Urban trees to attract wild birds in a tropical urban residential complex in Sentul, West Java, Indonesia

A Mardiastuti

Department of Forest Resources Conservation and Ecotourism
Faculty of Forestry and Environment, IPB University (Bogor Agricultural University) Bogor, Indonesia

Email: aniipb@indo.net.id; ani_mardiastuti@apps.ipb.ac.id

Abstract. In an urban residential complex, in addition to providing environmental services, trees also attract wild birds. The objective of this research was to identify trees planted in tropical urban residential areas that can attract wild birds. The research was conducted in Sentul City Residential Complex, Bogor, West Java, by observing wild birds that visit certain trees as part of their habitat components. Trees provide nectar, fruits, seeds, and insects as food for birds and nest materials. Trees also have important functions as birds’ cover and nesting sites. There were 103 tree species, all basically supporting the life of 51 bird species found in the study area. Examples of nectar producer trees were Spathodea campanulata, Callistemon citrinus, Erythrina cristagalli; fruit producers were Muntingia calabura, Syzygium polyanthum, Ficus benjamina; seeds producers were Leucaena leucocephala, Paraserianthes falcataria. Many trees also attracted insects for bird food, including Acacia mangium, Samanea saman. Conifers and small twigs and leaf petioles/rachis of many legumes, for example, Delonix regia, Calliandra calothyrsus) can be used as nest materials. Careful selection of trees could attract many wild birds to increase the environmental quality of the residential areas.

1. Introduction

Trees have been known to have a highly important role for urban areas, including control of surface temperature and air and generated from their shading and transpiration, reduce the effect of the urban heat island, absorbs various pollutants, sequestrate and store carbon, provision windbreaks, and reduce rainwater runoff [1]. In a residential complex, trees also contribute to an attractive green housing complex, providing the image of a positive, nature-oriented residential area [2]. Trees and their related green space have been recognized to link with high quality places to live, work, and spend leisure time [3].

Trees in a residential complex also provide a suitable habitat for various urban wildlife species, including birds [4]. Despite the fact that birds in residential areas may face many challenges [5, 6] that include low ability food sources [7], higher exposure to novel predators including house cats [8], limited habitat types [9], and the existence of some human-induced stressors such as light at night [10], certain birds are still able to inhabit residential areas.

Although there is a rapid increase in studies from the southern hemisphere and tropical areas, research in the urban and residential areas is unfortunately still centered in the northern hemisphere [6]. Research on urban birds and trees in residential areas has become more important, along with the increasing
environmental awareness of urban residents. Residential areas having more green open space, tree diversity, as well as bird diversity, are considered to have higher quality, which in turn would increase the quality of their residents.

In West Java, Indonesia, bird research in the residential areas has been conducted in Sentul City in the outskirt of Bogor City [11, 12]. However, the linkage between birds and trees has not been conducted, and thus the objective of this research was to identify trees planted in tropical urban residential areas that can attract wild birds. Sentul City residential complex was selected to represent the tropical urban residential complex, mainly to the excellent landscaping design of the area.

2. Methods

2.1. Study site

Established in 1994, Sentul City (06°33’55”- 06°37’45”S; 106°50’20”-106°57’10”E; figure 1) is a satellite township in the outskirt of Bogor City, West Java, Indonesia (figure 1). It is a big complex covering 3,100 ha of residential areas and many other facilities, including a hospital, malls, traditional market, convention center, mosques, amusement park, hotels, house-shop complex, schools, and 18-hole golf course [13].

Sentul City has a vast green area, about 65% of its total area. This township is well known for its diverse plants along the 6.2 km green boulevard and streets. Each housing cluster gate, traffic island, roadsides, and median road were planted with many trees. Earlier survey [14] reported 84 species of trees and palm species in the township. With the rapid progress of the area, including the development of many new housing clusters, there was a possibility that there had been some additional new tree species.

