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Bird Diversity in Urban Residential Areas: In Supporting Sustainable Agriculture

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Abstract | Food and shelter availability affect birds in an area, and a decline in bird diversity may affect its function change. Urban residential areas can serve as bird living spaces besides human dwellings since green sections are deduced to support bird activities. Through direct and indirect field observation in such areas, this study aims to determine bird diversity, bird richness, bird evenness rates, and vegetation composition. Data taken covers activity, encounter time, species, quantity, and behavior and is presented in a descriptive analysis. Observations were found and recorded as a result 1 006 bird individuals of 20 species belong to 14 families, with Bondol Peking (*Lonchura punctulate* Linnaeus, 1758), Cucak Kutilang (*Pycnonotus aurigaster* Vieillot, 1818) and Burung Gereja (*Passer domesticus* Linnaeus, 1758) as the most dominant species at 19.38 %, 12.43 %, and 11.93 %, respectively. The diversity index (H') is 2.59, while the evenness index (E) is 0.86, and the richness index (R) is 2.75. Regarding density, Bondol Peking (19.50) is the most dominant, followed by Cucak Kutilang (12.50) and Burung Gereja (12.00), density in this case is the number of individuals divided by the observation area.. Birds in residential landscapes function as human leftover food control systems, ecosystem protectors, and indicators of environmental change. They assist sustainable agricultural activities in seeding, dispersal, pollinating plants, and controlling pests.

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Introduction

Being able to live in natural and artificial environments, the bird is the most commonly encountered wild animal in areas with plants. Having vast areal coverage makes this species a vital natural resource (Pei *et al*., 2018; Tryjanowski *et al*., 2017) as it serves the function as a parameter of areal metamorphosis (Sekercioglu, 2012; Xu *et al*., 2018) in ecological system harmony (Chanate *et al*., 2020; Machar *et al*., 2021). Perceptible to interaction among ecosystem elements, it is inevitable that birds support the environmental sustainability cycle (Batisteli *et al*., 2018) by distributing vegetation. Birds for agricultural activities can help control pests and pollinate crops.

A specific locale's variety of living environments should impinge on its bird diversity (Lešo *et al*., 2019; Vale *et al*., 2018). As one fulfills certain birds' needs for living and breeding (Shah and Sharma, 2022), different characteristics affect the ranges of birds found (Hagen *et al*., 2017; Xu *et al*., 2018). It is, therefore, imperative to conserve such areas to protect bird species (Hoek *et al*., 2017), and the attempt requires data on habitation, similar individual assemblage, and local situation.

Physical and human resource development has been underway in the capital of Riau province, Pekanbaru. Specifically, in the Umban Sari District of the Rumbai Region, more land has been opened for plantations, business spots, and residences, involving more people. The activity must be effective toward birds' existence as less and less vegetation remains in their habitats. Birds (and other species of animals) subsist with sufficient food and dwellings (Benedetti *et al*., 2022), and their decrease in number and variety is often caused by ecological disturbance due to area function changes (Callaghan *et al*., 2018).

When plants are in their landscapes, residential areas can serve as bird dwellings in addition to homes for humans (Hagen *et al*., 2017). Notably, plant diversity supports more bird species (Vijay *et al*., 2016). Birds also play an essential role in agricultural activities, such as controlling pests and helping pollinate plants. Land cover changes in Riau Province from 2012 to 2020 were dominated by oil palm plantations and plantation forests, which tended to be homogeneous at 60.79 %, and there was a continuing upward trend (Forestry, 2021). This condition has an impact on bird habitat, which continues to decrease (Aronson *et al*., 2014). This is thought to affect the diversity of bird species. The presence of diverse birds can help reduce the need for pesticides and increase plant regeneration. Therefore, identifying plant diversity, bird diversity, and bird evenness levels based on vegetation to support sustainable agriculture in residential areas is appointed as the purpose of this study.

