



Bird diversity in paddy field habitats during the paddy ripening phase (*Oryza sativa* L.) Jurong Peujeura Village, Aceh Besar Regency, Indonesia

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Abstract

Birds are organisms that can be found in a variety of habitats. One of the bird habitats is paddy fields. Birds found in paddy fields generally carry out activities such as foraging, breeding, and competing. This study aims to determine the diversity of birds in paddy field habitats during the paddy ripening phase (*Oryza sativa* L.). The study was conducted from April to June 2022. The location of the study was Jurong Peujeura Village, Ingin Jaya District, Aceh Besar Regency. This study used the Point Count method with a radius of 50 m and a distance between points of 150 m. Observations were made at nine observation points with four repetitions, in which the duration of observations was 10 minutes at each observation point. The observation was conducted in the morning and evening at 06.30-10.00 AM and 03.30-05.00 PM. The results obtained were 2586 bird individuals of 14 species from 11 families. The species with the highest number of individuals are *Lonchura punctulata*, with 1535 individuals, and *Bubulcus ibis*, with 637 individuals. *Ardeidae* (22%) and *Estrildidae* (15%) are the highest percentage of families by species. The Shannon-Wiener bird species diversity index in the paddy field area during the paddy ripening phase was obtained $H' = 1.24$, indicating the bird species' diversity level is moderate. Meanwhile, based on the dominance index, Simpson shows a value of $C = 0.42$, which indicates a low bird dominance level. The low level of bird dominance is due to the moderate species diversity in the paddy field area.

Keywords: Birds, paddy fields, bird diversity, paddy ripening phase, Aceh Besar.

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Background

Indonesia plays an important role in food security in the agricultural sector, which has extensive paddy fields. Paddy fields act as a habitat for various organisms, maintaining water purification, controlling floods and droughts, and preserving biodiversity. Wetlands are crucial because they can reduce the impact of extreme climates that can harm regional communities and global ecosystems (Lee et al., 2018). Paddy fields are the largest area that can support a higher species richness and abundance. Various types of birds can use the area of paddy fields in wet or dry conditions according to the activity of the rice planting season (*Oryza sativa* L.) (Choi et al., 2021). There are two organs in the process of rice plant formation: the vegetative organs, such as roots, stems, and leaves, and the generative organs, such as panicles and seeds (Parul, 2017). Paddy

fields are temporary wetlands with great potential to support various species of birds. Thus, the study of birds in rice fields continues to increase worldwide. Bird diversity in paddy fields is vital due to the fact that paddy fields have various stages in rice planting, which causes the birds encountered to be different at each stage. The different stages in the rice fields are plowing, draining water, and planting (Munira et al., 2014). It can attract a variety of different birds to forage and breed (Munira et al., 2014).

Birds have an important role in running ecosystems in crop distribution, biological conservation, and agriculture (Nurqamareena, 2018). The ecological view of birds plays a role in regulating ecosystem health (seed dispersal), plant pollination, and pest control (Sekerciogl, 2012). Almost a third of all bird species use agricultural habitats such as paddy fields (Sekerciogl,

2012). Birds act as predators of pest organisms such as insects and rats that can result in paddy field crop losses (Nisa & Setyoko, 2021). Paddy field birds are important species in controlling invertebrate populations, generally acting as pests causing losses to rice plants. Aside from being an important species, paddy field birds also function as indicator species in paddy fields (Kirinde et al., 2015). Birds can also regulate the presence of arthropod populations, which can increase the productivity of rice plants in paddy fields.

Kecamatan Ingin Jaya is located in Aceh Besar Regency, with the capital of the sub-district Lambaro. The area of the sub-district is 24.34 km² (2,424 Ha), and the geographical location is 5.48-5.53°LU – 95.34-95.40°BT. There are six settlements, one of which is Pagar Air Village (6.37 km²). The number of villages in Ingin Jaya Sub-district is 50 villages. Pagar Air Village has 12 villages, one of which is Jurong Peujeura Village. The Jurong Peujeura Village area is 0.77 km² (77 Ha). Jurong Peujeura Village has 34 Ha of paddy fields and is in a non-coastal area (BPS Aceh

Besar District, 2020). The conversion of 80% of paddy fields results in 10% of birds dying for a population of 50,000-100,000 birds per year and eliminates the function of paddy fields' ecological role (Horgan et al., 2017). The presence of birds in the paddy field habitat during the paddy ripening phase attracts the attention of various bird species, considering that the conversion of paddy fields into settlements continues to increase. Therefore, this study aims to determine the richness and diversity of birds found during the rice harvesting phase in the paddy field habitat of Jurong Peujeura Village, Aceh Besar District.

