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Composition and feeding guilds bird community in tropical peatland of Orang Kayo Hitam Forest Park buffer area, Jambi, Indonesia

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Abstract. *Pangestu PG, Iswandaru D, Wulandari C, Novriyanti, Prasetia H. 2023. Composition and feeding guilds bird community in tropical peatland of Orang Kayo Hitam Forest Park buffer area, Jambi, Indonesia. Intl J Bonorowo Wetlands 13: 57-65.* Tropical peat ecosystems are vulnerable to fire damage and conversion, including in the Orang Kayo Hitam (OKH) Forest Park buffer villages, Jambi Province, Indonesia. The peat ecosystem is a habitat for various birds. In the ecosystem, birds act as seed dispersers, pest controllers, and pollinators, so their presence can be used as bioindicators of environmental quality. This study aims to analyze the composition and feed guilds of the bird community. The line transect method is used to explore the path in bird watching. The data were then analyzed using descriptively and qualitatively. In total, 29 species from 18 families comprised five species of waterbirds and 25 species of land birds. The families with the highest number of species were Alcedinidae, with a percentage of 13.79% each (4 species). At the same time, the lowest were Apodidae, Bucerotidae, Hirundinidae, Laniidae, Meropidae, Psittacidae, Rallidae, Cisticolidae, Turnicidae, Ploceidae, and Passeridae, with only one species (3.45%) identified per family. Based on the feed guild, there were nine types of guilds, with the highest rate being granivore (24,14%), while the lowest was insectivore on the forest floor (3.45%). The presence of bird species based on the feed guild indicates that shrubs or weeds dominate the land cover of the buffer village around the OKH Forest Park.

Keywords: Bioindicators, bird, foraging ecology, peat ecosystem, wetland

INTRODUCTION

Tropical peat ecosystems are wetland-type marginal areas vulnerable to fire (Karmila et al. 2021). The pressure caused by deforestation and the drying of land makes it experience a decline in quality, making it vulnerable to fires (Usup et al. 2004; Prasetyo et al. 2022). In addition, deforestation and degradation that occurred since 1990 (Miettinen et al. 2016; Wijedasa et al. 2018; Wulandari et al. 2021) resulted in peatland areas in Indonesia decreasing from an initial total of 20.6 million ha to 14 .83 million ha (Wulandari et al. 2021). Orang Kayo Hitam Forest Park (OKH Forest Park) or *Taman Hutan Raya Orang Kayo Hitam*, located on the island of Sumatra, Jambi Province, Indonesia is one of the peat conservation areas. As a conservation area with peatland characteristics, it must overcome these problems. Repeated fires have caused the OKH Forest Park area to experience severe degradation (Tamin et al. 2021). Peat is an accumulation of the remains of organic matter (Setyawati and Suwarsono 2018; Shah et al. 2020) that has been deposited for a very long period (Prayoto et al. 2017), makes it very susceptible to fire when it experiences drought. The damage to peat ecosystems by fires impacts the local environment and buffer areas such as surrounding villages (Anhar et al. 2022).

In addition, fires in peat ecosystems have global-scale impacts on economic, social, and ecological aspects, including burning habitats for endemic plants and animals and increasing extinction threats (Saharjo dan Novita 2022). They impacted decreasing biodiversity (Lee et al. 2017; Harrison and Rieley 2018; Wasis et al. 2019) and influenced global climate change (Syaufina 2016; Kurniasari et al. 2020; Saharjo and Novita 2022). Differences in the peat ecosystem's physical, biological, and chemical characteristics due to damage to the peat ecosystem (Prasetia and Syaufina 2020) will potentially cause various types of animals to lose their habitat, including birds. Birds are wild animals that use the peat ecosystem as a place to live and find food (Pramudianto 2018). Ecologically, birds have an important role in dispersing seeds (Ning et al. 2019) and helping flower pollination (Lindell and Thurston, 2013; Iswandaru et al. 2022) and have a high sensitivity to climate change (Li et al. 2021). Birds are one of the animals with the top position in the food chain, making them sensitive to prey and environmental changes (Egwumah et al. 2017). The presence of birds in an ecosystem is closely related to food availability (Tryjanowski et al. 2018). The distribution of birds that is reasonably wide and easy to observe, as well as their sensitivity to environmental changes, makes the presence of bird composition in an ecosystem can be used as a bioindicator in assessing the condition of the surrounding environment (Adelina et al. 2016; Julyanto et al. 2016; Egwumah et al. 2017; Hutapea et al. 2020).