![Figure 1. Map of the study area in Sentul City residential complex.](image)

2.2. Methods

Survey on tree species, defined as woody species having a distinct crown, were conducted in the first and second week of May 2021 through observation of the entire area within Sentul City, by
systematically walking or slow-speed vehicle along the main boulevard, main streets connecting housing clusters, and small roads within all housing clusters. The species list by previous researchers [14] was checked and updated. Non-tree species, namely palms and large non-woody species, were excluded. Data collected were Latin names and Indonesian names of the tree, as there have been no standard common names for trees. A list of tree species was presented in alphabetical order of its Latin name. Information on the tree origin, either native to Java/Melanesia or introduced from other regions, was cross-checked based on a list of trees in the area [15].

Bird species found in Sentul City were based on previous research [11], which listed 43 bird species. Updated new bird species were conducted through observations from January to May 2021, along with the tree surveys. Birds were observed along existing roads and boulevards by using binoculars or identified through their call or song. Information on the use of certain tree species by birds was collected during the tree and bird surveys, combined with a 30-year Author’s personal experience as an avian ecologist. The use of trees by birds were grouped based on relevant birds’ habitat requirement, namely food – consisted of nectar, seed, fruit, insect - and cover, including the provision of nesting materials, nesting site, and perch site. Bird nomenclature and sequence follow a common bird field guide [16].

3. Results

3.1. Diversity of tree species

There were 103 tree species found in the study area (table 1). Some areas were less or un-accessible, for example, the wilderness area of Northridge Cluster, areas within the golf course, or area at the backyard of large private housing, which might cause some underestimation of the total observed tree species. However, the un-recorded number of tree species was estimated to be low of less than five species, considering the intensiveness and extensive coverage of the survey. Based on the tree origin, about half (51; 49.5%) of the tree species were of Melanesia origin, including Java.

For example, in some housing clusters, the Bukit Golf Hijau Cluster, the trees have reached maturity and might need some regeneration in the near future. For instance, some of the trees, Ficus benjamina in Victoria Cluster, have grown too big, and they sometimes needed to be pruned, trimmed, or cut-off. Meanwhile, in the newly developed clusters, many trees were still in pols stages.

Trees in Sentul City were carefully selected to include consideration of species diversity, aesthetic value, as well as function. Furthermore, the planted trees are also meant to characterize each housing cluster (figure 2). Many of the tree species were already considerably rare. Some examples of local fruit that have been difficult to find anymore are Sandoricum koetjape (also known as ‘Sentul’, the same name of the residential complex), Cinometra cauliflora, Diospyros discolor, Flacourtia inermis, and Antidesma bunius.

In addition to the tree species, many tree-like species were widely planted, including ‘kelapa sawit’ Elaeis guineensis, ‘palem putri’ Veitchia merillii, ‘palem ekor tupai’ Wodyetia bifurcata, ‘palem raja’ Roystonea regia, palem botol Hyophorbe lagenicaulis, ‘palem phoenix’ Phoenix roebelenii, ‘palem kipas’ Livistona chinensis, ‘palem bismarkia perak’ Bismarckia nobilis), ‘pisang kipas’ Ravenala madagascariensis, and some varieties of frangipani (Plumeria). Other ornamental shrubs and ground cover were also planted along boulevards, roadides, traffic islands, and other green open spaces of various types.

3.2. Diversity of bird species

The number of birds observed during the study was 51 species (table 2), of which almost all of them (48 species; 94.1%) depend on trees for their existence. These birds were typical birds that already adapted to the urban areas in West Java and its surrounding.

Sentul City has some bodies of water, including small lakes, streams, rivers, and thus many species depend on water also can be observed in the area, including night heron, waterhen, and some species of kingfishers. One species of raptor, namely Spotted Kestrel quite often seen soaring above the residential complex. These water-dependent species and raptors surely need trees, at least as their perching and
roosting site. The rest of the bird species, which constituted the majority of species, were terrestrial small-sized birds.

Some bird species were considered sensitive and can only be found in the less human disturbance area, including Pink-necked Green-Pigeon, Drongo-Cuckoo, Pied Triller, Small Minivet, Great tit Long-tailed Shrike, and all babblers. Others, such as Sooty-headed Bulbul and Eurasian Tree Sparrow, were abundant and widespread.

