



## Avian Diversity in the Paddy Field Ecosystem Surrounding the Assam University Campus in Silchar During the Rainy Season

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### Article History:

Received: 10<sup>th</sup> Sep., 2023

Accepted: 21<sup>st</sup> Oct., 2023

Published: 30<sup>th</sup> Oct., 2023

### Keywords:

Agricultural land, avian diversity, avifauna, rice field, ecosystem, Barak Valley, north east India

### How to cite this Article:

Hemanta Gogoi, Jayaditya Purkayastha and Shubhadeep Roychoudhury (2023). Avian diversity in the paddy field ecosystem surrounding the Assam University campus in Silchar during the rainy season. *International Journal of Experimental Research and Review*, 34(Spl.), 120-137.  
DOI : <https://doi.org/10.52756/ijerr.2023.v34spl.012>

**Abstract:** Rice (*Oryza sativa* L.) is one of the most effective crops for absorbing carbon dioxide. Paddy is a temporary reservoir for rainwater during the rainy season, prevents soil erosion, and emits oxygen through photosynthesis. In Assam, it occupies 88.89 percent of the net cropped area. Paddy field ecosystems are also home to various cultivated and wild species of plants and animals where numerous aquatic and bird species can be found. These fields provide waste rice, a crucial food source for various bird species. The quantity of waste rice positively correlates with rice yields, and birds often feed on freshly planted rice seeds. Paddy fields constitute a semi-aquatic ecosystem that is heavily infested by insect pests. These fields also attract waterfowls, wading birds, shorebirds, and other waterbirds for migratory movements and foraging. From this pilot study conducted in the paddy field ecosystem surrounding the Assam University campus in Silchar we report 95 species of birds that belong to 37 families and 14 orders. Highly sighted avifauna included Egret, Heron, Bittern (family Ardeidae), Waterhen (family Rallidae), Kingfisher (family Alcedinidae), Drongo (family Dicuridae), and Dove (family Columbidae). Interestingly, eight 'Least Concern' bird species according to the International Union for Conservation of Nature (IUCN) – Hooded Pitta (*Pitta sordida* – family Pittidae), Cinnamon Bittern (*Ixobrychus cinnamomeus* – family Ardeidae), Watercock (*Gallinula cinerea* – family Rallidae), Common Sandpiper (*Actitis hypoleucos* – family Scolopacidae), Emerald Dove (*Chalcophaps indica* – family Columbidae), White-Browed Piculet (*Sasia ochracea* – family Picidae), Dark-Necked Tailorbird (*Orthotomus atrogularis* – family Muscicapidae) and Brown Fish-Owl (*Ketupa zeylonensis* – family Strigidae) as well as a 'Vulnerable' species Lesser Adjutant Stork (*Leptoptilos javanicus* – family Ciconiidae) and 'Near Threatened' species Alexandrine Parakeet (*Psittacula eupatria* – family Psittacidae) were also noted. Out of a total 95 avian species, 46 species belonged to the insectivorous category, accounting for the greatest number according to the feeding guild recorded within different line transects in Visual Encounter Surveys (VES) conducted weekly from March 2023 to August 2023. Although the avifaunal studies have enormous potential in the Barak Valley, conservation measures are essential to protect the biodiversity. Public involvement in awareness campaigns and conservation activities is crucial for conserving avian diversity within the Valley. As paddy fields are used primarily by grassland and wetland bird species, there are significant information gaps in the monitoring of bird populations in paddy cultivation as well as in different stages of rice growing cycles, which makes it essential to understand the importance of paddy fields on avian populations as well as diversity.

### Introduction

The Rice (*Oryza sativa* L.) was first cultivated by humans approximately 10,000 years ago (Elphick, 2010). From Asia, it has spread to other parts of the world and become one of the world's most important crops. The

crop is grown in at least 114 countries worldwide, occupying over 1% of the Earth's ice-free land surface and providing 21% of the calories and 15% of the proteins humans consume (Elphick, 2010). In monsoon Asia, the paddy field is a typical agricultural land type



with almost 1.7 billion hectares, of which India has the largest total cropland area of 168 million hectares (FAO, 2021). As one of the most effective crops for absorbing carbon dioxide, paddy is a temporary reservoir for rainwater during the rainy season, prevents soil erosion, fixes atmospheric carbon dioxide, and emits oxygen through photosynthesis (Kim et al., 2011). In the north east region of India, only 17%–18% of the total land area is under cultivation (Dikshit and Dikshit, 2014). In Assam, the gross cropped and net cropped areas are 39.75 lakh hectares and 26.99 lakh hectares, respectively, and its resulting cropping intensity is 145 percent. Among all the crops, paddy is the most dominant crop, occupying 88.89 percent of the net cropped area in Assam (Ministry of Agriculture & Farmers Welfare, Govt. of India, 2023). In the southern part of the State of Assam, 38.62% (146219 hectares) of Barak Valley's total geographic area is under cultivation in the Cachar district alone (Cachar District, Govt. of Assam, 2023). Assam University campus in Silchar is situated in the Barak Valley, which comprises three districts of Cachar, Karimganj, and Hailakandi, with a total area of 6992 square km. The majority of the Valley's vegetation is tropical evergreen, and its northern and south-eastern regions are home to significant areas of rainforest (Hussain, 2015). For 2 to 4 months during the monsoon season, most of the paddy fields in this district remain flooded. During the cultivation time of May to September (Ahmed et al., 2009), only rice is grown in the flooded fields. However, paddy is grown in all seasons throughout the year under different cropping cycles: rabi or summer rice, pre-kharif or autumn rice, and two different varieties of kharif or winter rice (Bhattacharjee and Das, 2014).