Bird research has been carried out in OKH Forest Park, especially in the PLN Restoration Block, which recorded 25 species with 418 individuals (Nurfitri et al. 2022). In addition, other studies regarding the composition and

community of avifauna in the Leyte Sab-a Basin Peatland, Philippines, and its surroundings found as many as 67 bird species from 37 families recorded (Matutes and Densing, 2022). These studies provide an overview of the value and condition of the land. However, research on family composition and feed guilds in the OKH Forest Park buffer area has yet to be conducted optimally, so this research is considered essential for further study. The birds' composition in an ecosystem reflects the habitat quality; this relates to the relationship of birds to environmental changes and vegetation composition, which will affect their diversity (Kurniawan et al. 2019). Furthermore, grouping species based on food groups can be a way of assessing or knowing the ecosystems' ability to provide for these species' needs. Therefore, a study of bird community feed guilds in the OKH Forest Park buffer area is needed to provide an overview of their environmental conditions through their ability to provide feed. This study aimed to analyze the bird community's species composition and feed guilds in the OKH Forest Park buffer area and describe efforts to restore the peat ecosystem.

MATERIALS AND METHODS

Study area

The research location is one of the supporting villages for OKH Forest Park, namely Jebus Village, Kumpeh Sub-district, and Muaro Jambi District, Jambi Province, Indonesia. Geographically, Jebus Village is between 1º20'38.85" and has a longitude of 104º01'58.90". The area of Jebus Village reaches 23,072.71 Ha, and 94.9% is a peat area; this village is also located in the Batanghari River basin. Furthermore, due to river overflows, Jebus Village is affected by flooding almost yearly. In addition, Jebus Village experienced much loss of flora due to the fire in 2015. The following is a map of the research locations presented in Figure 1.

Procedures

Bird data were collected using the line transect method, sampling in observation line units form (Asrianny et al. 2018). Each transect line is 2 km long and 50 meters wide to the right or left of the bar (Figure 2). Transect 1 (TR 1) is placed on the road that separates agricultural land and swamps, and transect 2 (TR 2) on the road separating residential and plantation areas. Observations were made in the morning from 06.00-09.00 and afternoon from 15.00-18.00 (Asrianny et al. 2018; Lwin 2018; Iswandaru et al. 2020a; Ramadhani et al. 2022). Observers strolled along the transect, and each encounter recorded the type of bird observed (Sabo et al. 2022). In addition, bird species are recorded at each direct encounter. Species identification is based on MacKinnon et al.'s (2010), and species nomenclature refers to the Handbook of the Birds of the Word and BirdLife International (2020). Observations cannot be made during rain because it is difficult to observe, and the dominant birds hide while it rains. Observations were carried out for 10 days by a team of 5 observers.