Materials and Methods

Conducted in Rumbai Region, Pekanbaru, Riau Province, Indonesia (101° 25' 12.41" E and 0° 34' 42.61" N), the research started in March 2023 and concluded in October 2023. Employing a tally sheet and the map of Pekanbaru to determine habitat types, birds in the area had been observed. Equipment covered a pair of binoculars (Arsson XB821PP 500 X 25, China), camera (Canon EOS 100D DS126191, Taiwan), GPS tracker (Garmin eTrex 10 SEA, Swiss), audio recorder (Sony ICD-PX333, China), timer (Casio G Shock GA 500, Thailand), the guide book of birds (MacKinnon *et al*., 2010) and stationery.

Operating line transect (Bibby *et al*., 2000), both direct and indirect information on birds' activity, time of encounter, variant, quantity, and behavior was recorded while moving down the streets of residential areas. Following prearranged tracks, observation time ranges were 6:30 to 8:30 AM and 4:00 to 6:00 PM. This time is the most active time for birds to do daily activities. Observations are made at least three times a week. The focused data were on the activity, name, and quantity of each bird variant found (Bibby *et al*., 2000).

Diversity index

Shannon-Wiener diversity index was exercised to assess the bird diversity level as per Equation 1 (Thukral, 2010):

$$H' = - \sum pi \ln pi \quad \ldots(1)$$

Note: H' = Shannon-Wiener diversity index; pi = (ni/N); ni = number of i variant; N = total individual; ln = natural logarithm.

The result of H'< 1.5 is considered low diversity, while H' 1.5 to 3.5 average diversity and H' = > 3.5 "high diversity.

Evenness index

To define the evenness level of a certain bird variant in a community, the Shannon-Wiener evenness index was utilized as per Equation 2 (Thukral, 2010).

$$E= H'/\ln S \quad \ldots(2)$$

Note: E= evenness index (ranged from 0 to 1), H'= Shannon-Wiener diversity index, S= number of variants, ln= natural logarithm.

The result of $0 < E \leq 0.4$ is considered low evenness, while $0.4 < E \leq 0.6$ is average evenness, and $0.6 < E \leq 1$ is high evenness.

Richness index
To calculate the variety level, the Margalef richness index is applied as per Equation 3 (Thukral, 2010):

$$R = \frac{(S-1)}{\ln N} \quad \ldots (3)$$

Note: R= Margalef richness index, S= number of variants, N= total individual, ln= natural logarithm.

While $R < 2.5$ means a low richness level, $2.5 \leq R < 4$ shows an average richness level, and $R \geq 4$ represents a high level.

Dominance index
To establish the dominant, subdominant, and rare bird composition, the relative density was verified in regards to Thukral (2010) as per Equation 4 and Equation 5.

$$\text{Density (K)} = \frac{\textit{Number of individuals of a species}}{\textit{Total areas sampled}} \quad \ldots (4)$$

$$\text{Relative Density} = \frac{\textit{Density of species}}{\textit{Density all species}} \times 100\,\% \quad \ldots (5)$$

A bird species is dominant when the relative density rate is >5 %, subdominant 2 % to 5 %, and rare if it is < 2 %.

Encounter index
The encounter rate of bird species was revealed as per Equation 6 (Bibby *et al*., 2000).

$$\text{Encounter Rate} = \frac{\sum \textit{per bird species}}{\sum \textit{Observation time}} \times 10\text{ h} \quad \ldots (6)$$

The categories are listed in Table 1.

Table 1: *Encounter rate of birds as the basis of abundance level determination (Bibby et al., 2000).*

Category (individual per 10 h observation)	Abundance rate	Abundance level
< 0.1	1	Rare
0.1 to 2.0	2	Uncommon
2.1 to 10.0	3	Frequent
10.1 to 40.0	4	Common
> 40.0	5	Abundant

Vegetation data
Types of plants and parts that become food for birds were recorded for the purpose.

Result and Discussion

Birds of a residential area
Overall, 1 006 individuals of 20 species belong to 14 families were detected during observation, as listed in Table 2.