Moreover, paddy fields in the Barak Valley region of north east India offer numerous habitat services. They support biodiversity by providing habitat to various species of birds, amphibians, insects, etc. Paddy fields submerged in water are considered seasonal wetlands, providing other resources like fish during the aquatic phase and forage during the terrestrial phase (Misra and Ranjan, 2020). Although the primary purpose of a paddy field is foodgrain production (i.e., a provisioning ecosystem service), it also has several other essential ecosystem services such as the habitat service (most importantly for several wetland species, as mentioned above) and the regulating service (such as flood control, greenhouse gas emission control, land conservation, sustainable management of renewable natural resources and preservation of biodiversity in general) (Osawa and Nishida, 2022).

Paddy field ecosystems are also home to a variety of cultivated and wild species of plants and animals. Micro- and macro-invertebrates, especially arthropods, dominate most vegetation, water, and soil sub-habitats. Numerous aquatic and bird species can be found in wet fields (Bambaradeniya and Amarasinghe, 2003). The duration of flooding and water availability affect the biotic communities, affecting the ecology and biodiversity of such ecosystems (Ambiya et al., 2016; Dayawansa and Mowjood, 2017; Paul et al., 2017). Moreover, the region's favourable climate, topography, and soil conditions support diverse plant communities and sustain a wide range of fauna, including mammals, primates, reptiles, amphibians, fish, birds, butterflies, and moths. This interconnected web of life demonstrates the importance of these paddy fields in supporting regional biodiversity (Assam State Biodiversity Board, 2023).

A fascinating aspect of these paddy fields is their role in providing waste rice, a crucial food source for various bird species. The amount of waste rice positively correlates with rice yields; birds often feed on freshly planted paddy seeds (Stafford et al., 2010). These paddy field ecosystems provide diverse food resources, including seeds, fruits, grains, green vegetation, arthropods, and bird habitats, which help farmers with pollination and pest control. The diversity of bird species in agricultural landscapes is linked to the availability of food, nesting, and roosting sites (Dahiya et al., 2022; Chowdhury, 2023). Birds' economic and ecological importance has led to interest in their management, including conservation, pest control, and environmental impact assessment. Understanding the association of birds with agriculture requires comprehensive information on ecological aspects like feeding, breeding, roosting behavior, damage potential, and population dynamics (Dhindsa and Saini, 1994; Bhattacharya, 2015). For example, the sights of critically endangered Yellow-Breasted Bunting in the paddy fields of Barak Valley after more than 100 years shows its potential to support a diversity of bird species as a habitat (Choudhury and Choudhury, 2021). This region is home to 550 species of birds, and 21 of them are threatened (Hussain, 2015).

The study of birds' association with agriculture is broad, comprehensive, and highly complicated. Such understanding, however, can formulate management practices once consummate information is gathered on the ecological aspects such as feeding, breeding, roosting behaviour, damage potential, and population dynamics (Das et al., 2016; Dahiya et al., 2022). The main objective of the present study was to create an inventory of bird species of the paddy field ecosystem surrounding

the Assam University campus in Silchar, north east India, and to study the factors impacting the birds in the area as pointed out below.

