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Diversity of Bird Species in The Border City of Pontianak, Indonesia, and Sarawak, Malaysia

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Abstract: The island of Kalimantan is an island with a very large area. On this island there are three countries namely Brunei Darussalam, Malaysia and Indonesia. Therefore, there are several areas that are border areas between countries, such as North Kalimantan, Indonesia with Sabah Malaysia, and West Kalimantan, Indonesia with Sarawak, Malaysia. Kalimantan Island is known to have high biodiversity, including a variety of bird species, making it very interesting to explore its species diversity. The purpose of this research is to analyze the diversity of bird species and their conservation status found in the border cities of Pontianak, Indonesia, and Sarawak, Malaysia. The method used in this research is the Point Count Method at each predetermined location. All data obtained were analyzed for their diversity index values and the conservation status of each bird species found was determined based on the International Union for Conservation of Nature and Natural Resources (IUCN). The research results indicate that the bird species diversity index in the border city of Pontianak is 1.795, and Sarawak is 1.70. The research results identified a total of 12 bird species from the two border cities. The bird diversity index value in the border area city of Pontianak is 1.795 and Sarawak is 1.70. The value of the diversity index falls into the moderate category. The conservation status of the 12 bird species found is that one species is classified as Vulnerable (VU) and 11 species are classified as Least Concern (LC).
Keywords: Diversity; bird; border area cities

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INTRODUCTION

Kalimantan Island, also known as Borneo Island, is one of the largest islands in the world with an area of approximately 743,330 km². This island is divided into three national territories: Indonesia with the largest area (Tando et al., 2019) of about 73%, Malaysia with approximately 26%, and Brunei Darussalam with the smallest area of about 1% (East Kalimantan, 2019). The three countries have interconnected land areas known as border regions. Geographically, Brunei Darussalam shares a direct border with Malaysia, and Indonesia shares a direct border with Malaysia.

Kalimantan, which is part of Indonesia, is divided into five provinces: South Kalimantan, East Kalimantan, Central Kalimantan, North Kalimantan, and West Kalimantan. The provinces of North Kalimantan and West Kalimantan are regions that share direct borders with another country, namely Malaysia. North Kalimantan Province borders Malaysia's Sabah (Sudiar, 2017) and West Kalimantan Province directly borders Malaysia's Sarawak (Bangun, 2014).

Indonesia, which has a very vast territory and numerous border areas, certainly faces many challenges and difficulties in its management. This is different from Malaysia, which is a country with a smaller land area, a more stable economy, better quality education, and sufficient human resources, making it easier to manage its

country. These conditions certainly do not only affect human welfare but also the living conditions of other creatures such as animals and plants.

Kalimantan Island is known to have very high biodiversity (Wandini & Hamzah, 2023). This island has great potential for the exploration of its natural resources, including birds (Aves). This animal has a character of mobility and a very wide range of exploration because it performs activities by flying. In addition, this animal has a high sensitivity to environmental changes, making it easy to migrate or relocate (Oktaviani et al., 2021).

Various types of birds are found on the island of Kalimantan, ranging from small to large sizes, from those commonly found in various places to endemic birds. The extensive vegetation allows birds to live and find food on this island. Thus, it is not surprising that various types of birds, both in species and numbers, are found on this island.

Globally, Indonesia ranks fourth in the world with a high diversity of bird species, so this potential must be maintained and become the focus of all parties to carry out conservation efforts for all types of birds, including those on the island of Borneo. Both Indonesia and Malaysia play an important role in the conservation efforts for these birds by preserving the forests and environment.

The border area located in West Kalimantan Province with Sarawak, Malaysia, is also an area that has quite good vegetation. However, over time, the construction of buildings, roads, and other infrastructure, along with the increasing human population, especially in urban areas, has caused significant environmental changes in the region. These changes can certainly trigger alterations in the bird communities present in the area.

Research on the diversity of birds found in Kalimantan Island, especially in border city areas, is still limited, making it very important to conduct exploratory research on this bird diversity. Several studies that have been conducted include the diversity of waterbirds found in the mangrove forest of Pontianak (Elfidasari, 2018) and the types of birds on Tanjungpura Campus (Indra et al., 2020). In addition, several studies on bird diversity have been conducted in Sarawak, Malaysia, including the diversity of birds captured in the Gunung Gading National Park area, Sarawak, Malaysia (Arif & Mohd-Azlan, 2014) and bird surveys in rice fields and dipterocarp forests in Kuching, Sarawak, Malaysia (Nurqamareena et al., 2018).