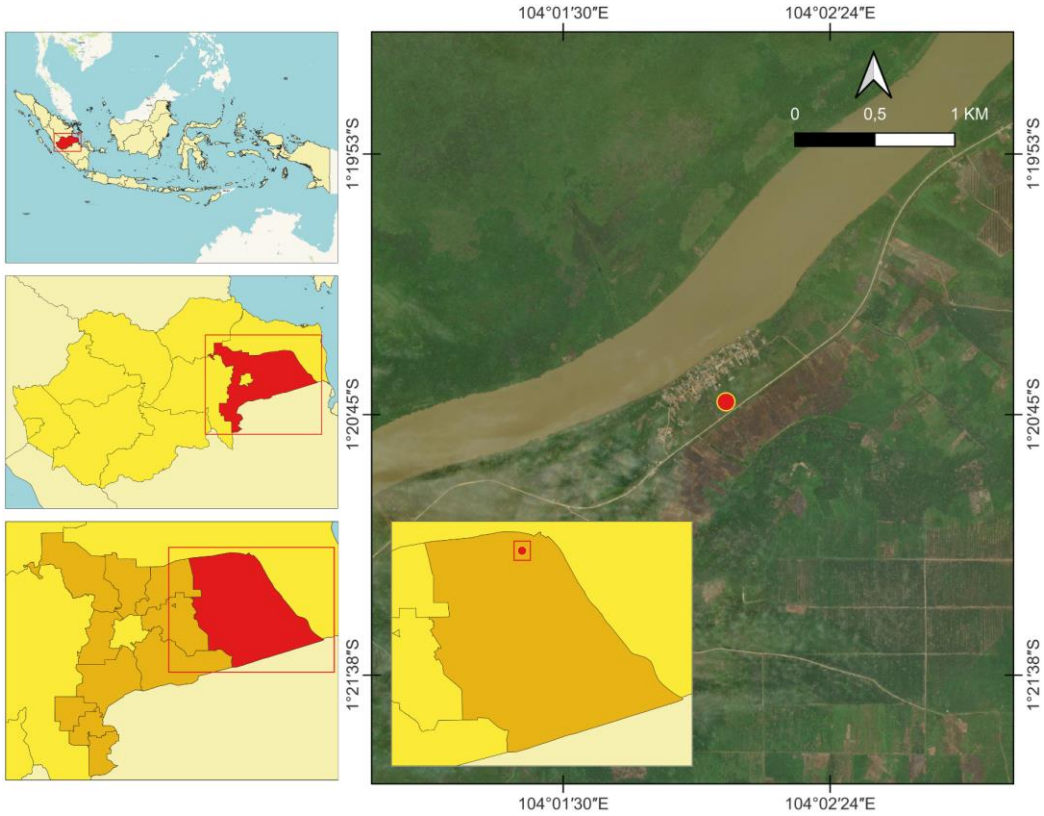

Figure 1. Maps of the research location in Jebus Village, Kumpeh Sub-district, Muaro Jambi District, Jambi Province, Indonesia

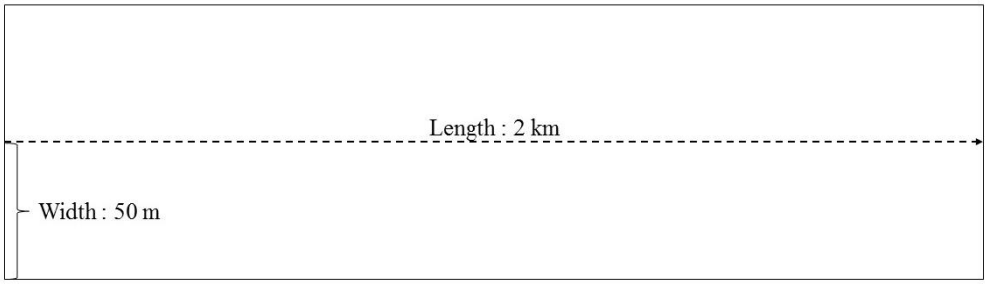

Figure 2. Transect-line methods

Data analysis

The research data were analyzed qualitatively, with the result generated as a description of bird-field conditions. Bird data grouped by habitat (waterbird and landbird) refers to Lee et al. (2018). Landbird is a group of birds whose main activity is in terrestrial habitats (Rich et al. 2004), such as: forests, plantations, agriculture, and agroforestry (Franklin and Steadman 2010; Pyle et al. 2020), while waterbirds are a group of birds who are dependent on wetlands (Prasetya and Anisia 2021) such as peatlands, watersheds, and mangroves (Firdausy et al. 2021; Haider et al. 2022; Nurfitri et al. 2022). Furthermore, birds are grouped by their family based on MacKinnon et al.'s (2010), and feeding guild refers to Iswandaru et al.'s (2020b) (Table 1). Finally, the descriptive analysis provides an overview of the data obtained during this study (Sitanggang et al. 2020).