Based on Table 2, the quite dominant bird species are Bondol Peking (*Lonchura punctulate* Linnaeus, 1758) at 19.38 %, Cucak Kutilang (*Pycnonotus aurigaster* Vieillot, 1818) at 12.43 %, and Burung Gereja (*Passer domesticus* Linnaeus, 1758) at 11.93 %. Those species are of the communal type that generally do their group activities. Sufficient vegetation for food and shelter in urban residential areas also allows them to breed (Callaghan *et al*., 2018; Pena *et al*., 2017) the birds above and others live in coconut, palm, and bamboo trees. Several nectarine family members also benefit from adequate flowering plants in the area. Cucak Kutilang birds, as insect eaters, will help control plant pests, while Bondol Peking and Burung Gereja help disperse plant seeds (Şekercioĝlu *et al*., 2012). This will support sustainable agricultural activities (Martinez *et al*., 2021).

Birds in residential landscapes serve as not only protectors of the ecosystem but also indicators of environmental change and assist agricultural activities (Batisteli *et al*., 2018; Dearborn and Kark, 2010; Lešo *et al*., 2019). The existence of varied bird species in an urban residential area should be cherished as they contribute to the natural diversity and balance (Hagen *et al*., 2017; Xie *et al*., 2020). Grain-eating, fruit-eating, and nectar-eating birds support seeding and pollination processes in plants (Şekercioĝlu *et al*., 2012) while insect-eating ones help to control human pests and also plant insect. Additionally, birds bring aesthetic value wherever they are. Their feathers come with assorted colors, patterns, and visually enjoyable textures. Their sounds have a calming effect that matches the purpose of a residence. The landscape of a residential area that focuses on the environment is critical to birds' sustainability and diversity (Beninde *et al*., 2015). Among points of consideration are food accessibility and additional food (Ciach and Fröhlich, 2017; Tryjanowski *et al*., 2015), vegetation structure (Droz *et al*., 2019; Xie *et al*., 2016), and plant composition (Nooten *et al*., 2018).

Table 2: *Birds of residential area.*

No	Local name	Binomial nomenclature	Family	Individual		Type of feed
				Quantity	%	
1	Bondol Peking	*Lonchura punctulate* Linnaeus, 1758	Estrildidae	195	19.38	Granivore
2	Cucak Kutilang	*Pycnonotus aurigaster* Vieillot, 1818	Pycnonotidae	125	12.43	Insectivore
3	Burung Gereja	*Passer domesticus* Linnaeus, 1758	Ploceidae	120	11.93	Granivore
4	Perkutut Jawa	*Geopelia striata* Linnaeus, 1766	Columbidae	98	9.74	Granivore
5	Burung Madu Kelapa	*Antrheptes malacensis* Scopoli, 1786	Nectariniidae	75	7.46	Nectarivore
6	Burung Madu Polos	*Antrheptes simplex* Müller, 1843	Nectariniidae	55	5.47	Nectarivore
7	Tekukur Biasa	*Streptopelia chinensis* Scopoli, 1786	Columbidae	50	4.97	Granivore
8	Burung Madu Sriganti	*Nectarinia jagularis* Linnaeus, 1766	Nectariniidae	45	4.47	Nectarivore
9	Cabai Jawa	*Dicacum trchileum* Sparrman 1789	Dicaeidae	40	3.98	Frugivore
10	Merbah Cerukcuk	*Pycnonotus flavescens* Scopoli, 1786	Pycnonotidae	40	3.98	Insectivore
11	Pijantung Kecil	*Arachnothera longirostra* Latham, 1790	Nectariniidae	35	3.48	Nectarivore
12	Cinenen Kelabu	*Orthotomus ruficeps* Temminck, 1836	Silviidae	32	3.18	Insectivore
13	Kerak Ungu	*Acridotheres javanicus* Cabanis, 1851	Sturnidae	20	1.99	Insectivore
14	Prenjak Jawa	*Prinia familiaris* Horsfield, 1821	Sylvidae	20	1.99	Insectivore
15	Cipoh jantung	*Aegithina viridissima* Bonaparte, 1850	Aegithinidae	15	1.49	Insectivore
16	Kapasan Kemiri	*Lalage nigra* Forster, 1781	Campephagidae	15	1.49	Insectivore
17	Gelatik Batu Kelabu	*Parus major* Linnaeus, 1758	Paridae	12	1.19	Granivore
18	Bondol Haji	*Lonchura maja* Linnaeus, 1766	Estrildidae	8	0.80	Granivore
19	Wiwik Kelabu	*Cacomantis merulinus* Scopoli, 1786	Cuculidae	4	0.40	Insectivore
20	Bentet Kelabu	*Lanius schach* Linnaeus, 1758	Pachycephalidae	2	0.20	Insectivore
Total				1 006	100	