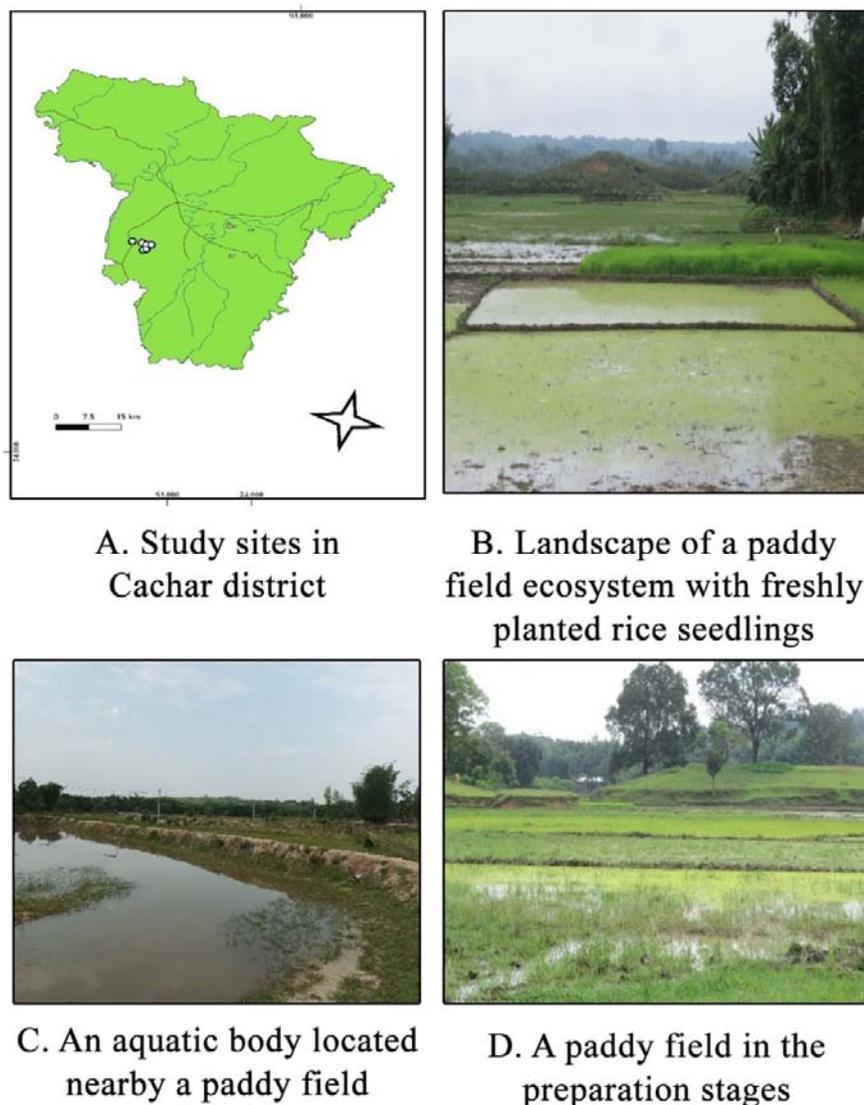
## Materials and Methods

### Study area

As shown in Figure 1, the survey was carried out in the paddy field ecosystems in Cachar district of Barak Valley in the areas surrounding the Assam University campus in Silchar, India (24.6890°N, 92.7422°E). The area was spread across a varied topography. The main habitat types included tea gardens, grassy meadows, scrub jungles, open forests, moderately dense forests on the hill, and different floodplain habitats like swamps and marshes with emergent shrubs and other flora. The Silchar-Hailakandi road passes through this area.

### Methodology

To create a data sheet (checklist of birds) the current work recorded the observations made during the field. In addition, previous and contemporary sighting records were collected for the purpose (Grimmett, 2014; Dev, 2015; Chakdar et al., 2016; Hussain et al., 2018, 2022). The paddy field ecosystems were studied for bird sightings on a weekly basis for 6 months from March to August 2023. A total of seven sites were randomly selected. During the study, every location was visited and observed at least twice. The investigation started in the hot dry summer season (from the end of March till May). Visual Encounter Surveys (VES) were used within different line transects, requiring the observer to walk along a specified trail while noting birds on either side.



**Figure 1.** Study area characterized by paddy field ecosystem showing the study sites: A) white dots in the Cachar district of Barak Valley in Assam, India (which lies up to approximately 6 km south to the Assam University campus in Silchar); B) landscape of a paddy field ecosystem with freshly planted rice seedlings; C) an aquatic body located nearby a paddy field; and D) a paddy field in the preparation stages.

**Table 1. Avifauna recorded from the paddy field ecosystem surrounding the Assam University campus in Silchar show their distribution, status, habitat and feeding guilds**

Sl. No.	Common and Scientific Names with Order and Families of the Species	Distribution	Status in Assam	Habitat Guild	Feeding Guild
	<b>Pelecaniformes:</b> Phalacrocoracidae				
1	Little Cormorant <i>Phalacrocorax niger</i>	R	C	A	P
	<b>Ciconiiformes:</b> Ardeidae				
2	Cattle Egret <i>Bubulcus ibis</i>	R	C	A	P
3	Great Egret <i>Casmerodius albus</i>	R	C	A	P
4	Intermediate Egret <i>Mesophoyx intermedia</i>	R	C	A	P
5	Indian Pond Heron <i>Ardeola grayii</i>	R	C	A	P
6	Cinnamon Bittern <i>Ixobrychus cinnamomeus</i>	R	U	A	P
	<b>Ciconiiformes:</b> Ciconiidae				
7	Lesser Adjutant Stork <i>Lepototilos javanicus</i>	R	U	G	C
8	Open Bill Stork <i>Anastomus oscitans</i>	R	C	G	C
	<b>Anseriformes:</b> Anatidae				
9	Lesser Whistling-Duck <i>Dendrocygna javanica</i>	R	C	A	O
	<b>Falconiformes:</b> Accipitridae				
10	Crested Serpent Eagle <i>Spilornis cheela</i>	R	C	F	C
	<b>Gruiformes:</b> Rallidae				
11	Water Crock <i>Gallicrex cinerea</i>	R	U	A	O
12	White-Breasted Waterhen <i>Amaurornis phoenicurus</i>	R	C	A	O
	<b>Charadriiformes:</b> Jacanidae				
13	Bronze-Winged Jacana <i>Metopidius indicus</i>	R	C	A	O
	<b>Charadriiformes:</b> Scolopacidae				
14	Common Sandpiper <i>Actitis hypoleucos</i>	R	U	A	I
	<b>Charadriiformes:</b> Charadriidae				
15	Red- Wattled Lapwing <i>Vanellus indicus</i>	R	C	A	O
	<b>Columbiformes:</b> Columbidae				
16	Ashy-Headed Green Pigeon <i>Treron pompadora</i>	R	C	F	G
17	Emerald Dove <i>Chalcophaps indica</i>	R	U	F	G
18	Oriental Turtle Dove <i>Streptopelia orientalis</i>	R	C	G	G
19	Red Collared Dove <i>Streptopelia tranquebarica</i>	R	C	G	G
20	Spotted Dove <i>Streptopelia chinensis</i>	R	C	G	G
21	Yellow-Footed Green Pigeon <i>Treron phoenicoptera</i>	R	C	F	G