Materials and Methods

Time and Study Area

This study was conducted in paddy habitats from April to June 2022 adjusted to the rice harvesting phase schedule (*Oryza sativa* L.). The location of the study is in Jurong Peujeura sub-district of Ingin Jaya, Aceh Besar Regency, Aceh Province, Indonesia (Figure 1).

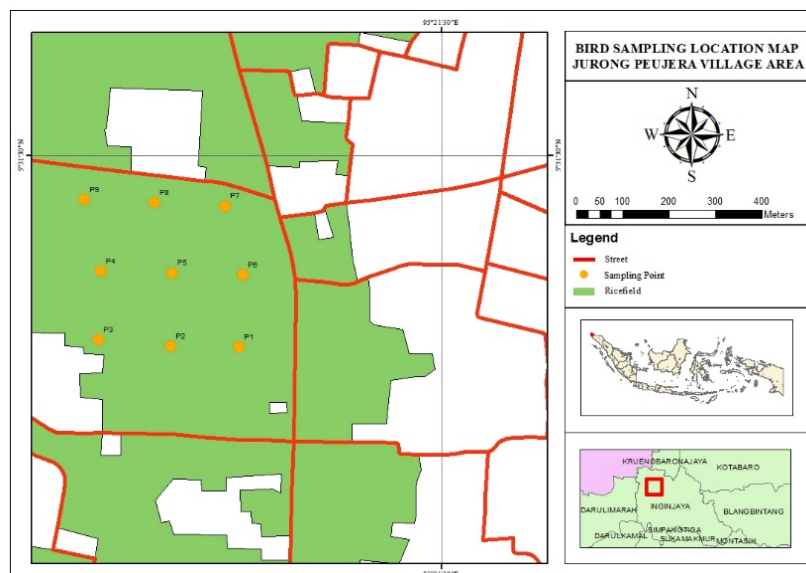


Figure 1. Research location of birds in paddy field habitat in Jurong Peujeura Village. Location coordinates 95°21'30"E and 5°31'30"N.

Research Procedures

The materials used in this study were research objects of birds in rice fields, identification using Mackinnon et al. (2010) and Taufiqurrahman et al. (2022), and the *burungnesia.id* application. Bird research

uses the point count method. Birds seen and heard were recorded, the type and number of individuals were observed silently at a predetermined point, then the birds found from nine points and four repetitions of observations in the paddy ripening phase

were recorded. One point has a radius of 50 m, the distance between the first point and the next point is 150 m, and one point is observed for 10 minutes before walking to the next observation point. Observations were conducted in the morning and evening at 06.30-10.00 AM and 03.30-05.00 PM which is the time when birds are active, such as food finding, flying, and other details.

Identification of a bird in the field is conducted by observing the general appearance of the body characteristics, body size, voice, behavior, color, and pattern of plumage by using Nikula brand binoculars (Mahardono et al., 1980). Birds are then photographed for easier identification using a Canon PowerShot SX70 HS camera (Bismark, 2011). Further identification utilized the field guidebooks of Mackinnon et al., (2010) and Taufiqurrahman et al. (2022), as well as assistance from the *burungnesia.id* application.

Species and number of individual birds found in the field were recorded in each direct encounter, namely the number of individual birds, the number of species, bird activity, and the time of bird encounter in the rice ripening phase (Ramadhani et al., 2022).

Data analysis

Species diversity index

Bird species diversity is calculated using the Shannon-Wiener species diversity index (Ludwig & Reynold, 1988) as follows:

$$H' = -\sum P_i \ln P_i, \text{ which is } P_i = \left(\frac{ni}{N} \right)$$

Description:

H' = Species diversity index,

P_i = Total proportion of species abundance i ,

N = Number of individuals of all species,

$\ln$ = Natural logarithm,

ni = Number of individuals of a species.

Dominance Index

The dominance index for obtaining information about bird species that dominate a community within a research area determined by Simpson is determined using

the formula (Ludwig & Reynold, 1988) as follows:

$$C = \sum_{i=1}^n \left[\frac{ni}{N} \right]^2$$

Description:

C = Simpson's Dominance Index,

ni = Number of individuals of a species,

N = Number of individuals from all species.

In addition, the protection status of bird species is determined based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.106/MENLHK/SETJEN/KUM.1/12/2018 concerning Amendments to the Regulation of the Minister of Environment and Forestry No P.20.MENLHK/SETJEN/KUM.1/6/2018 regarding types of protected plants and animals, while the conservation status is determined according to the IUCN of 2022.