Data on the number and species of birds were analyzed to predict the species' diversity, richness, and evenness. Species diversity was analyzed using the Shannon-Wiener (H') method (Iswandaru et al. 2020a,b; Zhang et al. 2021), species richness index using the Margalef method (Sina and Zulkarnaen 2019; Pramudita et al. 2023), while evenness uses the Pielou evenness index (Fikriyanti et al. 2018; Iswandaru et al. 2020b). The three index formulas are presented as follows:

$$\mathbf{H' = -\sum_{i=1}^{S} (pi)\, lnpi}$$

$$\boldsymbol{R = \frac{(S-1)}{Ln\ N}}$$

$$\mathbf{E = \frac{H'}{Ln\ S}}$$

Where:

H': Shannon-Wiener diversity index

R: Margalef richness index

E: Pielou evenness index

S: the number of types

pi: the proportion of the number of individuals it-i (ni/N)

N: total number of individuals observed

Ln: natural logarithm

Table 1. Feeding guilds of the bird community (Iswandaru et al. 2020b)

Guilds type
Insectivore
Insectivores while flying (Iw)
Insectivores on branches of the canopy (Ic)
Insectivore on the forest floor (If)
Eating insects by grabbing (E)
Meat eaters
Piscivore (Pc)
Carnivore (Cr)
Granivore (G)
Frugivore (F)
Omnivore (O)

The criteria in the Shannon-Wiener index are: (I) if H'<1.5, then the diversity is low, (II) if 1.5≤ H'≥ 3.5, then the diversity is medium, (III) and if H'>3, 5 then it is said to be high diversity. The criteria for the richness index include (I) if R<2.5, it is defined that the species richness is low, (II) if 2.5>R>4, then the species richness is moderate, (III) whereas if R>4 then the species richness is high. Finally, the evenness index has criteria with a range of 0-1; if the index value is close to 1, it is defined as evenness is high (even) and vice versa.

RESULTS AND DISCUSSIONS

Bird family composition

There were 29 bird species recorded in the Orang Kayo Hitam Tahura buffer area (Table 2). The number of birds found comprised five species of water birds (16.67%) and 25 land birds (83.33%). The 30 bird species found consisted of 18 families, including Alcedinidae, Columbidae, Ardeidae, Caprimulgidae, Cuculidae, Pycnonotidae, Estrildidae, Apodidae, Bucerotidae, Hirundinidae, Laniidae, Meropidae, Psittacidae, Rallidae, Cisticolidae, Turnicidae, Ploceidae, and Passeridae (Figure 3). The dominating family is Alcedinidae, with four species (13.79%). Other families with the highest number of species below them are Ardeidae and Columbidae, with the number of species in each family being three (10.34%). Members of the Alcedinidae family are the Stork-billed Kingfisher (*Pelargopsis capensis*), Small Blue Kingfisher (*Alcedo coerulescens*), White-throated Kingfisher (*Halcyon*

smyrnensis), and Collared Kingfisher (*Todiramphus chloris*). The Ardeidae family includes Cinnamon Bittern (*Ixobrychus cinnamomeus*), Purple Heron (*Ardea purpurea*), and Cattle Egret (*Bubulcus ibis*). Then the Columbidae Family consists of Pink-necked Green-Pigeon (*Treron vernans*), Zebra-Dove (*Geopelia striata*), and Spotted-Dove (*Spilopelia chinensis*). Some bird species can be seen in Figure 4.

Indices of diversity, richness, and evenness of bird species in the buffer area around OKH Forest Park

Based on the results of observations, it was found that 139 individual birds were recorded from 29 bird species that could be identified. Therefore, bird species diversity, richness, and evenness in the buffer area are moderate, high, and low, respectively. The index of diversity, richness, and evenness of bird species in the OKH Forest Park is presented in Figure 5.