Society should recognize and prevent threats to birds' existence in an urban residential area, such as habitat loss, pollution, and hunting. Environmentally friendly activities like tree planting and pesticide restriction should help conserve birds (Cox *et al*., 2017, 2018) and maintain urban ecosystem sustainability (Wood *et al*., 2018).

Diversity index, evenness index, and richness index

The data computing results came out with a diversity index (H') of 2.59, an evenness index (E) of 0.86, and a richness index (R) of 2.75, as detailed in Table 3.

Table 3: *Diversity index, evenness index, and richenness index.*

No.	Index type	Value	Category
1	Diversity index (H')	2.59	Currently
2	Evenness index (E)	0.86	High
3	Richenness index (R)	2.75	Currently

The average diversity index shows that the studied residential areas are good enough for birds to live in. The geographical situation, management intensity, and landscape complexity are essential in expanding bird diversity (Dehling *et al*., 2014; Lešo *et al*., 2019), and the studied areas can meet the requirements. As bird diversity relies on the environment, particularly shade composition and vegetation size (Callaghan *et al*., 2018; Vale *et al*., 2018), shady trees, shrubbery, fruit trees, agricultural plants, decorative plants, and grasses found in the areas support their existence quite satisfactorily.

Residential areas can provide living space for several bird species. Any change in its diversity, particularly in urban/residential areas, is often influenced by urbanization and vegetation coverage (Benedetti *et al*., 2022; Hagen *et al*., 2017; Pei *et al*., 2018). Protecting and developing varied green open spaces (Callaghan *et al*., 2018; Yang *et al*., 2020) for a sustainable urban environment (Namood *et al*., 2021) should mitigate bird diversity decline. Knowing bird species diversity in residential areas opens possibilities to conserve their habitats, keep their ecosystem balance (Nowak and Greenfield, 2012), and ensure their sustainability for the sake of the locale (Hepburn *et al*., 2021; Żmihorski *et al*., 2019).