Results and Discussion

Species diversity

Bird diversity at the research site of Jurong Peujeura Village, Ingin Jaya District, during the paddy ripening phase (*Oryza sativa L.*), a 100-day age of birds found consisting of 14 species belonging to 11 families. A total of 2586 bird individuals (Table 1). Bird diversity at the research site in Jurong Peujeura Village, Wana Jaya District, during the ripening phase of rice (*O. sativa L.*) in which the ripe rice was around 100 days of age, birds consisting of 14 species belonging to 11 families were found with a total of 2586 individuals (Table 1).

The percentage of families based on the number of species (Figure 2) that were present is the highest from the *Ardeidae* family (21%) with three species and *Estrildidae* (14%) with two species. The following families have the same presentation based on the number of species of 7% including the family *Artamidae* (one species), *Cisticolidae* (one species), *Columbidae* (one species), *Hirundinidae* (one species), *Meropidae* (one species), *Passeridae* (one species), *Ploceidae* (one species), *Pycnonotidae* (one species), and *Sturnidae* (one species).

Table 1. Bird diversity during the paddy ripening phase in the paddy field habitat of Jurong Peujera Village, Aceh Besar, Indonesia

Family/ Species	Indonesia Name	International Name	The number of individuals	Status		Food
				PermenLHK P.106	IUCN 2022	
Ardeidae						
<i>Ardea purpurea</i>	Cangak merah	Purple Heron	2	TD	LC-d	O
<i>Bubulcus ibis</i>	Kuntul kerbau	Cattle Egret	637	TD	LC-i	O
<i>Egretta garzetta</i>	Kuntul kecil	Little Egret	3	TD	LC-i	O
Artamidae						
<i>Artamus leucorhynchus</i>	Kekep babi	White-breasted Woodswallow	14	TD	LC-s	I
Cisticolidae						
<i>Cisticola juncidis</i>	Cici padi	Zitting Cisticola	110	TD	LC-i	I
Columbidae						
<i>Spilopelia chinensis</i>	Tekukur biasa	Eastern Spotted Dove	4	TD	LC-i	G
Estrildidae						
<i>Lonchura maja</i>	Bondol haji	White-headed Munia	135	TD	LC-s	G
<i>Lonchura punctulata</i>	Bondol peking	Scaly-breasted Munia	1535	TD	LC-s	G
Hirundinidae						
<i>Hirundo javanica</i>	Layang-layang batu	Pacific Swallow	37	TD	LC-i	I
Meropidae						
<i>Merops philippinus</i>	Kirik-kirik laut	Blue-tailed Bee-eater	30	TD	LC-d	I
Passeridae						
<i>Passer montanus</i>	Burung gereja erasia	Eurasian Tree Sparrow	47	TD	LC-d	G
Ploceidae						
<i>Ploceus philippinus</i>	Manyar tempua	Streaked Weaver	27	TD	LC-s	G
Pycnonotidae						
<i>Pycnonotus goiavier</i>	Merbah cerucuk	Yellow-vented Bulbul	3	TD	LC-i	F
Sturnidae						
<i>Acridotheres javanicus</i>	Kerak kerbau	Javan myna	2	TD	VU-d	I
Total			2586			

Note: 1) Protection status according to Minister of Environment and Forestry, Republic of Indonesia No P.106/MENLHK/SETJEN/KUM.1/12/2018 (2018): TD: unprotected. 2) Conservation status according to IUCN (2022): VU: vulnerable, LC: least concern, i: increasing, d: decreasing, s: stable. 3) Bird Guild Composition: I: insectivore, G: granivore, O: omnivore, F: frugivore.

The presentation of bird families based on the number of individuals present was partially dominated by the *Estrildidae* family (64.58%) including the White-headed Munia (135 individuals), the Scaly-breasted Munia (1535 individuals), the *Ardeidae* family (24.83%) including the Purple Heron (two individuals), Cattle Egret (637 individuals), Little Egret (three individuals). Furthermore, the smaller percentage of families is *Cisticolidae* (4.25%), which is *Zitting cisticola* (110 individuals), *Passeridae* (1.82%), which is Eurasian Tree

Sparrow (47 individuals), *Hirundinidae* (1.43), which is Pacific Swallow (37 individuals), *Meropidae* (1.16%) which is Blue-tailed Bee-eater (30 individuals), *Ploceidae* (1.04%) which is Streaked Weaver (27 individuals), *Artamidae* (0.54%) which is White-breasted Woodswallow (14 individuals), *Columbidae* (0.15%) which is Eastern Spotted Dove (four individuals), *Pycnonotidae* (0.12%) which is Yellow-vented Bulbul (three individuals), and *Sturnidae* (0.08%) which is *Javan myna* (two individuals).