3.3. Tree species that can attract bird

Trees obviously have many roles for birds, including providing important habitat components, mainly food and cover. Some tree species could attract certain bird species due to the bird food they produced or/and cover provided by the trees’ thick canopy.

Birds can feed on various insects of many stages on leaves, branches, twigs, barks of the tree trunk, and even underneath barks. Flowering trees are crucial for nectarivorous birds, judging from the bird species frequently spotted on flowering trees, such as Bauhinia purpurea, which flowers all-year round, or Cassia fistula which flowering seasonally (figure 3). The tree produces fruits, specifically small-sized fruits, which were strongly preferred by many bird species. Species that produce all-year fruit, such as Muntingia calabura, are highly needed for many birds. For instance, other seasonally fruiting trees, Syzygium polyanthum and Antidesma bunius, were also very important for birds. Most tree legumes produced seeds for birds.

Trees also attract birds by providing a safe nesting site, either among branches within the canopy, hanging on the canopy, or in cavities inside the tree trunk by woodpeckers and barbets. Nest materials, mostly open or closed cup-shaped nests, also were provided by trees, specifically long and flexible needle leaves of Pinus, Casuarina, Araucaria. In addition, small twigs and leaf petioles/rachis of many legumes can also be used as nest materials, for instance, Delonix regia, Calliandra calothyrsus.

Table 1. List of tree species observed in Sentul City residential complex, with information on their roles as habitat components for the wild birds; the number of native tree species: 51.

| No | Latin Name | Local Name | Java Origin* | Nectar | Seed | Fruit | Insect | Nest Material | Nesting Site | Perch Site |
|----|------------|------------|--------------|--------|------|-------|--------|---------------|--------------|-----------|
| 1  | Acacia mangium | Mangium | 0 | ● | ● | ● | ● | ● |● |
| 2  | Acacia auriculiformis | Akasia | 0 | ● | ● | ● | ● | ● |● |
| 3  | Adenanthera pavonina | Saga pohon | 1 | ● | ● | ● | ● | ● |● |
| 4  | Aegle marmelos | Maja | 1 | | | | | | |
| 5  | Agathis dammara | Damar | 1 | | | ● | ● | ● |● |
| 6  | Alstonia scholaris | Pulai | 1 | | | | | | |
| 7  | Annona muricata | Sirsat | 0 | | | | | | |
| 8  | Anthocephalus chinensis | Jabon | 1 | | ● | ● | ● | ● |● |
| 9  | Antidesma bunius | Buni | 1 | | ● | ● | ● | ● |● |
| 10 | Araucaria heterophylla | Cemara norfolk | 0 | | ● | ● | ● | ● |● |
| 11 | Araucaria cunninghamii | Cemara papua | 0 | | ● | ● | ● | ● |● |
| 12 | Artocarpus elasticus | Sukun | 0 | | | | | | |
| 13 | Artocarpus heterophyllus | Nangka | 0 | | | | | | |
| 14 | Pithecellobium dulce | Asam londo | 0 | | ● | ● | ● | ● |● |
| 15 | Averrhoa bilimbi | Belimbing wuluh | 0 | | | | | | |
| 16 | Averrhoa carambola | Belimbing | 1 | | | | | | |
| 17 | Barringtonia asiatica | Butun | 1 | | | | | | |
| 18 | Bauhinia purpurea | Bunga kupu-kupu | 0 | | | | | | |
| 19 | Brassaia actinophylla | Walisongo | 0 | | | | | | |
| 20 | Calliandra calothyrsus | Kaliandra merah | 0 | | | | | | |