Table 4: *Density, dominance, and abundance.*

No.	Local name	Binomial nomenclature	K	KR (%)	Dominance category	Abu-dance	Abudance value	Sequence scale
1	Bondol Peking	*Lonchura punctulate* Linnaeus, 1758	19.50	19.38	Dominance	162.50	5	Abundant
2	Cucak Kutilang	*Pycnonotus aurigaster* Vieillot, 1818	12.50	12.43	Dominance	112.50	5	Abundant
3	Burung Gereja	*Passer domesticus* Linnaeus, 1758	12.00	11.93	Dominance	100.00	5	Abundant
4	Perkutut Jawa	*Geopelia striata* Linnaeus, 1766	9.80	9.74	Dominance	81.67	5	Abundant
5	Burung Madu Kelapa	*Antrheptes malacensis* Scopoli, 1786	7.50	7.46	Dominance	62.50	5	Abundant
6	Burung Madu Polos	*Antrheptes simplex* Müller, 1843	5.50	5.47	Dominance	45.83	5	Abundant
7	Tekukur Biasa	*Streptopelia chinensis* Scopoli, 1786	5.00	4.97	Sub dominance	41.67	5	Abundant
8	Burung Madu Sriganti	*Nectarinia jagularis* Linnaeus, 1766	4.50	4.47	Sub dominance	37.50	4	Common
9	Cabai Jawa	*Dicacum trchileum* Sparrman 1789	4.00	3.98	Sub dominance	33.33	4	Common
10	Merbah Cerukcuk	*Pycnonotus flavescens* Scopoli, 1786	4.00	3.98	Sub dominance	33.33	4	Common
11	Pijantung Kecil	*Arachnothera longirostra* Latham, 1790	3.50	3.48	Sub dominance	29.17	4	Common
12	Cinenen Kelabu	*Orthotomus ruficeps* Temminck, 1836	3.20	3.18	Sub dominance	26.67	4	Common
13	Kerak Ungu	*Acridotheres javanicus* Cabanis, 1851	2.00	1.99	Rare	33.33	4	Common
14	Prenjak Jawa	*Prinia familiaris* Horsfield, 1821	2.00	1.99	Rare	16.67	4	Common
15	Cipoh jantung	*Aegithina viridissima* Bonaparte, 1850	1.50	1.49	Rare	12.50	4	Common
16	Kapasan Kemiri	*Lalage nigra* Forster, 1781	1.50	1.49	Rare	12.50	4	Common
17	Gelatik Batu Kelabu	*Parus major* Linnaeus, 1758	1.20	1.19	Rare	10.00	4	Common
18	Bondol Haji	*Lonchura maja* Linnaeus, 1766	0.80	0.80	Rare	6.67	3	Frequent
19	Wiwik Kelabu	*Cacomantis merulinus* Scopoli, 1786	0.40	0.40	Rare	3.33	3	Frequent
20	Bentet Kelabu	*Lanius schach* Linnaeus, 1758	0.20	0.20	Rare	1.67	2	Unsommon

K= Density; KR= Relative density.

The evenness index is 0.86, meaning the individuals are almost evenly distributed throughout the studied areas. This index informs diversity and ecosystem stability (Tu *et al*., 2020), essential in prioritizing a conservation program. Foods and predators affect the index as food availability invites birds, and certain predators shape birds' behavior and activity. Regular observation of bird population change should serve as an early warning towards ecosystem alteration, such as green area reduction and predator overgrowth. Although birds natural fluctuation may be a challenge in interpreting the evenness index, it is a valuable insight for sustainable environmental development.

With a richness index of 2.75, the areas are considered safe for birds on average. Factors supporting bird growth, like varied habitats (trees, shrubbery, water) (Redlich *et al*., 2018) and a balanced ecological system (Villaseñor *et al*., 2020), exist. Bird richness can indicate biodiversity and environmental wellness. Therefore, areas with a high richness index should be prioritized in conservation.

Deforestation, urbanization, and land function change often devastate bird richness as they lose their natural habitats (Hepburn *et al*., 2021; Proppe *et al*., 2013; Żmihorski *et al*., 2019), while climate change affects bird distribution and migration. Conserving bird habitats in urban areas is critical to recovering their abundance (Aronson *et al*., 2014) as it defines the environmental wellness of an area (Luck *et al*., 2013), so ecosystem restoration is called for when it is damaged. Motivating the society to actively conserve birds and care for the environment along with the government, related organizations, and researchers should prevent birds from extinction.

Density, dominance, and abundance

Table 4 shows the relatively high density, dominance, and abundance rates of Bondol Peking, Cucak Kutilang, and Burung Gereja in the studied areas.

Table 5: *Foods, species, and individuals.*

Type of food	Number of species	%	Number of individuals	%
Insectivore	9	45.00	273	27.14
Granivore	6	30.00	483	48.01
Nectarivore	4	20.00	210	20.87
Frugivore	1	5.00	40	3.98
Total	20	100	1 006	100

Bird density refers to the quantity in an area or habitat over a certain period. Table 5 demonstrates that Bondol Peking has the highest density at 19.50, followed by Cucak Kutilang and Burung Gereja at 12.50 and 12.00, respectively.

Vegetation type, food availability, and dwelling availability determine bird density in an area. Grains, insects, or fruits in a residential area correspond to varied species monitored. Dwellings in trees or buildings are in proportion to bird reproduction and survival. The land function changes in buildings, streets, and parks influence local bird density (Dehling *et al*., 2014), and residential areas can drive natural habitat fragmentation toward both density and diversity (Lerman *et al*., 2012). Moreover, noise and air pollution in urban areas can affect birds behavior and health. Parks, gardens, and other green spots in a residential area should affect bird diversity positively as they serve as habitat structures like trees, shrubbery, and open spaces (Lerman *et al*., 2014).