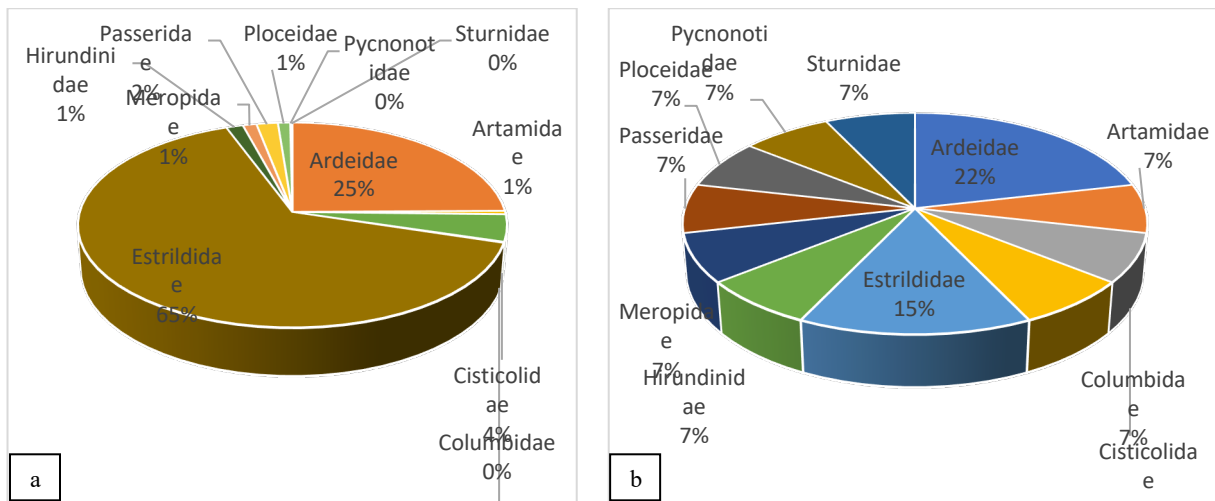


Figure 2. a. Family Percentage based on the number of individuals present, b. family percentage based on the number of bird species present in the rice cooking phase in the rice field habitat of Jurong Peujeura Village, Aceh Besar, Indonesia.

Based on the presentation of the bird feed guild, most of them were found to be Insectivores (35.71%) with as many as five species, which are White-breasted Woodswallow, *Zitting cisticola*, Pacific Swallow, Blue-tailed Bee-eater, and *Javan myna*. Five bird species were identified as granivores (35.71%) which are Eastern Spotted Dove, White-headed Munia, Scaly-breasted Munia, Eurasian Tree Sparrow, and Streaked Weaver. Bird food guilds on Omnivores (21.34%) include Purple Heron, Cattle Egret, Little Egret, and Frugivores (7.14%) feeding guild Yellow-vented Bulbul. The bird food guild was smaller on Omnivores (21.34%), which includes Purple Heron, Cattle Egret, Little Egret, and the Frugivore eating guild (7.14%), including Yellow-vented bulbul.

Previous studies have shown that paddy fields provide suitable habitats for foraging, breeding activities, and shelter for various bird species. This includes migratory bird species that utilize paddy fields located along bird migration routes. Agricultural activities, rice growing season, and landscape features of paddy fields are the main factors influencing the use of paddy fields by birds and the presence of birds (Munira et al., 2014).

The last stage is harvesting, in which the fields are drained to dry and the rice plants are harvested. Rice plants are harvested using a tractor that attracts the attention of Cattle Egrets and Little Egrets to

follow the movement of the tractor. The turning of the soil from the tractor causes fish, amphibians, snakes, and lizards, which are food to the birds, to appear on the surface. In addition, the insectivorous White-breasted Woodswallow, *Zitting cisticola*, Pacific Swallow, Blue-tailed Bee-eater, and *Javan myna* fly around because, along with the running tractor are, the insects flying. The grain that remains after harvest is used by granivorous species. The paddy ripening phase was dominated by the Scaly-breasted Munia bird because the paddy field birds spent most of their time moving around and looking for food (Dwijayanti et al., 2021).