	<b>Psittaciformes: Psittacidae</b>				
22	Alexandrine Parakeet <i>Psittacula eupatria</i>	R	U	F	F
23	Red-Breasted Parakeet <i>Psittacula alexandri</i>	R	C	F	F
24	Rose-Ringed Parakeet <i>Psittacula krameri</i>	R	C	F	F
	<b>Cuculiformes: Cuculidae</b>				
25	Asian Koel <i>Eudynamys scolopaceus</i>	R	C	G	O
26	Indian Cuckoo <i>Cuculus micropterus</i>	R	C	G	I
27	Green-Billed Malkoha <i>Rhopodytes tristis</i>	R	C	F	I
28	Greater Coucal <i>Centropus sinensis</i>	R	C	F	I
	<b>Strigiformes: Strigidae</b>				
29	Collared Scops Owl <i>Otus bakkamoena</i>	R	C	F	C
30	Brown Fish-Owl <i>Ketupa zeylonensis</i>	R	C	F	C
31	Asian Barred Owlet <i>Glaucidium cuculoides</i>	R	C	G	C
32	Spotted Owlet <i>Athene brama</i>	R	C	G	C
	<b>Apodiformes: Apodidae</b>				
33	Asian Palm Swift <i>Cypsiurus balasiensis</i>	R	C	O	I
	<b>Coraciiformes: Alcedinidae</b>				
34	White-Throated Kingfisher <i>Halcyon smyrnensis</i>	R	C	A	P
35	Common Kingfisher <i>Alcedo atthis</i>	R	C	A	P
	<b>Coraciiformes: Meropidae</b>				
36	Blue-Tailed Bee-eater <i>Merops philippinus</i>	R	C	O	I
37	Chestnut-Headed Bee-eater <i>Merops leschenaulti</i>	R	C	O	I
38	Asian Green Bee-eater <i>Merops orientalis</i>	R	C	O	I
	<b>Coraciiformes: Coraciidae</b>				
39	Indochinese Roller <i>Coracias benghalensis</i>	R	C	G	I
	<b>Coraciiformes: Upupidae</b>				
40	Common Hoopoe <i>Upupa epops</i>	R	C	O	I
	<b>Piciformes: Capitonidae</b>				
41	Blue-Throated Barbet <i>Megalaima asiatica</i>	R	C	F	F
42	Coppersmith Barbet <i>Megalaima haemacephala</i>	R	C	F	F
43	Lineated Barbet <i>Megalaima lineata</i>	R	C	F	F
	<b>Piciformes: Picidae</b>				
44	Greater Flameback <i>Chrysocolaptes lucidus</i>	R	C	F	I
45	White-Browed Piculet <i>Sasia ochracea</i>	R	U	F	I
	<b>Passeriformes: Eurylaimidae</b>				
46	Hooded Pitta <i>Pitta sordida</i>	R, L	U	F	I
	<b>Passeriformes: Alaudidae</b>				
47	Bengal Bush-Lark <i>Mirafra assamica</i>	R	C	O	O

	<b>Passeriformes: Hirundinidae</b>				
48	Barn Swallow <i>Hirundo rustica</i>	R, W	C	O	I
49	Grey-Throated Martin <i>Riparia Chinensis</i>	R	C	G	I
	<b>Passeriformes: Motacillidae</b>				
50	White Wagtail <i>Motacilla alba</i>	W	C	G	I
51	Citrine Wagtail <i>Motacilla citreola</i>	W	C	G	I
52	Paddyfield Pipit <i>Anthus rufulus</i>	R	C	O	I
	<b>Passeriformes: Campephagidae</b>				
53	Grey-Backed Shrike <i>Lanius tephronotus</i>	W	C	G	I
	<b>Passeriformes: Pycnonotidae</b>				
54	Black-Crested Bulbul <i>Pycnonotus melanicterus</i>	R	C	F	F
55	Red-Vented Bulbul <i>Pycnonotus cafer</i>	R	C	G	F
56	Red-Whiskered Bulbul <i>Pycnonotus jocosus</i>	R	C	F	F
	<b>Passeriformes: Irenidae</b>				
57	Common Iora <i>Aegithina tiphia</i>	R	C	F	I
	<b>Passeriformes: Muscicapidae: Turdinae</b>				
58	Oriental Magpie Robin <i>Copsychus saularis</i>	R	C	G	I
	<b>Passeriformes: Muscicapidae: Timaliinae</b>				
59	Puff-Throated Babbler <i>Pellorneum ruficeps</i>	R	C	F	I
60	Abbott's Babbler <i>Malacocincla abbotti</i>	R	C	F	I
61	Striped Tit Babbler <i>Macronous gularis</i>	R	C	F	I
62	White-Browed Scimitar Babbler <i>Pomatorhinus schisticeps</i>	R	C	F	I
63	Lesser Necklaced Laughingthrush <i>Garrulax monileger</i>	R	C	F	I
64	Rufous-Necked Laughingthrush <i>Garrulax ruficollis</i>	R	C	F	I
	<b>Passeriformes: Muscicapidae: Sylviidae</b>				
65	Dusky Warbler <i>Phylloscopus fuscatus</i>	W	C	F	I
66	Tickell's Leaf Warbler <i>Phylloscopus affinis</i>	W	C	F	I
67	Yellow-Browed Warbler <i>Phylloscopus inornatus</i>	R, W	C	F	I
68	Common Tailorbird <i>Orthotomus sutorius</i>	R	C	F	I
69	Dark-Necked Tailorbird <i>Orthotomus atrogularis</i>	R	U	F	I
	<b>Passeriformes: Muscicapidae: Muscicapinae</b>				
70	Taiga Flycatcher <i>Ficedula albicilla</i>	W	C	F	I
	<b>Passeriformes: Muscicapidae: Pachycephalinae</b>				
71	White-Rumped Shama <i>Copsychus malabarica</i>	R	C	F	I
	<b>Passeriformes: Dicaeidae</b>				
72	Scarlet-Backed Flowerpecker <i>Dicaeum cruentatum</i>	R	C	F	N