*Java Origin: 0 = Java, 1 = Java origin
| No  | Latin Name                  | Local Name | Java Origin | Nectar | Seed | Fruit | Insect | Nest Material | Nesting Site | Perch Site |
|-----|-----------------------------|------------|-------------|--------|------|-------|--------|---------------|--------------|-----------|
| 21  | Callistemon citrinus        | Sikat botol| 0           |        | ●    | ●     | ●      | ●             |             |           |
| 22  | Cananga odorata             | Kenanga    | 0           |        | ●    | ●     | ●      | ●             |             |           |
| 23  | Canarium commune             | Kenari     | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 24  | Cassia fistula               | Tengguli   | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 25  | Cassia siamea               | Johar      | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 26  | Casuarina sumatrana          | Cemara angin| 1          |        | ●    | ●     | ●      | ●             |             |           |
| 27  | Cassia quisquetifolia       | Cemara laut| 1           |        | ●    | ●     | ●      | ●             |             |           |
| 28  | Cerbera odollam             | Bintaro    | 0           |        | ●    | ●     | ●      | ●             |             |           |
| 29  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 30  | Citrus grandis              | Jeruk bali | 0           |        | ●    | ●     | ●      | ●             |             |           |
| 31  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 32  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 33  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 34  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 35  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 36  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 37  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 38  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 39  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 40  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 41  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 42  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 43  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 44  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 45  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 46  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 47  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 48  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 49  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 50  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 51  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 52  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 53  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 54  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 55  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 56  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 57  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 58  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 59  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 60  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 61  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 62  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 63  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 64  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 65  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 66  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 67  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 68  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 69  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
| 70  | Cinnamomum burmanni         | Kayumanis  | 1           |        | ●    | ●     | ●      | ●             |             |           |
### Table 2. List of bird species observed in Sentul City residential complex, with information on the preferred food for each bird species (◼: main food; □: alternate food).