Based on that background, research on bird species diversity in the border city of Pontianak, Indonesia, and Sarawak, Malaysia, is very important to conduct. This is to determine the level of diversity found in the border city area so that it can serve as comparative data for the diversity index of Indonesia and Malaysia, particularly in the border city area of Pontianak, Indonesia, and Sarawak, Malaysia.

METHOD

The research on bird species diversity in this border city was conducted from March to June 2024. The border area city that serves as the research location is Pontianak City, Indonesia, with coordinates 0°02’20.24’’S 109°20’27.78’’E (Figure 1). The research on bird species diversity in this border city was conducted from March to June 2024. The border area city that serves as the research location is Pontianak City, Indonesia, with coordinates 0°02’20.24’’S 109°20’27.78’’E (Figure 1).

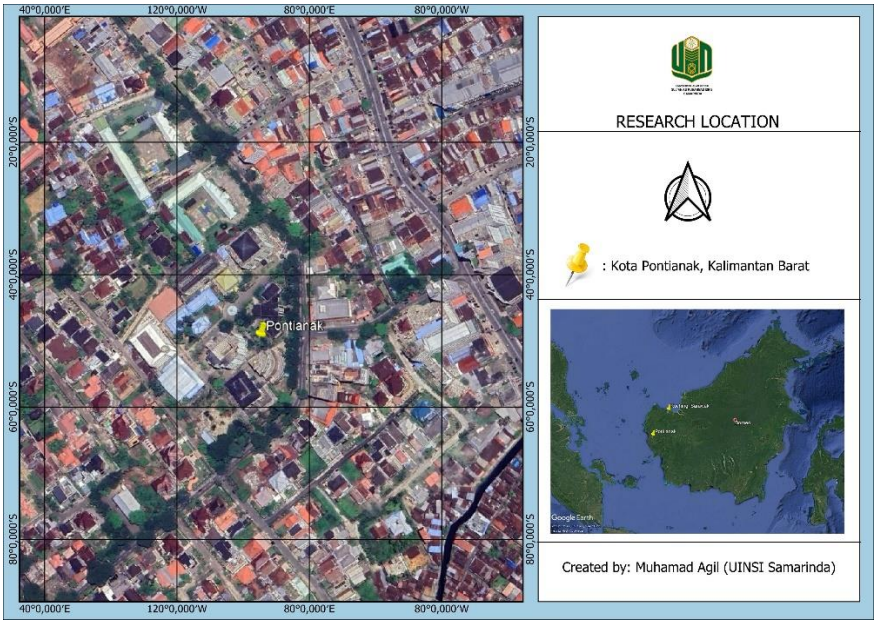

Figure 1. Research location in Pontianak City, Indonesia

The next research location is Sarawak, Malaysia with coordinates 1°33'38.91''N 110°21'10.86''E, which is a border area with Indonesia (Figure 2).

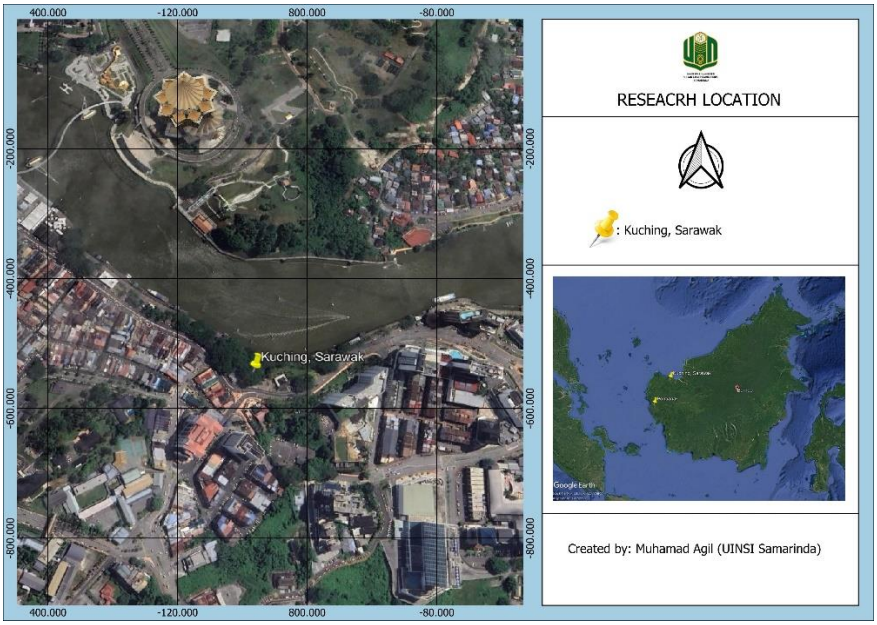

Figure 2. Research location in Sarawak City, Malaysia

Data Collection

Data collection on bird species diversity was conducted using the Point Count method at predetermined observation points (Fontúrbel et al., 2020) (Mulvaney & Cherry, 2020). Observation times were conducted in the morning from 06:00-09:00 AM and in the afternoon from 15:00-18:00 PM (Agil et al., 2024).