	<b>Passeriformes: Nectariniidae</b>				
73	Purple Sunbird <i>Nectarinia asiatica</i>	R	C	F	N
74	Crimson Sunbird <i>Aethopyga siparaja</i>	R, L	C	G	N
75	Purple-Rumped Sunbird <i>Nectarinia zeylonica</i>	R	C	F	N
76	Ruby-Cheeked Sunbird <i>Anthreptes singalensis</i>	R	C	F	N
77	Little Spiderhunter <i>Arachnothera longirostra</i>	R	C	F	N
	<b>Passeriformes: Zosteropidae</b>				
78	Oriental White-Eye <i>Zosterops palpebrosus</i>	R	C	F	I
	<b>Passeriformes: Estrildidae</b>				
79	White-Rumped Munia <i>Lonchura striata</i>	R	C	F	G
	<b>Passeriformes: Passeridae: Passerinae</b>				
80	House Sparrow <i>Passer domesticus</i>	R	C	O	G
	<b>Passeriformes: Passeridae: Ploceinae</b>				
81	Baya Weaver <i>Ploceus philippinus</i>	R	C	G	G
	<b>Passeriformes: Oriolidae</b>				
82	Black-Hooded Oriole <i>Oriolus xanthornus</i>	R	C	G	0
	<b>Passeriformes: Sturnidae</b>				
83	Asian Pied Starling <i>Gracupica contra</i>	R	C	G	I
84	Chestnut-Tailed Starling <i>Sturnia malabarica</i>	R	C	G	I
85	Jungle Myna <i>Acridotheres fuscus</i>	R	C	G	I
86	Common Myna <i>Acridotheres tristis</i>	R	C	G	I
87	Hill Myna <i>Gracula religiosa</i>	R	C	F	I
	<b>Passeriformes: Dicruridae</b>				
88	Ashy Drongo <i>Dicrurus leucophaeus</i>	R, W	C	G	I
89	Black Drongo <i>Dicrurus macrocercus</i>	R	C	G	I
90	Bronzed Drongo <i>Dicrurus aeneus</i>	R	C	G	I
91	Greater Racket-Tailed Drongo <i>Dicrurus paradiseus</i>	R	C	F	I
92	Lesser Racket-Tailed Drongo <i>Dicrurus remifer</i>	R	C	F	I
93	Spangled Drongo <i>Dicrurus hottentottus</i>	R	C	G	I
	<b>Passeriformes: Corvidae</b>				
94	Rufous Treepie <i>Dendrocitta vagabunda</i>	R	C	F	O
95	Large-Billed Crow <i>Corvus macrorhynchos</i>	R	C	G	O
<p>Habitat Guild: F - Forest habitant; G - Generalist; O - Openland habitant; A - Aquatic habitant; Feeding Guild: G = Granivores; P = Piscivores; I = Insectivores; C = Carnivores; O = Omnivores; F = Frugivores; N = Nectarivores; Distribution Status: R = Resident; L = Local and altitudinal migrant; W = Winter visitor; M= Migrant; but some breeds here; Status in Assam: C= Common; U= Uncommon</p>					

**Table 2. Numbers of avian species under each family, along with their orders**

Sl. No.	Order	Family	No. of Species
1	Pelecaniformes	Phalacrocoracidae	1
2	Ciconiiformes	Ardeidae	5
		Ciconiidae	2
3	Anseriformes	Anatidae	1
4	Falconiformes	Accipitridae	1
5	Gruiformes	Rallidae	2
6	Charadriiformes	Jacanidae	1
		Scolopacidae	1
		Charadriidae	1
7	Columbiformes	Columbidae	6
8	Psittaciformes	Psittacidae	3
9	Cuculiformes	Cuculidae	4
10	Strigiformes	Strigidae	4
11	Apodiformes	Apodidae	1
12	Coraciiformes	Alcedinidae	2
		Meropidae	3
		Coraciidae	1
		Upupidae	1
13	Piciformes	Capitonidae	3
		Picidae	2
14	Passeriformes	Eurylaimidae	1
		Alaudidae	1
		Hirundinidae	2
		Motacillidae	3
		Campephagidae	1
		Pycnonotidae	3
		Irenidae	1
		Muscicapidae	14
		Dicaeidae	1
		Nectariniidae	5
		Zosteropidae	1
		Estrildidae	1
		Passeridae	2
		Oriolidae	1
		Sturnidae	5
Dicruridae	6		
Corvidae	2		



