Park Structures as Determinant of Bird Species Diversity in Putrajaya

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Abstract

The presence of birds is important to verify ecological condition in cities since they respond well to the availability of habitat structure. This study aims at investigating park structures which influence bird species diversity in Putrajaya. The studied areas consist of six metropolitan parks. Vegetation structure and bird species data were collected through distance sampling method. Evaluations of overall 12 points were carried out to be mapped in the Standard Computer-aided Design (CAD) software. The results reveal that park with higher density vegetation supports higher habitat variables including food, foraging substrate and nesting site for birds to survive in Putrajaya.

Keywords: Vegetation structure, Bird diversity, Ecological guilds, Putrajaya

DOI: https://doi.org/10.21834/aje-bs.v5i17.47

1.0 Introduction

Parks are different to each other as each park have different function that demonstrate different physical character. Physical characters including vegetation distribution pattern, density and canopy coverage are some factors that influence park performance which is important for bird species habitants in cities. Hence, this study aimed at investigating species distribution and abundance of birds which were influenced by vegetation structure of the parks. The bird diversity and abundance were differentiate based on ecological guilds including primary food habit, foraging substrate and nesting habit. The correlation between birds abundance and vegetation structures were verified through evaluation of the ecological guilds listed in this study.The study would finally consider how the vegetation structures relate to the abundance and distribution of bird species in Putrajaya. Finally, this paper hypothesised that park with complex vegetation structures would promote higher level of inhabitants for bird species.

2.0 Literature Review

2.1 Importance of Parks in Urbanized Area

The result of two factors which is natural increase in population and migration to urban areas are the urbanization process that increase propotion of an entire population lives in a city. In Malaysia, the urbanization process is expanding rapidly (Tarmiji et.al, 2012) due to high demand of residential, business and industrial development. The high development process have extremely impacts on the limited green spaces in city area. Hence, the process of fragmentation alter and give big changes on physical surface of the land (Sham Sani, 1984). Hence, urban green spaces such parks, garden and green corridor play a vital role in stabilizing ecosystem function within city areas. The urban green spaces are represented by various types consists of (1) natural landscape which also called as remnant patches of original ecosystem (Forman and Godron 1986 and Abdullah et al. 2006) such as forests, riparian zone, etc.; (2) human landscape which been created and managed by man (Tamara and Eva 2004 and Abdullah et al. 2006) such as parks, street landscape, gardens, greenways, etc.; and (3) areas where natural succession occurs due to the absence of direct human influence (Tamara and Eva 2004) such as abandoned courtyards, areas of destroyed buildings, etc. (Forman and Godron, 1986). However, among all the urban green spaces listed, park which is categorized as human landscape begin to be recognized as conservation land in the urban areas. Thus, park areas need to be preserved as it serves good ecological functions towards city area as a whole (Tamara and Eva, 2014). Furthermore, parks can be seen as influential factors of biodiversity richness as they offer diversity by adding to the complexity, patterns, richness and intricacy of biotic community (Mazlina et al. 2010). Up to that point, urban green space planning in Malaysia develops basic requirement which necessitate at least ten percent of open space to be integrated in all urban development including residential, commercial, institutional and industrial area (Department of Town and Regional Planning, 2006). In accordance with the planning requirement, Putrajaya has developed their own standard parks typology primarily divided based on its size hierarchy

(Table 1).

Table 1: Hierarchy and distribution of open space for Putrajaya-Land Use Class III (Perbadanan Putrajaya)

	Open Space Category	Area (Hectares)	Percentage
1.	Metropolitan park	667.22	34.55
2.	Urban park	166.81	8.64
3.	Local park	116.74	6.05
4.	Neighbourhood park	21.69	1.12
5.	Playground	5.30	0.27
6.	Green Connector	267.22	13.84
7.	Buffer zone	112.64	5.83
8.	Water bodies	573.03	29.68
	TOTAL	1930.43	100.00