Bird Identification

All types of birds encountered at the observation points were observed, documented, their morphology recorded, their numbers counted. The bird was then identified using an identification book (MacKinnon, 2010).

Data Analysis

The obtained data were analyzed using the Shannon Wiener diversity index (H') (Goudarzian & Erfanifard, 2017), relative abundance index (Iswandaru, 2018), evenness index (E), richness index (Latumahina et al., 2020), Sorensen similarity index (Pattinasarany et al., 2021), feeding guild (Leyequién et al., 2014), and conservation status based on the International Union for Conservation of Nature and Natural Resources (IUCN).

Formula of Shannon Wiener Index:

$H' = -\Sigma Pi \ln Pi$

$Pi = ni / N$

Information:
H' = Shannon-Wiener Diversity Index
Pi = Proportion of Types (obtained from the number of individuals of a particular type divided by the number of all individuals obtained in a location)
ni = Number of individuals of a species
N = Number of individuals of all types
H' < 1 : Low diversity index
1 < H' < 3 : Medium diversity index
H' > 3 : High diversity index

Formula of Relative Abundance Index:

Relative abundance index= $\frac{ni}{N}$ x 100

Information:
High Category (>20%)
Medium Category (15-20%)
Low Category (<15%)

Formula of Evennes Index:

$$E = \frac{H'}{\text{Ln } (S)}$$

Information:
E = Evennes Index
H' = Shannon-Wiener Diversity Index
S = Number of types found
E<0,20 : Low Category
0,21<E<1 : High Category

Formula of Richness Index:

$$R = \frac{S-1}{\text{Ln } N}$$

Information:
R = Richness Index
S = Number of types found
N = Number of individuals of all types
R<2.5 : Low Category
2.5<R<4 : Medium Category
R>4 : High Category

Formula of Sorensen Similarity Index:

Sorensen Similarity Index=$\frac{2C}{2C+A+B}$x100

Information:
A =species found only in habitat A
B =species found only in habitat B
C =species found in habitat A and B

RESULT AND DISCUSSION

Based on the research on bird species diversity conducted in the border city of Pontianak, Indonesia, and Sarawak, Malaysia, a total of 12 bird species were identified, consisting of 2 species from the order Passeriformes and 9 species from the order Columbiformes. The types of birds found in the city of Pontianak amounted to 8 species, while in the city of Sarawak, Malaysia, there were 9 species. Quantitatively, the number of bird species found in Sarawak, Malaysia, is greater than in Pontianak, Indonesia.

The city of Sarawak, Malaysia has a more organized infrastructure than Pontianak, Indonesia. In addition, the condition of the vegetation in the city of Sarawak, Malaysia, appears to be more abundant, varied, and larger in size, thereby supporting the existing bird life. As an urban area with a dense number of buildings and residents, it often becomes a barrier to the presence of birds (Tryjanowski et al., 2015).

The bird species diversity index value in Pontianak City is 1.795 (Table 1) and in Sarawak is 1.70 (Table 2), placing their diversity in the moderate category. As an urban area, the conditions still provide tolerance for several bird species, especially those from the orders Passeriformes and Columbiformes, to live, forage, and breed. In fact, there are several types of birds that can be seen foraging for food at a distance quite close to humans, such as Geopelia striata, Passer montanus, Aplonis panayensis, and Columba livia.

Figure 3. Bird populations engaging in activities quite close to humans

Table 1. Results of the diversity index values in Pontianak City, Indonesia

No	Birds Species	Local Name	Ordo	Amount	IKR (Relative Abundance Index) (%)
1	*Anthreptes malacensis*	Madu Kelapa	Passeriformes	6	8.70
2	*Geopelia striata*	Perkutut	Columbiformes	5	7.25
3	*Hirundo rustica*	Layang	Passeriformes	14	20.29
4	*Lonchura punctulata*	Bondol Peking	Passeriformes	3	4.35
5	*Muscicapa dauurica*	Sikatan	Passeriformes	2	2.90
6	*Passer montanus*	Gereja	Passeriformes	21	30.43
7	*Prinia familiaris*	Prenjak Kebun	Passeriformes	3	4.35
8	*Pycnonotus aurigaster*	Kutilang	Passeriformes	15	21.74
Total Amount				**69**	
Diversity Index (H')					**1.795**
Evenness Index (E)					**0.863**
Richness Index					**1.65**

The relative abundance index value of bird species in Pontianak City, Indonesia, which falls into the high category, includes Passer montanus, Pycnonotus aurigaster, and Hirundo rustica, with relative abundance index values exceeding 20%. These three bird species are quite dominant in the community in the city of Pontianak and are known to have a good adaptability to environmental conditions (Mardiastuti et al., 2020) (Tian et al., 2022). Meanwhile, the other 5 types of birds have an IKR value that falls into the low category. This is certainly related to the limited availability of food and the urban environmental conditions that tend to be crowded with human activities, thereby affecting the bird population (Seipalla, 2020) (Seress & Liker, 2015).

