[33] Callaghan C T, Slater M, Major R E, Morrison M, Martin J M and Kingsford R 2018 Travelling birds generate eco-tourists: The economic potential of vagrant birdwatching *Hum. Dimens. Wildl.* **28**(1): 71-82

[34] Maple L C, Eagle P F J and Rolfe H 2010 Birdwatchers’ specialization characteristics and national park tourism planning *J. Ecotourism* **9**(3): 219-238

[35] Celis-Diez J L, Muñoz C E, Abades S, Marquet P A and Armesto J J 2017 Biocultural homogenization in urban settings: public knowledge of birds in city parks of Santiago, Chile *Sustainability* **9**(485): 1-14

[36] Steven R 2015 The Relationship between birders, avitourism, and avian conservation (Griffith: Griffith University)

[37] Ditton R B, Loomis D K and Choi S 1992 Recreation specialization: Re-conceptualization from a social worlds perspective *J. Leis. Res.* **24**(1): 33-51
[38] Scott D, Ditton R B, Stoll J R and Eubanks Jr. T L 2005 Measuring specialization among birders: utility of a self-classification measure *Hum. Dimens. Wildl.* **10**: 53-74

[39] Martini A, Biondi D and Batista A C 2018 Distance and intensity of microclimatic influence provided by urban forest typologies *Floresta e Ambiente* **25**(2): 1-12

[40] Wang H, Dai X, Wu J, Wu X and Nie X 2019 Influence of urban green open space on residents’ physical activity in China *BMC Public Health* **19**: 2-12

[41] Zhang Y, Van den Berg A E, Van Dijk T and Weitkamp G 2017 Quality over quantity: contribution of urban green space to neighborhood satisfaction *Int. J. Environ. Res. Public Health* **14**: 1-10

[42] White R L, Eberstein K and Scott D M 2018 Birds in the playground: Evaluating the effectiveness of an urban environmental education project in enhancing school children’s awareness, knowledge, and attitudes towards local wildlife *Journal PLoS ONE* **13**(3): e0193993

[43] Pujiati A, Bowo P A and Nihayah D M 2018 The urban sustainability index in urban agglomeration *J. of Economics and Policy* **11**(2): 294-305