Figure 2. Individual Lesser Adjutant Storks (*Leptotilos javanicus*) foraging in the paddy field.



Figure 3. An adult (on the left) and a juvenile Brown Fish-owl (*Ketupa zeylonensis*) perched on a tree near a paddy field.



Figure 4. A Cattle Egret (*Bubulcus ibis*) and an Intermediate Egret (*Mesophoyx intermedia*) foraging on paddy fields.



Figure 5. Nests of Baya Weavers (*Ploceus philippinus*) on a betel nut tree near a paddy field.

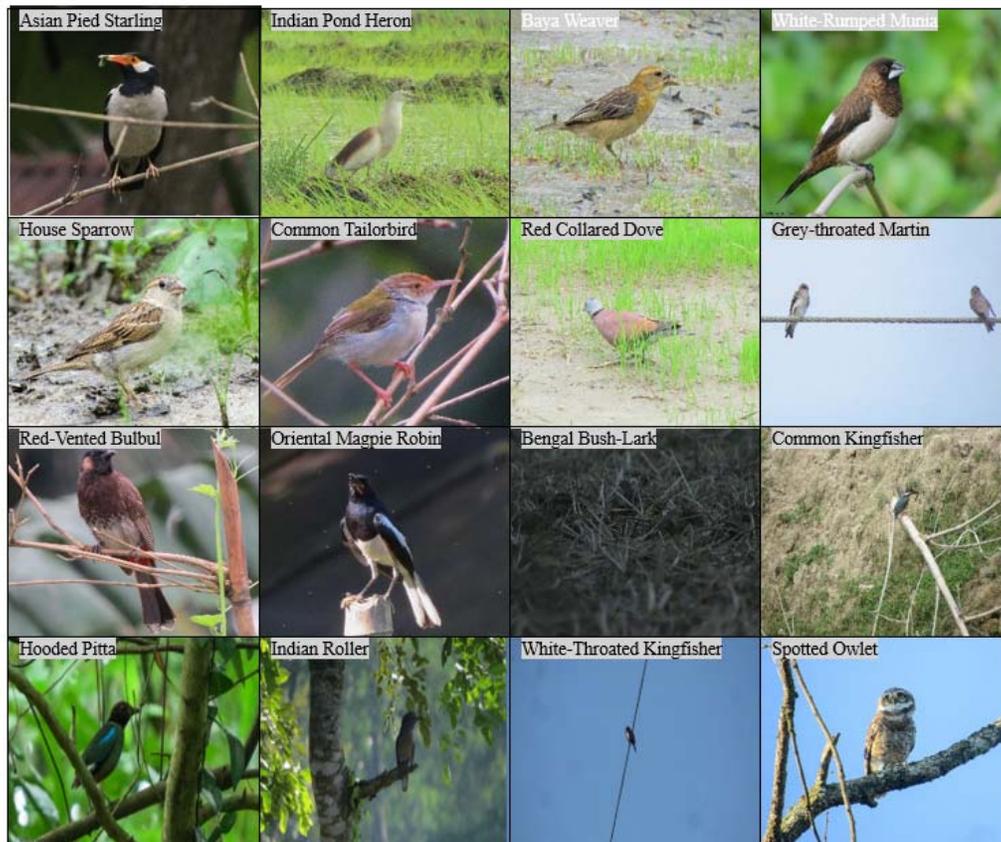


Figure 6. Some avifauna were recorded in and around the paddy field ecosystem during the study.

In the bird's distance from the transect line was often measured in absolute terms, hence the distance was measured perpendicular to the transect line (Gregory et al., 2004). All the birds seen or heard were complemented by using field guide (Ali, 1949; Grimmett, et al., 2014) and binocular (Nikon, Japan – 10 x 40X) and photographs were taken by using digital camera (Canon Power shots S X 50 HS, Japan). The species-level identification of the observed birds was done using available books, literature, and other sources of online identification and also with the help of experienced bird watchers. Distribution, status in Assam, habitat guild, and feeding guild were included in a final checklist of the observed birds (Ali, 1949; Manakadan and Pittie, 2001; Grimmett et al., 2014; Chakdar et al., 2016; Hussian et al., 2018, 2022).

## Results

The study noted 95 species of birds from 37 families and 14 orders. Of these, 40 species were found in crop fields, and the remaining species were observed in adjoining habitats such as secondary-growth forests and water bodies. Figures 2 – 6 show some of the birds and/or their nests recorded during the study. Avifauna belonging to the orders Pelecaniformes, Anseriformes, Falconiformes, Gruiformes, Columbiformes, Psittaciformes, Cuculiformes, Strigiformes, and Apodiformes were found to occur least frequently, with only one family of each bird. In contrast, the order Passeriformes was predominant with 17 families (Table 1).