Bird feed guild composition

The composition of the bird feed guilds in OKH Forest Park is quite varied. Five feed guilds can be found: granivore, frugivore, omnivore, raptor, and insectivore. The percentage of feed guilds is presented in Figure 6.

Discussion

This study analyzed birds' composition in the OKH Forest Park buffer area, grouped by family and feeding guild. Three bird families that dominate the study area include Alcedinidae, Columbidae, and Ardeidae. Three families, one of which are water birds, namely Ardeidae (Lee et al. 2018). The presence of water birds in peatlands naturally occurs because peat is a wetland that is an ideal habitat for water birds to live and find food (Prasetya dan Anisia 2021). It is said that 10% of bird species out of the total global number depend on wetlands, and 20% use them to find food, rest, and breed (Rannestad et al. 2015; Kačergytė et al. 2021; Jangral and Vashishat 2022). In a study of bird diversity and populations in the wetlands of the Bangpu Nature Education Center, Thailand, it was recorded that eight families of water birds lived and used the wetlands, including Scolopacidae, Ardeidae, Charadriidae, Laridae, Ciconiidae, Phalacrocoracidae, Recurvirostridae, and Rallidae (Chanate et al. 2020). In China, Luo et al.'s (2019) research in the Dianchi Lake wetlands revealed that 67 of the 182 bird species were water birds. In addition, a similar study conducted in the Taunsa Barrage Ramsar site (wetland) in Punjab, Pakistan, by Haider et al. (2022) found that 150 species of 53 families with the highest number of species were Accipitridae, Ardeidae, and Anatidae, of which two of them belonged to a group of waterbirds.

Table 2. Feeding guild of birds in the buffer area of OKH Forest Park, Muaro Jambi District, Jambi Province, Indonesia

Name	Nama Ilmiah	Family	Feeding guild								
			G	F	O	Pc	Pr	Iw	Ic	If	E
Stork-billed Kingfisher	*Pelargopsis capensis*	Alcedinidae				✓					
Small Blue Kingfisher	*Alcedo coerulescens*	Alcedinidae				✓					
White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae					✓				
Collared Kingfisher	*Todiramphus chloris*	Alcedinidae					✓				
Glossy Swiftlet	*Collocalia esculenta*	Apodidae						✓			
Cinnamon Bittern	*Ixobrychus cinnamomeus*	Ardeidae				✓					
Purple Heron	*Ardea purpurea*	Ardeidae				✓					
Cattle Egret	*Bubulcus ibis*	Ardeidae								✓	
Oriental Pied Hornbill	*Anthracoceros albirostris*	Bucerotidae		✓							
Savannah Nightjar	*Caprimulgus affinis*	Caprimulgidae						✓			
Large-tailed Nightjar	*Caprimulgus macrurus*	Caprimulgidae						✓			
Yellow-bellied Prinia	*Prinia flaviventris*	Cisticolidae							✓		
Zebra-Dove	*Geopelia striata*	Columbidae	✓								
Spotted-Dove	*Spilopelia chinensis*	Columbidae	✓								
Pink-necked Green-Pigeon	*Treron vernans*	Columbidae		✓							
Lesser Coucal	*Centropus bengalensis*	Cuculidae							✓		
Plaintive Cuckoo	*Cacomantis merulinus*	Cuculidae							✓		
White-headed Munia	*Lonchura maja*	Estrildidae	✓								
Black-headed Munia	*Lonchura atricapilla*	Estrildidae	✓								
Pacific Swallow	*Hirundo tahitica*	Hirundinidae						✓			
Long-tailed Shrike	*Lanius schach*	Laniidae									✓
Blue-tailed Bee-eater	*Merops philippinus*	Meropidae									✓
Eurasian Tree Sparrow	*Passer montanus*	Passeridae	✓								
Baya Weaver	*Ploceus philippinus*	Ploceidae	✓								
Long-tailed Parakeet	*Belocercus longicaudus*	Psittacidae	✓								
Sooty-headed Bulbul	*Pycnonotus aurigaster*	Pycnonotidae		✓							
Yellow-vented Bulbul	*Pycnonotus goiavier*	Pycnonotidae		✓							
White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae			✓						
Barred Buttonquail	*Turnix suscitator*	Turnicidae			✓						