2.2 Relationship Between Park Structure and Bird Species diversity

Diversity of birds in the development of urban park areas must have strong correlation to the level of vegetation diversity. Inhabitants level of park to birds usually influenced by habitat variables including vegetation density and diversity, the abundance and age of trees, the amount of native vegetation, presence of waterbodies and the level of human disturbance (Jokimaki 1999 and Fernandez Juricic 2004). Furthermore, the tree structure and composition is usually associated with the abundance and diversity of wildlife species as it provides essential shelter and food resources (Diaz et.al, 2005 and Hagar, 2007) which creates comfort and secure for wildlife. Scientists estimated that approximately 60-90 percent of life is found in the trees as they receive food and nesting site from the foliage, cavity, bark and branch. Referring to Bartemucci (2006) in his paper stated that there would be less diversity in understory plant species if the nurse log was exposed to a higher level of light and a lower canopy density because these plants usually live on the forest floor where they are shaded by the tall surrounding trees. Understory vegetation like small trees, shrubs and undergrowth are also important in supporting wildlife species and ecosystem services (Tuanmu et.al, 2010) especially for Malaysian birds which are not strong fliers and spend much time at or near ground level. Inasmuch, basic habitat requirements of park is diverse plant species, diverse low vegetation and dense vegetation. Thus, bird species abundance would increase along with the increasing of vegetation diversity.

However, the performance of parks to bird species diversity would be based on other influential factors like the park function because different types of parks may have different physical character. Logically, parks that serve ecological functions would have better numbers of bird inhabitants as this types of park usually have much complex, dense and diverse vegetation types. Thus, it is believed that type and function of parks also have significance value towards bird species diversity.

3.0 Methodology

3.1 Site Selection

Putrajaya is a city with 38% of the area has been set aside as green areas. Putrajaya was well-known as an estate land primarily consists of oil palm plantations. Hence, all green spaces occured now can be categorized as human created landscape which were designed and planned properly. In total, Putrajaya consists of eight types of open spaces but the sites used in the survey were all public access sites consists of only six Metropolitan Park within Putrajaya area (figure 1) including Taman wetland, Taman Botani, Taman Wawasan, Taman Putra Perdana and Taman Warisan Pertanian. The selected parks were within 5km x 5km in distance located at the centre of Putrajaya. First part of the survey was done early September of 2012 followed by the second part on June 2014.

The six parks were categorized based on its function; conservation and recreational (table 2). Besides, size of each parks were also tabulated in the table to give initial ideas on park characteristics. Three out of six parks including Taman Wawasan, Taman Putra Perdana and Taman Pancarona were designed mainly for recreational purposes. The other three which are Taman Wetland, Taman Botani and Taman Warisan Pertanian were designed for conservation purposes.

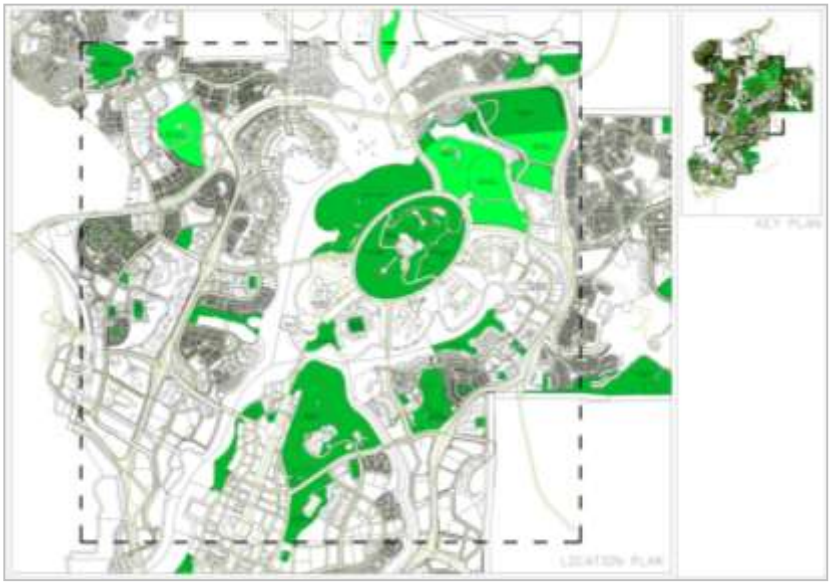


Figure 1: The study are selected was within 5km x 5km in distance (includes six parks)