| No | Ref# | Latin Name                  | Local Name | Java-Origin | Nectar | Seed | Fruit | Insect | Nest-Material | Nesting Site | Perch Site | Meat/Fish* | Aquatic Plants* |
|----|------|-----------------------------|------------|-------------|--------|------|-------|--------|---------------|--------------|------------|------------|----------------|
| 71 | 45   | Mimusops elengi             | Tanjung    | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 72 | 118  | Morinda citrifolia          | Mengkudu   | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 73 | 148  | Moringa oleifera            | Kelor      | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 74 | 157  | Muntingia calabura          | Kersen     | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 75 |      | Nepheleium lappaceum        | Rambutan   | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 76 |      | Paraserianthes falcataria   | Sengon     | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 77 |      | Parkia speciosa             | Petai      | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 78 |      | Peronema canescens          | Sungkai    | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 79 |      | Persea americana            | Alpukat    | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 80 |      | Pinus merkusii              | Pinus      | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 81 |      | Podocarpus macrophyllus     | Lohansung  | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 82 |      | Polyalthia longifolia       | Glodokan tiang | 0 | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 83 |      | Pometia pinnata             | Matoa      | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 84 |      | Podocarpus macrophyllus     | Jambu klutuk | 1 | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 85 |      | Pterocarpus indicus         | Aangsana   | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 86 |      | Salix babylonica            | Yang-liu   | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 87 |      | Samanea saman               | Trembesi   | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 88 |      | Sandoricum koetjape         | Kecapi     | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 89 |      | Spathodea campanulata       | Ki acret   | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 90 |      | Syzgium mahagoni            | Mahoni     | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 91 |      | Syzgium aqueum              | Jambu air  | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 92 |      | Syzgium malaccense          | Jambu bol  | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 93 |      | Syzgium polyanthum          | Salam      | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 94 |      | Tabebuia caraiba            | Tabebuia kuning | 0 | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 95 |      | Tamarindus indica           | Asam jawa  | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 96 |      | Tectona grandis             | Jati       | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 97 |      | Terminalia catappa          | Ketapang   | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 98 |      | Terminalia mantaly          | Ketapang kencana | 0 | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 99 |      | Thespesia populnea          | Waru laut  | 1           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 100|      | Theobroma cacao             | Pohon coklat | 0 | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 101|      | Thevetia peruviana          | Ginje      | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 102|      | Toona sureni                | Suren      | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| 103|      | Xanthostemon chrysanthus    | Santos     | 0           | ◼      | ◼   | ◼    | ◼      |                |              |            |            |                |
| No | Ref# | Latin Name               | Local Name              | Nectar | Seed | Fruit | Insect | Meat/Fish* | Aquatic Plants* |
|----|------|--------------------------|-------------------------|--------|------|-------|--------|------------|----------------|
| 7  | 277  | Spotted-Dove             | Streptopelia chinensis  |        |      |       |        |            |                |
| 8  | 278  | Zebra-Dove               | Geopelia striata        |        |      |       |        |            |                |
| 9  | 297  | Banded Bay Cuckoo        | Cacomantis sonneratii   |        |      |       |        |            |                |
| 10 | 298  | Plaintive Cuckoo         | Cacomantis melurinus    |        |      |       |        |            |                |
| 11 | 299  | Rusty-breasted Cuckoo    | Cacomantis sepulcralis   |        |      |       |        |            |                |
| 12 | 305  | Drongo-Cuckoo            | Sturnus luguìris        |        |      |       |        |            |                |
| 13 | 316  | Lesser Coucal            | Centropus bengalensis   |        |      |       |        |            |                |
| 14 | 330  | Collared Scopsowl        | Otus lempii             |        |      |       |        |            |                |
| 15 | 349  | Large-tailed Nightjar    | Caprimulgus macrurus    |        |      |       |        |            |                |
| 16 | 350  | Savannah Nightjar        | Caprimulgus affinis     |        |      |       |        |            |                |
| 17 | 355  | Black-nest Swiftlet      | Collocalia maxima       |        |      |       |        |            |                |
| 18 | 358  | Cave-Swiftlet            | Collocalia linchi       |        |      |       |        |            |                |
| 19 | 365  | Little Swift             | Apus affinis           |        |      |       |        |            |                |
| 20 | 378  | Blue-eared Kingfisher    | Alcedo meninting        |        |      |       |        |            |                |
| 21 | 387  | Javan Kingfisher         | Halcyon cyanovenstris   |        |      |       |        |            |                |
| 22 | 389  | Collared Kingfisher      | Todiramphus chloris     |        |      |       |        |            |                |
| 23 | 423  | Coppersmith Barbet       | Megalaima haemacephala  |        |      |       |        |            |                |
| 24 | 442  | Fulvous-breasted Woodpecker | Dendrocopos macei   |        |      |       |        |            |                |
| 25 | 474  | Pacific Swallow          | Hirundo tahitica        |        |      |       |        |            |                |
| 26 | 476  | Striated Swallow         | Hirundo striolata       |        |      |       |        |            |                |
| 27 | 477  | Asian House-martin       | Delychon dasypus        |        |      |       |        |            |                |
| 28 | 485  | Pied Triller             | Lalage nigra            |        |      |       |        |            |                |
| 29 | 488  | Small Minivet            | Pericrocotus cinnamomeus|        |      |       |        |            |                |
| 30 | 494  | Common Iora              | Aegithina tiphia        |        |      |       |        |            |                |
| 31 | 509  | Sooty-headed Bulbul      | Pycnonotus aurigaster   |        |      |       |        |            |                |
| 32 | 514  | Yellow-vented Bulbul     | Pycnonotus goavicer     |        |      |       |        |            |                |
| 33 | 736  | White-breasted Wood-swallow | Artamus leucorrhynchus |        |      |       |        |            |                |
| 34 | 739  | Long-tailed Shrike       | Lanius schach           |        |      |       |        |            |                |
| 35 | 555  | Great tit                | Parus major             |        |      |       |        |            |                |
| 36 | 559  | Black-capped Babbler     | Pellorneum capistratum  |        |      |       |        |            |                |
| 37 | 565  | Horsfield’s Babbler      | Malacocincla sepiarium  |        |      |       |        |            |                |
| 38 | 600  | Chestnut-capped Babbler  | Timalia pileata         |        |      |       |        |            |                |
| 39 | 647  | Golden-bellied Gerygone  | Gerygone sulphurea      |        |      |       |        |            |                |
| 40 | 663  | Common Tailorbird        | Orthotomus sutorius     |        |      |       |        |            |                |
| 41 | 666  | Olive-backed Tailorbird  | Orthotomus sepiun      |        |      |       |        |            |                |
| 42 | 672  | Bar-winged Prinia        | Prinia familiaris       |        |      |       |        |            |                |
| 43 | 733  | Common Pipit             | Anthus novaeselendiae   |        |      |       |        |            |                |
| 44 | 761  | Olive-backed Sunbird     | Nectarinia jugularis    |        |      |       |        |            |                |
| 45 | 766  | Little Spiderhunter      | Arachnothera longirostra|        |      |       |        |            |                |
| 46 | 789  | Scarlet-headed Flowerpecker | Dicaeum trochileum   |        |      |       |        |            |                |
| 47 | 790  | Oriental White-eye       | Zosterops palpebrosums  |        |      |       |        |            |                |
| 48 | 800  | Eurasian Tree Sparrow    | Passer montamus         |        |      |       |        |            |                |
| 49 | 810  | Javan Munia              | Lonchura leucogastroides|        |      |       |        |            |                |
| 50 | 813  | Scaly-breasted Munia     | Lonchura punctulata     |        |      |       |        |            |                |
| 51 | 816  | White-headed Munia       | Lonchura maja           |        |      |       |        |            |                |