Note: G: Granivore, F: Frugivore, O: Omnivore, Pc: Piscivore, Cr: Carnivore, Iw: Insectivore while flying, Ic: Insectivore on branches of canopy, If: Insectivore on the forest floor, E: Eating insects by grabbing

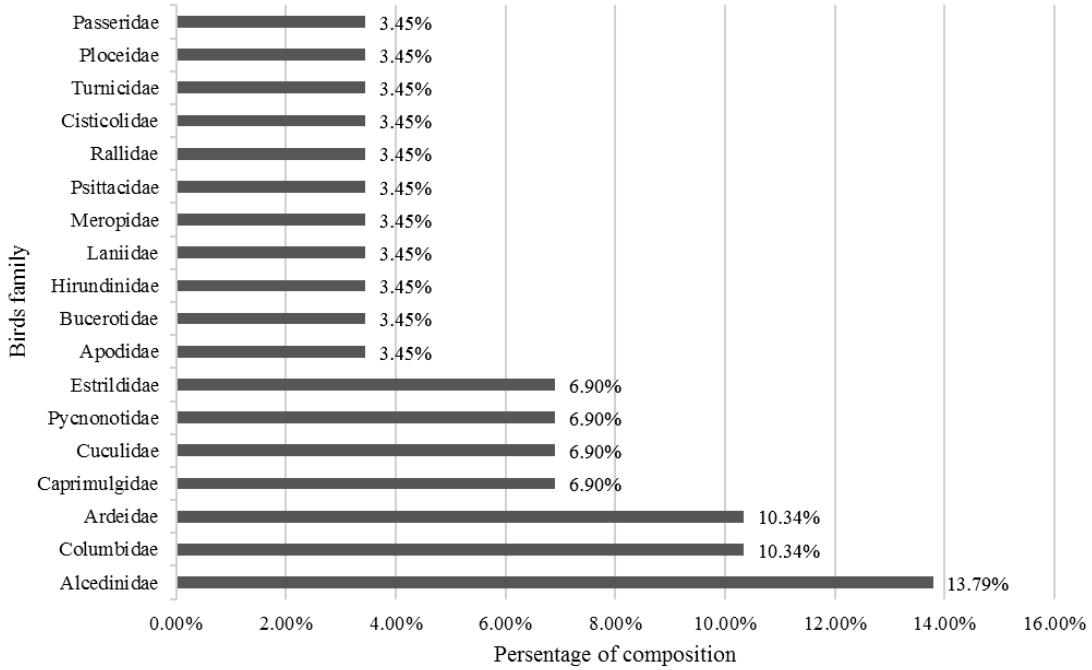

Figure 3. Composition of bird families in the buffer area around OKH Forest Park, Muaro Jambi District, Jambi Province, Indonesia

Figure 4. Several bird species exist in the buffer area of Orang Kayo Hitam Forest Park, Muaro Jambi District, Jambi Province, Indonesia: A. Lesser Coucal (*Centropus bengalensis*), B. White-throated Kingfisher (*Halcyon smyrnensis*), C. Pacific Swallow (*Hirundo tahitica)*, D. Purple Heron (*Ardea purpurea*)

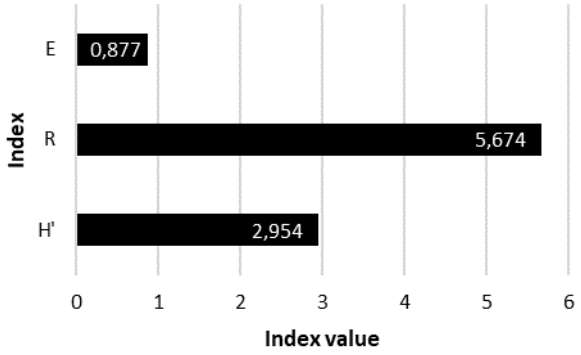

Figure 5. Diversity index (H'), Richness (R), and Evenness (E) bird species in the buffer area around OKH Forest Park, Muaro Jambi District, Jambi Province, Indonesia