Table 2: Characteristics and function of the Studied Parks

Parks	Size (ha)	Function
Taman Wetland	126	Conservation
Taman Botani	93	Conservation
Taman Wawasan	137	Recreational
Taman Putra Perdana	62.4	Recreational
Taman Pancarona	14.2	Recreational
Taman Warisan Pertanian	14.6	Conservation

3.2 Data Collection

Two observers were assigned for data collection which one person recorded habitat variables including vegetation height, vegetation types and vegetation arrangement while the other one person recorded birds existence including individual species and perched site. Observers were assigned to assess two points for each park areas. During a count, an observer stand in a point of 50 meter radius and recorded all birds seen and heard for 15 minutes. Judgement of distance was aided with the use of a rangefinder. All counts were conducted early in the morning between 7:00 and 10:00 hour and before late evening between 4:00 and 7:00 hour on days without rain. Time selected for the observation were early in the morning and late evening because birds are active during that hours.

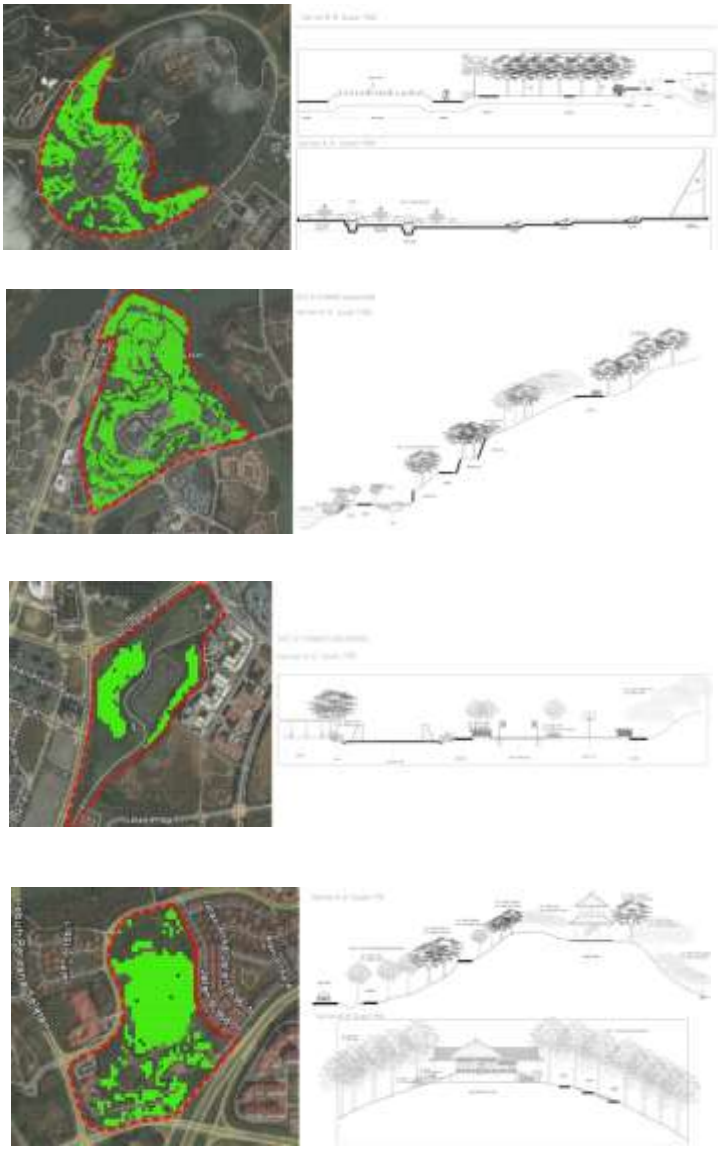
3.3 Analysis

Bird counts were classified into broad categories based on the primary food habit, foraging substrate and nesting habit requirements. For each ecological guilds, a species could only be assigned to one category. The observation recognised seven dietry guilds: granivore, frugivore, nectarivore, insectivore, insectivore-Complex, omnivore and carnivore. Granivores were birds that took mainly seeds. Frugivores were birds that fed on fruits. Nectarivores nectar feeders. Insectivores were birds that fed on insects and small anthropods while insectivores-complex were birds that took not only insects but also fruits or seeds or nectar. Omnivores generally eat animal and plant material such as non-insects and fruits. Carnivores the active hunter ate everything from fish, rodents and other small birds as their primary food habits.