# corresponds to the sequence number of the field guide [16]
*trees might be important to produce these food types
Figure 2. Examples of streets that had planted by certain tree species as themes of housing clusters in Sentul City: (A) *Pinus merkusii* at the entrance of Andalusia Cluster, (B) *Cerbera odollam* in Mediterania 2 Cluster, (C) *Polyalthia longifolia* in Pasadena Cluster, (D) *Callistemon citrinus* in Sakura Cluster, (E) *Spathodea campanulata* in Venesia Cluster; (F) *Diospyros discolor* in Casablanca Cluster.

Figure 3. Examples of bird species observed at trees in Sentul City residential complex: (A) Pink-necked Green-Pigeon searched for food at *Ficus benjamina* tree, (B) Yellow-vented Bulbul perched near the seed of *Leucaena leucocephala*, (C) Olive-backed Sunbird feed on nectar of *Bauhinia purpurea*, (D) Oriental White-eye at *Cassia fistula* flower, (E) Banded Bay Cuckoo and (F) Fulvous-breasted Woodpecker foraging for insects. ©A-F: Amar Singh, Joseph Morlan, Lip Kee Yap, Manjusha Savant, Pranjal J. Saikia, Iftiaque Hussain; photos were taken elsewhere

4. Discussion
The richness of tree species in the study area was increased compared to a previous study [14], which has listed 48 tree species, and 19 non-tree species, totaling 67 species. Most of the additional tree species were from the plantation of street trees in the new housing clusters.
The high number of tree species planted as street trees, within clusters, traffic island, the main avenue, and boulevard, or in pocket parks, public squares, and woodlands, along with the influence of many other factors, including safety from illegal hunting, the presence of non-tree plants, apparently have attracted highly diverse bird species. Bird species in the study area have been studied since 2016 [11, 12] and have shown an increase of species ever since. This is most likely due to more intensive observations that also covered nocturnal birds. Unfortunately, a study on bird species richness in a similar set of housing residences in Indonesia was not available, and thus a proper comparison cannot be conducted.

About half of the tree species were non-native, leading to a concern about an ecological phenomenon called biotic homogenization, i.e., the replacement of local biotas by non-native species that are able to co-exist with humans [17]. As Sentul City is a residential area, it is understandable that aesthetic value is placed at the highest consideration in selecting tree species planted in the areas. In addition to tree species, there were also various palm species, including Bismarkia nobilis, Roystonea regia, Veitchia merrillii, Livistona chinensis, Hyophorbe lagenicaulis, and Wodyetia bifurcata, of which many of them were non-native. However, the question of whether a tree species is native or non-native has become vague, as sometimes it is difficult to trace back the actual origin of the trees.

Despite the concern of homogenization in the urban area, trees in Sentul City residential area have attracted many birds by providing birds’ important habitat components, mainly food and cover. A certain tree species always has a role for the bird, at least for perching and searching for food insects. All tree species potentially had some insects on them, including ants, caterpillars, bugs, butterflies, and moths.