The evenness index value (E) in the city of Pontianak is 0.863, indicating a high level of species evenness in the city, so there is no dominance of any particular species (Tu et al., 2020). The Richness Index shows 1.65, placing it in the low category.

Table 2. Results of the diversity index values in Sarawak City, Malaysia

No	Birds Species	Local Name	Ordo	Amount	IKR (Relative Abundance Index) (%)
1	*Acridotheres javanicus*	Jalak Kebo	Passeriformes	10	5.78
2	*Aplonis panayensis*	Perling Mata Merah	Passeriformes	8	4.62
3	*Columba livia*	Merpati	Columbiformes	78	45.09
4	*Geopelia striata*	Perkutut	Columbiformes	23	13.29
5	*Hirundo tahitica*	Layang	Passeriformes	8	4.62
6	*Lonchura atricapilla*	Bondol coklat	Passeriformes	2	1.16
7	*Passer montanus*	Gereja	Passeriformes	26	15.03
8	*Prinia familiaris*	Prenjak Kebun	Passeriformes	3	1.73
9	*Pycnonotus aurigaster*	Kutilang	Passeriformes	15	8.67
Total Amount				**69**	
Diversity Index (H')					**1.70**
Evenness Index (E)					**0.772**
Richness Index					**1.552**

The highest relative abundance index value in Sarawak City, Malaysia, is Columbia livia with a value of 45.09%. Meanwhile, other bird species have a low IKR category because it is below 15%. The value of the evenness index (E) obtained is 0.772, which falls into the high category. The result indicates that there is no dominance of certain species in the community. The species richness index value is 1.552, placing it in the low category. The result corresponds to the small number of bird species found. Birds have sensitivity to environmental changes and possess good flying abilities, making it easy for them to migrate in search of suitable habitats

(Åkesson & Helm, 2020). High sensitivity to environmental changes often makes them indicators of environmental changes (Bowler et al., 2019).

The value of the bird species similarity index in Pontianak City, Indonesia, and Sarawak, Malaysia, is 59%. This indicates that more than half of the bird population found have similar species. The habitat conditions are almost the same with sufficient food sources, abundant water because each city has a large river flow for drinking sources, vegetation as nesting sites, and other factors.

Table 3. Sorensen similarity index values

No	Code	Pontianak, Indonesia	Sarawak, Malaysia
1	A	3	-
2	B	-	4
3	C	5	5
		Nilai IS	**59%**

Based on the classification of their food types, it is known that there are 4 groups of birds, namely granivorous, insectivorous, nectarivorous, and omnivorous (Table 4). Granivorous birds were the most commonly found, accounting for 45%. The population of granivorous birds is larger compared to other bird populations because the existing habitat is capable of providing sufficient food and a good environment for the growth of these birds. It is known that the habitats in Pontianak, Indonesia, and Sarawak, Malaysia, are quite open and covered with vegetation that produces seeds, making them a source of food for granivorous birds (Gunawan et al., 2022). Several birds, including Columbia livia, Geopelia strata, and Passer montanus, were observed actively foraging on the ground surface. These birds, in addition to foraging on the ground, were also observed to be very close to humans (Paramita et al., 2015).

Table 4. Classification of birds based on feeding guild

No	Birds Species	Local Name	Feeding Guild
1	*Columba livia*	Merpati	Granivorous
2	*Geopelia striata*	Perkutut	Granivorous
3	*Lonchura atricapilla*	Bondol coklat	Granivorous
4	*Lonchura punctulata*	Bondol Peking	Granivorous
5	*Passer montanus*	Gereja	Granivorous
6	*Hirundo rustica*	Layang	Insectivorous
7	*Muscicapa dauurica*	Sikatan Bubik	Insectivorous
8	*Prinia familiaris*	Prenjak Kebun	Insectivorous
9	*Anthreptes malacensis*	Madu Kelapa	Nectarivora
10	*Acridotheres javanicus*	Jalak Kebo	Omnivorous
11	*Aplonis panayensis*	Perling Mata Merah	Omnivorous
12	*Pycnonotus aurigaster*	Kutilang	Omnivorous

Meanwhile, the number of nectarivorous birds is the smallest, at only 8%. This is likely due to factors such as vegetation conditions, food availability, and the specific types of food that are not abundantly available in urban areas. In general, birds play a significant role in the ecosystem, including helping with the dispersion of fruits and seeds, aiding in pollination, controlling insects or herbivorous arthropods, and more (Ponsian et al., 2024).