Foraging substrate refers to the perched site like bark, ground, lower foliage, upper foliage, air and water elements. While for nesting requirements refer to the nature of nesting site of bird species and were categorized based on the following categories: ground nesters, undergrowth or shrub nesters, tree nesters, cavity nesters, building nester and brood parasite. Information on dietry, foraging substrate and nesting habits were gathered from published literature (Wells, 1999 and Robson, 2000) and through site observations.

On the other hand, 10 meter x 10 meter lines was overlapped to the Google Earth image of each parks to evaluate the green coverage (figure 2). Areas with green coverage were hatched using green colour while the red line in the map indicate park boundary. As for the

other habitat variables like vegetation height, vegetation types and vegetation arrangement were then correlate to the bird species to see how birds react to the surrounding landscapes



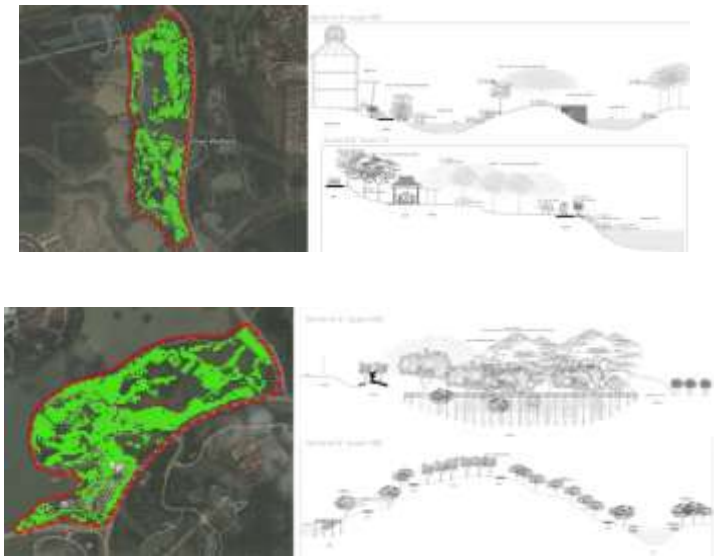


Figure 2: Planting Distribution Pattern in each parks from top to the bottom: Taman Putra Perdana; Taman Wawasan; Taman Pancarona; Taman Warisan Pertanian; Taman Wetland and Taman Botani

4.0 Result And Discussion

The data collected from each physical character of the parks observation, originally sketch by hand, was later translated into digital form. This information was supported by site images which captured during the field survey. The data from observation sheet were coded into Microsoft Excel Software for descriptive statistical analysis. The bird data were also been coded into Microsoft Excel Software to count their total abundance according to the selected ecological guilds in the study. The main focused of these analyses were to understand how park structures relate to bird abundance and diversity. The additional attributes such as park size and function details were also considered in giving additional information of the relationship.