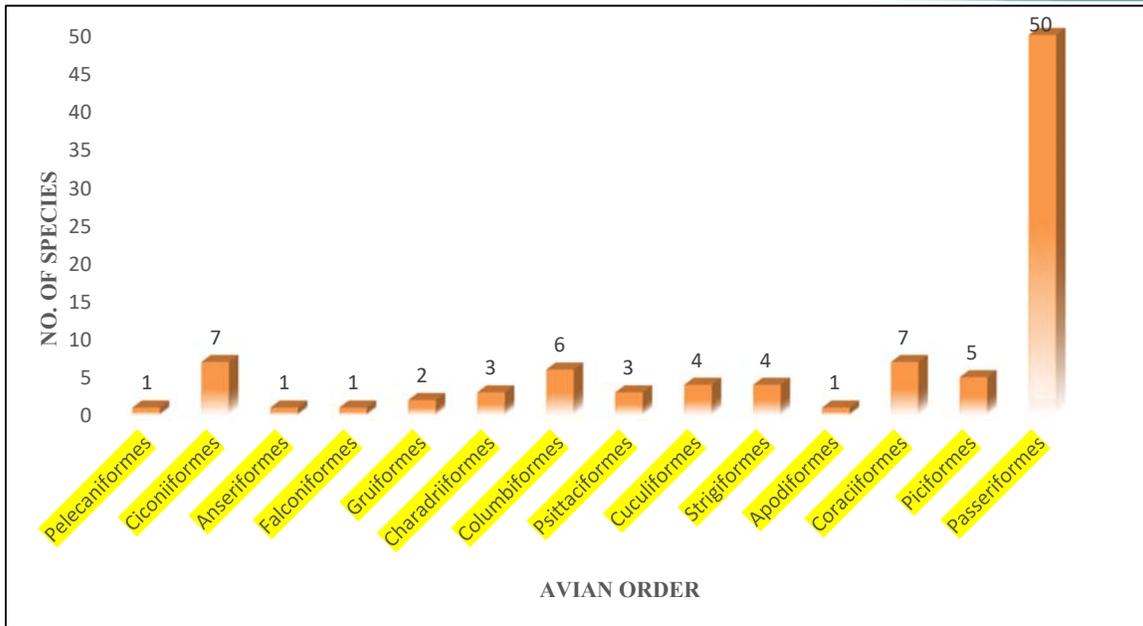
The majority of the birds that were observed throughout the study are common and resident to the Valley; however, 10 uncommon species belonging to 9 different orders, including Cinnamon Bittern (*Ixobrychus cinnamomeus*) (LC), Lesser Adjutant Stork (*Leptotilos javanicus*) (VN), Watercock (*Gallixrex cinerea*) (LC), Common Sandpiper (*Actitis hypoleucos*) (LC), Emerald Dove (*Chalcophaps indica*) (LC), Alexandrine Parakeet (*Psittacula eupatria*) (NT), White-Browed Piculet (*Sasia ochracea*) (LC), Hooded Pitta (*Pitta sordida*) (LC), Dark-Necked Tailorbird (*Orthotomus atrogularis*) (LC) and Brown Fish-Owl (*Ketupa zeylonensis*) (LC) were also recorded.

The Valley's altitudinal migrants and winter visitors are birds like Barn Swallow (*Hirundo rustica*), White Wagtail (*Motacilla alba*), Citrine Wagtail (*Motacilla citreola*),

Grey-Backed Shrike (*Lanius tephronotus*), Grey-backed Shrike (*Lanius tephronotus*), Tickell's Leaf Warbler (*Phylloscopus affinis*), Yellow-browed Warbler (*Phylloscopus inornatus*), Taiga Flycatcher (*Ficedula albicilla*), Ashy Drongo (*Dicrurus leucophaeus*).

Table 2 shows the numbers of species recorded under each avian family along with their orders. As mentioned earlier, the order Passeriformes was predominant with 50 species of birds belonging to 17 different families. Also, 7 species of birds belonged to the orders Ciconiiformes (with 2 families) and Coraciiformes (3 families) each, whereas 6 species from the order Columbiformes (1 family), 5 species from the order Piciformes (1 family), 4 species from the order Cuculiformes and Strigiformes (1 family each), 3 species from the order Charadriiformes (3 families) each, and Psittaciformes (1 family), 2 species from the order Gruiformes (1 family) and 1 species from each from the orders Pelecaniformes, Anseriformes, Falconiformes, Apodiformes (1 family each) were recorded in the study. Figure 7 presents the avifauna recorded from the paddy field ecosystems surrounding the Assam University campus in Silchar, showing their order(s) with respect to the number(s) of bird species.