Bird dominance signifies the proportion of a bird species in the population of a particular area. A highly dominant species tends to excel in quantity and existence. Seven observed species are dominant in the regions studied as they were more frequently seen than the others. Habitat preference, food availability, and dwelling facility determine dominance. Some species are deduced to be dominant when able to adapt to new habitats like gardens or parks and build their nests on trees, stones, or home shades. Bird dominance can be seasonal due to food availability or other environmental factors. Since land management, plant cultivation, and habitat structure changes in a residential area incline bird dominance (Pellissier *et al*., 2012), regular observation of their population should give further information on population dynamics and species dominance. An ecological study of their behavior and habitat preference should identify dominance factors.

Bird abundance denotes the total quantity of a bird species in a particular habitat. Dominance is closely related to it as the more dominant a species is, the more abundant it likely is. Vegetation diversity affects bird abundance and diversity (Morelli *et al*., 2017; Zivanovic and Luck, 2016). Issues that may agitate them are communal activities (Cristaldi *et al*., 2017; Zhou and Chu, 2012), artificial disturbances (Jokimäki *et al*., 2020; Perillo *et al*., 2017), and noise (Fröhlich and Ciach, 2018). However, the abundance of Burung Gereja (*Passer domesticus* Linnaeus, 1758) seems to be unbothered by passers-by (MacGregor *et al*., 2017), possibly due to habit (Skórka *et al*., 2016).

Urban residential area management concerning bird needs can preserve biological diversity while benefiting society ecologically and aesthetically. Therefore, social conservation, which contributes to a sustainable ecosystem in such an area, should be encouraged so birds can coexist with humans.

Percentages of foods, species, and individuals

Based on food, insectivores and granivores are the dominant families, at 45 % and 30 %, respectively. Regarding individuals, granivores and insectivores are the dominant ones at 48.01 % and 27.14 %. The detailed observation result is provided in Table 5.

Birds obtain their foods from natural sources based on their biological needs, habitats, and seasons. Knowing the right foods should help ensure the availability and adequacy of their population while preserving their natural habitat (Harisha *et al*., 2021).

Vegetation

Table 6 lists the plants found in the studied residential areas: forest trees, fruit trees, palms, shrubbery, bamboo, agricultural plants, flowers, and grasses.

Vegetation in urban residential areas provides shelter, food, and dwellings for birds. Trees, shrubbery, and other plants are essential for bird nests (Luck *et al*., 2013; Zhou and Chu, 2012). Dense, leafy vegetation protects the nest and egg against predators and extreme weather. Most birds need specific vegetation structures for building their nests, such as branches, kindling, and leaves. While a lot of bird species make their nests on tall trees, shrubbery is favored by insect-eating birds. As urbanization and land function change diminish vegetation for bird dwelling (Batáry *et al*., 2014), retaining vegetation diversity and bird habitat by planting trees should be feasible. Expanding green space should follow as it is relevant to sustainable ecosystem management.

Vegetation and birds are linked in the food chain, so vegetation conservation in a residential area is a way to save birds (Huang *et al*., 2015; Lepczyk *et al*., 2017). Plants produce flowers for nectarines, fruit for frugivores, grain for granivores, and insects for insectivores.