4.1 Habitat Variables and Bird Counts

Descriptive analysis in Table 3 gave an overview on the character of vegetation found on site and total bird count for each studied parks. The empirical findings about park performance were discussed on the basis of differentiating between habitat variables measured including primary vegetation types and vegetation height which has strong relation towards the food and nesting availability for birds to survive. In addition, species total in the table descriptively explained the species richness of birds in each park. Thus, the highest species richness among the six studied parks was Taman wetland which recorded 224 individual total individual species belonging to 17 bird species. Taman Botani which have the same average

of tree height reported second highest of species richness calculation which is 13 in overall. Taman Wawasan which predominantly consists of forest trees range from 10 to 15 meters in height recorded the lowest species richness which is 11. While for the other three parks showed the same total of species richness but varied in individual bird total. Overall, the findings of the study indicate that species richness of birds is high among park with larger in size, higher green coverage, serve ecological functions and inhabits higher vegetation height

Table 3: Descriptive findings of habitat variables and total bird count at each park areas

Parks	Habitat Variables			Bird Count	
	Primary Vegetation types	Vegetation Height (m)	Green coverage (%)	Individual Total	Species Total
Taman Wetland (TW), (E)	Wetland Trees	10-15m	80	224	17
Taman Botani (TB) (E)	Botany Trees	10-15m	80	153	13
Taman Wawasan (TWW) (R)	Forest Trees	10-15m	80	209	11
Taman Putra Perdana (TPP) (R)	Aesthetic Trees	5-10m	80	183	12
Taman Pancarona (TP) (R)	Aesthetic Trees	0-5m	40	140	12
Taman Warisan Pertanian (TWP) (A)	Fruit Trees	5-10m	70	92	12

4.2 Ecological Guild Richness

The results revealed that most of the species found in Putrajaya were carnivores which predominantly eat fish (table 4). The findings indicate that the wetland ecosystem in Putrajaya function well as it successful in providing food materials for bird species including Great Egret, Little Egret, Black-crowned Night Heron, Purple Heron, Grey Heron, Kingfisher and Painted Stork. Frugivorous bird category was ranked at the second level after carnivorous species with total of six species found within studied parks. Accordingly, Putrajaya consists of a fruit conservation park (Taman Warisan Pertanian) which portrays its vegetation types that could support fruit eater birds to survive in Putrajaya city. The species richness reported to be third highest were granivores and insectivores which both recorded four species found. Generally, granivores and insectivores bird species can be found perched on ground to search for seeds and insects.

As for the foraging substrate, ground, lower foliage or branch and water elements were identified to be the most visited sites among bird species. This may be related to the character of Malaysian birds that are not strong fliers and usually spend much time at ground level. On the other hand, most required nesting site among bird species in Putrajaya was tree. Inasmuch, the result was a proven that many bird species require tree not only for foraging but also to build nest. The tree nesting guild is more adapted to urbanisation probably because its nest site are more readily available and their nests are better protected from disturbances due to the tall height of trees.

Table 4: Descriptive findings of habitat variables and total bird count at each park areas

	No of Species	Relative Abundance
Primary Diet Habits		
Granivore	4	0.034
Frugivore	6	0.065
Nectarivore	3	0.013
Insectivore	4	0.099
Insectivore-Complex	3	0.227
Omnivore	2	0.338
Carnivore	7	0.038
Foraging Substrate		
Bark	0	0
Ground	7	3.554
Lower Foliage/Branch	7	0.159
Upper Foliage/Branch	6	0.067
Air	2	0.098
Water	7	0.038
Nesting Habits		
Ground	2	0.017
Undergrowth/Shrub	3	0.035
Tree	17	0.264
Cavity	4	0.464
Building	3	0.117
Brood Parasite	0	0

4.0 Conclusion

The study found that bird community in Putrajaya areas were dominated by carnivores bird species as Putrajaya consists from wide range of wetland areas. The wetland probably offer wetland trees for bird nesting site and aquatic animals like fish for feeding materials. However, when refering to the relative abundance, the most common birds found in Putrajaya areas was omnivores birds. The omnivores diet guild is most adapted to urbanisation probably because the feeding materials from animals and plants can be found easily in city

areas. Thus, provision of areas of rough grass is likely to increase both insects and non-insects food resources for birds and therefore increase species richness. In overall, this study provides an exploratory look on the responses of bird guilds to the various facets of urbanisation. The presence of more wildlife species to the parks area regardless becasue of comfort and secure factors served.

Acknowledgment

This research is funded by GUP (Vot 00H65) and Mybrain 15 from the Ministry of Higher Education, Malaysia.

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