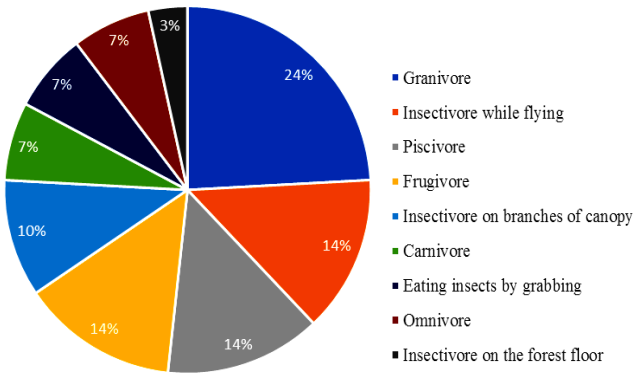

Figure 6. Percentage of feed guilds by species in OKH Forest Park, Muaro Jambi District, Jambi Province, Indonesia

Alcedinidae is a group of birds with long, solid beaks with bright colors, generally metallic blue (MacKinnon et al. 2010). The shape of the long and robust beak is intended to make it easier to find and catch its prey. The leading food of the Alcedinidae bird group is insects and several types of fish (Anugrah et al. 2017). The existence of Alcedinidae in the area around peat is based on the needs of this group of birds. Although not classified as a water bird, the family Alcedinidae depends on wetlands (Etayeb et al. 2015). Therefore, Ardeidae is part of a group of water birds dependent on wetlands (Hidayat and Dewi 2017). This dependence is based on their need to eat, rest, and reproduce (Miranda-García et al. 2021). In addition, Ardeidae has characteristics on the body, namely a long neck and characteristic long and straight beaks (MacKinnon et al. 2010; Nisa and Setyoko 2021). The characteristics of the long and straight beak are intended for taking prey such as fish, vertebrates, and small invertebrates.

Columbidae is a family of pigeons with short and robust beaks (MacKinnon et al. 2010). This type of beak supports the searching and taking food activity. Columbidae's leading food is generally fruits and seeds. These birds are scattered in various habitats, including lowland forests, highland forests, swamp forests, grasslands, deserts, and rural to urban areas (Sawitri and Garsetiasih, 2015). Environmental conditions and food availability influence the dominance of Columbidae around Orang Kayo Hitam Forest Park. OKH Forest Park is mostly dominated by pioneer plants with relatively fast-growing power, such as *Macaranga* sp., *Gluta rengas*, and *Tetrameristra glabra*. *Macaranga* sp. is a type of tree with small fruit that is easy for birds to eat (Pradwinata et al. 2020), so it is suspected to be a source of bird feed. According to Nurfitri et al. (2022), the OKH Forest Park area is widely planted with *Alstonia pneumatophora*, *Dyera lowii*, *Melaleuca leucadendra*, *Ficus* sp., *Melastoma candidum,* and *Scleria sumatrensis;* these plants which allow them to become birds' food sources.

Meanwhile, observing the types of feed guilds, the species found during the observation were dominated by G, followed by Iw, Pc, and F (Figure 6). This study found that the bird species from guild G habitually foraged on the ground. It indicates that most Jebus villages are open, and some are overgrown with shrubs. Changes in a habitat will affect birds' diversity, structure, and composition (Ntongani and Andrew, 2013). The fire in the peat area in 2015 changed this habitat. The fire caused Jebus Village, one of the buffer areas of OKH Forest Park, to experience much flora loss. Significant environmental changes by leaving grasses, herbs, and shrubs producing seeds and small fruit will cause a response to the granivore group (Putri et al. 2017). The granivore bird group prefers open areas with low vegetation density (Rofiq et al. 2021). In addition, it is observed that the granivore group has a response to increasing the number of groups after logging or loss of trees in a habitat and decreases while there is regrowth during the recovery period to a more complex forest (Burivalova et al. 2015; Nasruddin-Roshidi et al. 2021). Therefore, the presence of high G guilds in a specific area can indicate that the area has a low density of high-level vegetation.