Paddy fields in many countries support large numbers of migratory water birds. The reason for the abundance may be due to a large number of food supplies such as polychaetes, crustaceans, and molluscs, in the paddy fields during the bird migration season (Munira et al., 2014). Based on personal observations, waterbirds frequently move from one plot to another by selecting the quality and quantity of available habitat to take advantage of available prey resources and maximize foraging efficiency. In addition to water birds, land birds also use paddy fields to forage. This is consistent with the opinion of (Stafford et al., 2010) that the mixed species of waterbirds and land birds probably reflects the wide variety of animal and plant foods produced closely related to rice farming.

Species Index and Dominance Index

Shannon-Weiner bird species diversity index in the paddy field habitat during the paddy ripening phase of Jurong Peujeura Village, Aceh Besar was obtained $H' = 1.24$, which indicates a moderate level of bird species diversity. The diversity index (H') is used to get an overview of the population of organisms or the number of individuals of each species in a community or habitat, with a smaller H' category equal to 1 low diversity, low distribution, and low community stability. $H' 1 < H' < 3$ moderate diversity, moderate distribution, moderate community stability. H' greater equals three: high diversity, high distribution, and high community stability (Odum, 1971).

Based on Simpson's dominance index, where $C = 0.42$, which indicates a low level of bird dominance. The low level of bird dominance is due to the moderate diversity of species in the paddy field area of Jurong Peujeura Village. The dominance index aims to determine whether there is a dominant species in a community. Dominance index values range from 0-1, criteria for the ecological condition of the community based on dominance index values indicate that, if the dominance index value approaches 0, then almost no species are dominant. The index value of water indicates a community in a relatively stable state. Meanwhile, if the dominance index value is close to 1, then one species dominates the other species. This is caused by the community being in an unstable condition and ecological pressure occurs.

Bird Status

Based on the protection status of the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No P.106/MENLHK/SETJEN/KUM.1/12/2018 (2018), all bird species (100%) are categorized as not protected. Based on the IUCN conservation status (2022), most of the bird species (92.86%) are included in the Least Concern category with a population trend increasing (six species), which are Cattle Egret, Little Egret, *Zitting cisticola*, Eastern Spotted Dove, Pacific Swallow, Yellow-vented Bulbul, stable population (four species), which are White-breasted

Woodswallow, White-headed Munia, Scaly-breasted Munia, Streaked Weaver, and declining population (three species), which are Purple Heron, Blue-tailed Bee-eater, Eurasian Tree Sparrow. The rest are included in the vulnerable category (7.14%) with a declining population trend, which is the *Javan myna* from the *Sturnidae* family.

Populations of species within their natural range have declined rapidly as a result of trapping for bird trade and due to the effects of pesticide use (Eaton et al., 2015). The *Javan myna* species is vulnerable because it is traded in very large numbers from Sumatra to Java despite the greatly declining population numbers and is currently rarely seen. This decrease was almost entirely due to capture for the wild bird market, and 2054 were counted in a three-day inventory of birds openly sold in major markets in Java (Chng et al., 2015). Furthermore, a 2018 bird ownership survey involving more than 3,000 households in six provinces in Java estimated that $666,389 \pm 126,881$ *Javan myna* individuals were kept in Java alone (Marshall et al., 2020).

In addition, the conversion of land functions, especially paddy fields to housing, also poses a threat to birds. Paddy-dwelling birds that like dense undergrowth or residents under the canopy like *Zitting cisticola*. Birds that use paddy fields to eat vertebrates (fish and frogs) or invertebrates (molluscs, worms, and crustaceans) are grouped as water birds such as the red heron, Cattle Egret, Little Egret will lose their source of food if the paddy fields are converted to function as a change. Each bird species has its ecological roles and functions. For example, an insectivore plays a role in controlling pests and diseases in rice plants such as White-breasted Woodswallow, *Zitting cisticola*, Pacific Swallow, Blue-tailed Bee-eater, and *Javan myna*.

Conservation efforts in rice fields can be initiated through bird surveys in various paddy fields. This is important to provide up-to-date information on the status of birds and population estimates. This approach can build links between research universities and conservation projects, which can be beneficial for biodiversity

conservation in paddy fields (Munira et al., 2014). Research development by universities can be achieved by using paddy fields as a place to teach students to conduct research related to the ecology, management, and restoration of paddy fields. The purpose of all the aforementioned conservation actions is to maintain the quality of paddy fields as important habitat for various waterbirds. This implementation requires strong support and commitment from communities, conservation organizations, governments, and scientists to achieve successful conservation programs that will ultimately benefit humans and wildlife.

Conclusion

In conclusion, 14 species from 11 families and 2586 individual birds found in paddy fields during the paddy ripening phase were classified as minimal. The species diversity index of 1.24 belongs to the medium category, and the Dominance Index of 0.42 indicates no dominant species in the community.

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