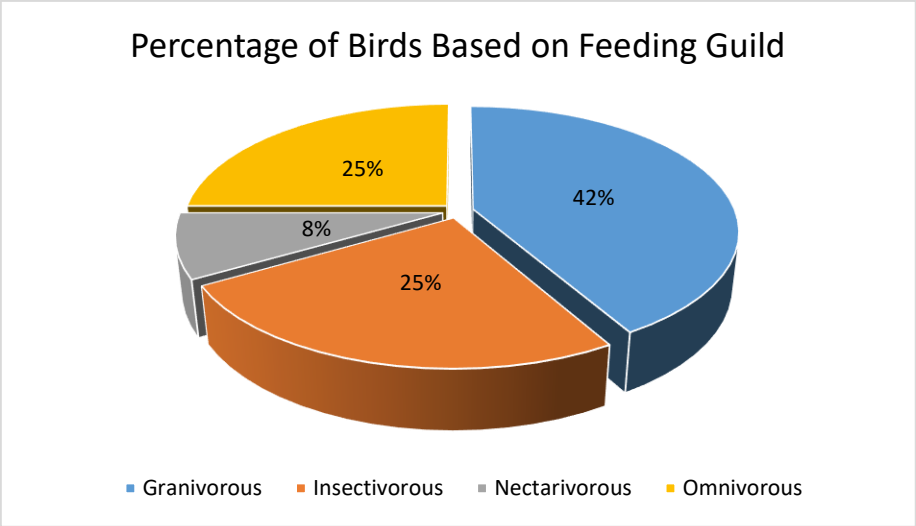

Figure 4. Percentage of bird classification based on feeding guild

The conservation status of birds found in the Border Area City of Pontianak, Indonesia, and Sarawak, Malaysia, based on the IUCN, is mostly classified as least concern (LC) and only one species is classified as vulnerable (VU) (Table 5). For birds with LC status, they show a low risk of extinction (NORMASIWI et al., 2015), and the ones that are of great concern are those with VU status because they are at high risk of extinction.

Table 5. Conservation status of birds in the border area Cities of Pontianak, Indonesia and Sarawak, Malaysia

No	Birds Species	Local Name	Conservation Status
1	*Acridotheres javanicus*	Jalak Kebo	VU
2	*Anthreptes malacensis*	Madu Kelapa	LC
3	*Aplonis panayensis*	Perling Mata Merah	LC
4	*Columba livia*	Merpati	LC
5	*Geopelia striata*	Perkutut	LC
6	*Hirundo rustica*	Layang	LC
7	*Lonchura atricapilla*	Bondol coklat	LC
8	*Lonchura punctulata*	Bondol Peking	LC
9	*Muscicapa dauurica*	Sikatan Bubik	LC
10	*Passer montanus*	Gereja	LC
11	*Prinia familiaris*	Prenjak Kebun	LC
12	*Pycnonotus aurigaster*	Kutilang	LC

Acridotheres javanicus is classified as vulnerable due to the fact that it is widely hunted and traded (Mulyana et al., 2019). This bird has an appeal due to its intelligence, melodious voice, and attractive feather colors, which makes many people interested in keeping it as a pet (Delfiah et al., 2024). If this condition is allowed to continue without any control, it will certainly threaten its existence in the wild and could lead to extinction. Therefore, the community and the government must work together to protect the existence of those birds.

CONCLUSION

Based on the research results on bird species diversity in the border city of Pontianak, Indonesia, and Sarawak, Malaysia, it can be concluded that the Shannon-Wiener species diversity index (H') of birds in Pontianak City, Indonesia, is 1.795, and in Sarawak, Malaysia, it is 1.70, placing both in the moderate category. Out of a total of 12 bird species found in the border city of Pontianak, Indonesia, and Sarawak,

Malaysia, 1 bird species has been identified with a conservation status of Vulnerable (VU), namely Achridotheres javanicus, and 11 other species are classified as Least Concern (LC).

RECOMENDATION

This study has revealed the diversity of birds in the border area of Pontianak and Sarawak. Further research can examine the impact of environmental changes or human activities and biodiversity modeling.

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