Although bird diversity was not the main intention of the tree planting, clearly Sentul City has become a good habitat for 51 bird species. There could be some bird species that were missed, especially in the wilderness area of Northridge Cluster. The previous study [11] only recorded 43 bird species. Examples of newly observed species were Large-tailed Nightjar, Savannah Nightjar (both are nocturnal birds), and Coppersmith Barbet, which was identified based on its unique sound.

5. Conclusion
In conclusion, all tree species are beneficial as bird habitat components, including as food source, roost/nest site, and provision of nest materials. Some tree species provide food, namely insects, fruits, seeds, and nectar, usually in short supply in residential areas. Careful selection of tree species could attract many wild birds in a residential complex and thus increase the environmental quality of the areas.

6. References
[1] Lütte U and Buckeridge M 2020 Trees: structure and function and the challenges of urbanization Trees [online] 01964-1
[2] Tyrväinen L, Pauleit S, Seeland K, and de Vries S 2005 Benefits and uses of urban forests and trees 117-148 in Urban Forests and Trees Konijnendijk C, Nilsson K, Randrup T and Schipperijn J (Eds) (Berlin: Springer-Verlag)
[3] Woodl and Trust 2015 Residential Developments and Trees (United Kingdom: Woodland Trust)
[4] Jokimäki J and Kaisanlahti-Jokimäki M 2012 Residential areas support overwintering possibilities of most bird species Ann Zool Fennici 49 240-256
[5] Reynolds S J, Ibáñez-Álamo J D, Petra Sumasgutner P and Mainwaring M C 2019 Urbanisation and nest building in birds: a review of threats and opportunities J of Ornithology 160 841-860
[6] Marzluff J M 2017 A decadal review of urban ornithology and a prospectus for the future Ibis 159 1-13
[7] Reynolds S J, Galbraith J A, Smith J A and Jones D N 2017 Garden bird feeding: insights and prospects from a north-south comparison of this global urban phenomenon Front Ecol Evol 5 24
[8] López-Flores V, MacGregor-Fors I and Schondube J E 2009 Artificial nest predation along a Neotropical urban gradient Landsc Urban Plan 92 90-95
[9] Rodewald A D, Kearns L J and Shustack D P 2013 Consequences of urbanizing landscapes to reproductive performance of birds in remnant forests *Biol Cons* **160** 32–39

[10] Holveck M-J, Grégoire A, Doutrelant C and Lambrechts M M 2019 Nest height is affected by lamppost lighting proximity in addition to nestbox size in urban great tits *J Avian Biol* **2019** e01798

[11] Mardiastuti A 2019 Bird community changes across gradient of habitat quality in the urban green open space *Proc IOP Conf Ser Earth Environ Sci* **407** 012012

[12] Mardiastuti A, Mulyani Y A, Asmoro A T and Putra M S K 2017 Bird community in urban residential area: Which species sustained after five elapse years? *Proc IOP Conf Ser Earth Environ Sci* **179** 012040

[13] PT Sentul City Tbk 2020 Annual Report 2019 (Bogor: PT Sentul City Tbk)

[14] Arifin H S and Nakagoshi N 2011 Landscape ecology and urban biodiversity in tropical Indonesian Cities *Landscape Ecol Eng* **7** 33–43

[15] Samsoedin I and Waryono T 2010 *Hutan Kota dan Keanekaragaman Jenis Pohon di Jabodetabek* (Jakarta: Indonesian Biodiversity Foundation)

[16] MacKinnon J, Phillipps K and van Balen B 2010 *Seri Panduan Lapangan Burung-Burung di Sumatera, Jawa, Bali dan Kalimantan* Birdlife International-Indonesia Program–Pusat Penelitian dan Pengembangan Biologi LIPI Bogor

[17] McKinney M L and Lockwood J L 1999 Biotic homogenization: a few winners replacing many losers in the next mass extinction *Trends Ecol Evol* **14** 450–453

**Acknowledgments**

The author would like to thank Amar Singh, Joseph Morlan, Lip Kee Yap, Manjusha Savant, Pranjal J. Saikia, and Iftiaque Hussain for their beautiful bird photos posted on the Oriental Bird Image (http://orientalbirdimages.org) website.