Insectivore is the most varied guild type, including Iw, Ic, E, and If. If the total variations are added, it will be even higher than the G type alone. The total number of insectivore guild types is ten species or 34.48% of the total species found. The division of the insectivore into several guild sub-types is based on the variation of birds in finding and preying on insects. Differences in finding or catching prey can be based on their need for the same food type; these birds use their strategies to avoid competition between species (Norazlimi and Ramli 2015). A high enough insectivore exists in an area based on environmental conditions or the habitat itself; each guild has a detailed response to a particular type of environment (Rumblat et al. 2016). Insectivore is generally found in grassy areas habitats (Bowler et al. 2019). In addition, research by Kerekes and Végvári (2016) revealed that the insectivore guild type has the highest abundance in swamp and grassland habitats. It aligns with the conditions in the OKH Forest Park buffer area, mainly dominated by shrubs and grassy areas due to the peat forest fires several years ago.

On the other hand, many groups of birds with guild types Iw, F, and Pc are also found in the OKH Forest Park buffer area. Insectivores can adapt to their environment, as evidenced by their existence, which can be found in various habitats (Bowler et al. 2019). In addition, the diversity of bird species is directly proportional to the diversity and abundance of insects (Beskardes et al. 2018; Bowler et al. 2019). Insects ideally live in open habitats such as grasslands and shrubs (Hopwood et al. 2016). The condition of the peat ecosystem around the OKH Forest Park is dominated by shrubs or grassland, a habitat that many insects prefer. The abundance of these resources responds to groups of insectivorous birds, including the Iw type. In addition, this condition also responds to small fruit-eating birds, such as *Pycnonotus aurigaster* are usually active in bush habitats to find food. In addition, the presence of these birds is also vital in the spreading of bush plant seeds (Partasasmita 2015). Even though shrubs dominate it, there are still places with high levels of vegetation; the presence of *Anthracoceros albirostris*, a member of the Bucerotidae family, evidences this. The Bucerotidae family usually lives in large and tall trees, and their leading food is fruit (Kamal et al. 2020). On the other hand, the peat ecosystem, a wetland, is an ideal habitat for water bird species, including the Pc guild type group. Peat ecosystems as wetlands are essential to water bird survival, including nesting, shelter, foraging, stopover during migration, and various other annual life cycles (Bouldjedri and Mayache 2020).

The bird species diversity level in the OKH Forest Park buffer area is moderate (H'= 2,954); this index is influenced by vegetation composition (Xu et al. 2022). Scrub or grassland types and young vegetation habitats dominate the area around the OKH Forest Park. The habitat type around the OKH Forest Park could provide the needs of various bird species based on their diversity index value (Praptiwi et al. 2019). That is also supported by the species

richness level with a relatively high index value (R= 5.674); the level of species richness shows the number of species in a community. The species richness index positively correlates to the complexity of the ecosystem attributes that compose it (Zhang et al. 2021). The high species richness index indicates that the post-fire peat ecosystem has gradually recovered. This is also supported by the evenness index, which is relatively high or evenly distributed (E = 0.887); the low species diversity index is caused by competition over resource use (Kurniawan et al. 2018; Iswandaru et al. 2020a,b). The evenly distributed bird species show no competition in resource use, so it can be said that the ecosystem could meet bird species' needs quite well.

The OKH Forest Park buffer area has a wealth of abundant birds, indicating that the area can still provide various food sources for various birds. The dominance of waterbird groups in family groupings shows peatlands' vital role as wetlands for waterbirds' sustainability. Post-fire conditions had a significant impact on the composition of the ecosystem. However, there are good recovery processes to support the needs of various birds. The dominance of the G guild group and the insectivore sub-guild illustrates peatlands dominated by shrubs or grassy weeds. The composition of birds in the buffer area around the OKH Forest Park needs to be reviewed and improved to support the peatland restoration.

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