Table 6: *Vegetation functions for birds.*

No	Name	Type of vegetation	Bird of food	Food part	Remark
1	Mahagony	Tree	Insectivore	Insect	Vegetation is for food as well as shelter and mating
2	Trembesi	Tree	Nectarivore, granivore, insectivore	Nectar, pollen, insect	
3	Oil Palm	Tree	Insectivore, granivore	Insect.grain	
4	Rubber	Tree	Insectivore, granivore	Insect.grain	
5	Avocado	Tree	Nectarivore, insectivore	Nectar, insect	
6	Melinjo	Tree	Frugivore, insectivore	Friut, insect	
7	Matoa	Tree	Insectivore, nectarivore	Nectar, Insect	
8	Jengkol	Tree	Insectivore	Insect	
9	Durian	Tree	Nectarivore, granivore, insectivore	Nectar, pollen, insect	
10	Rambutan	Tree	Frugivore, nectarivore, granivore, insectivore	Friut, nectar, pollen, insect	
11	Manggo	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
12	Water apple	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
13	Guava	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
14	Star Fruit	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
15	Longan	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
16	Cherry	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
17	Soursop	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
18	Jackfruit	Tree	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
19	Ketapang	Tree	Insectivore	Insect	
20	Coconut	Palm	Insectivore, granivore, nectarivore	Nectar, pollen, insect	
21	Areca Nut	Palem	Insectivore, granivore, nectarivore	Nectar, pollen, insect	
22	Palm	Palm	Insectivore, granivore, nectarivore	Nectar, pollen, insect	
23	Bamboo	Bamboo	Insectivore	Insect	
24	Banana	Horticulture	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
25	Papaya	Horticulture	Frugivore, insectivore, nectarivore	Fruit, insect, nectar	
26	Flowers	Herba	Granivore, insectivore, nectarivore	Grain, insect, nectar	
27	Grasses	Grass	Granivore, insectivore	Grain, insect	

Furthermore, plants feed other animals. These facts make vegetation in an urban residential area critical for a balanced ecosystem. Invasive plants are a good choice for marginal areas.

Vegetation provides choices of protection for birds (Gillings, 2019). Leafy, shady plants are suitable for hiding from predators and staying away from rain or intense sunlight; some birds can blend with the surrounding plants for their similar colors. Plant reduction makes birds more prone to predation. Conserving vegetation in urban residential areas should support bird survival and benefit humans (Belaire *et al*., 2015; Cox *et al*., 2017; Dallimer *et al*., 2012).

Vegetation, particularly trees and shrubbery, is a mating place for birds (Hadinoto *et al*., 2023). Tall trees are ideal spots for male birds to perch, interest the females with their chirps, and mark their territories. Perching points play an important role in bird reproduction, which, in the long run, determines an area's abundance index. If vegetation in a residential area is cut down, bird diversity will drop (Hadinoto and Suhesti, 2017).

Conclusions and Recommendations

The study discovered 1 006 bird individuals of 20 species and 14 families. The most frequently encountered kinds of bird were Bondol Peking (*Lonchura punctulate* Linnaeus, 1758), Cucak Kutilang (*Pycnonotus aurigaster* Vieillot, 1818), and Burung Gereja (*Passer domesticus* Linnaeus, 1758). The diversity index (H') in Rumbai urban residential areas averages 2.59, while the evenness index (E) is

0.86, and the richness index (R) is 2.75. Food source vegetation includes but is not limited to forest trees, fruit trees, palms, bamboo, shrubbery, agricultural plants, flowers, and grasses.

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Novelty Statement

Previous research (Bashan *et al*., 2020; Belaire *et al*., 2015; Hedblom *et al*., 2014; Lerman *et al*., 2021) has documented the presence of urban birds. However, previous investigations have only focused on people's perceptions, attitudes, and appreciation of urban birds. The current research shows something new because it identifies bird species in urban residential landscapes for sustainable agriculture. Furthermore, this research found 20 unique bird species that can be used as recommendations for urban bird conservation.

Author's Contribution

Hadinoto Hadinoto: Conceptualizing and designing research, outlining the contents of the paper, conducting literature searches, collecting data, analyzing data, formatting the manuscript, preparing the manuscript, and revising the manuscript.
Lili Zalizar, Joko Triwanto, and Ervayenri Ervayenri: Supervised the manuscript's contents literature search and reviewed the manuscript.
Eni Suhesti, Endang Dwi Purbajanti, Hasni Ruslan and Imran Ullah: Conducted literature search and manuscript review.
All authors have read and approved the final manuscript.

Conflict of interest
The authors have declared no conflict of interest.

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