Figure 8 shows four different habitat guilds, including forest habitants, generalists, openland habitants, and aquatic habitants of the avifauna recorded during the study. Forest habitants have been found to predominate comprising 43 species most of which are residents followed by winter visitors, local and altitudinal migrants to the Barak Valley. Hooded Pitta (*Pitta sordida*) is an elusive winter visitor worth mentioning here. Moreover, generalist habitants comprised of 28 species which show the potential of the paddy field ecosystem to provide food resources including seeds, fruits, grains, green vegetation, and arthropods as well as roosting sites available nearby. The aquatic habitants' category had 14 bird species recorded from water bodies (both natural and man-made) located near paddy fields as they depend on heavily vegetated wet fields and marshes they inhabit mainly in search of food. However, most insectivorous species were recorded under openland habitants' category, accounting for 10 species of birds.



**Figure 7 . Order-wise representation of avifaunal species recorded from the paddy field ecosystem surrounding the Assam University campus in Silchar.**

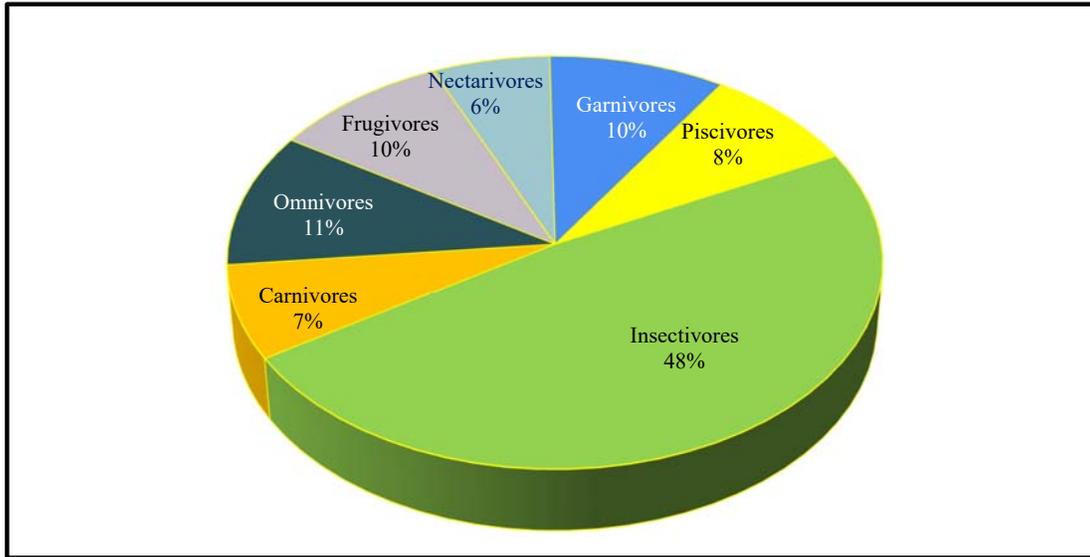


**Figure 8. Avifauna recorded from the paddy field ecosystem surrounding the Assam University campus in Silchar show their habitat guild concerning the numbers of species recorded.**

Different feeding guilds of recorded avifauna are

presented in Figure 9. Overall, 46 species (48%) belonged to the insectivores out of a total 95 species. The most common insectivorous birds that were frequently found in large numbers in paddy fields include the Asian Green Bee-Eater (*Merops orientalis*), Chestnut-Headed

different families, most of which were insectivores. Two individuals of the carnivore Lesser Adjutant Stork (*Leptoptilos javanicus*) were seen foraging in the paddy field during the present study.



**Figure 9. Avifauna recorded from the paddy field ecosystem surrounding the Assam University campus in Silchar show their feeding guilds concerning the number of species recorded.**

Bee-Eater (*Merops leschenaulti*), Common Hoopoe (*Upupa epops*), Barn Swallow (*Hirundo rustica*), Grey-Throated Martin (*Riparia Chinensis*), White Wagtail (*Motacilla alba*), Citrine Wagtail (*Motacilla citreola*), Paddyfield Pipit (*Anthus rufulus*), Black Drongo (*Dicrurus macrocercus*), Common Myna (*Acridotheres tristis*), Asian Pied Starling (*Gracupica contra*), Chestnut-Tailed Starling (*Sturnia malabarica*), Indochinese Roller (*Coracias benghalensis*), Oriental Magpie Robin (*Copsychus saularis*), and House Sparrow (*Passer domesticus*). Also, most of these birds are ground feeders, while some glided down to the paddy plants and remained grounded while others perched on trees, telegraph wires, and fences to feed on the insects. Interestingly, Baya Weavers (*Ploceus philippinus*) and White-Rumped Munia (*Lonchura striata*) were frequently observed feeding on crop plants, with nests found on betel nut trees near the paddy fields. Another important category was omnivores (11%) such as Cattle Egret (*Bubulcus ibis*), Great Egret (*Casmerodius albus*), Intermediate Egret (*Mesophoyx intermedia*), Indian Pond Heron (*Ardeola grayii*). Other categories included garnivores (10%), frugivores (10%), piscivores (8%), carnivores (7%) and nectarivores (6%).

### Discussion

In the present study, the order Passeriformes has been found to predominate with 50 species belonging to 17

The species is listed as 'Vulnerable' by IUCN and was also recorded several times from adjoining areas of Assam University campus in Silchar in February 2014, from Chotto Jalenga in August 2013 and September 2014, from Irongmara in November-December 2013 as well as from other areas of Cachar district like Kalinagar in August 2015, and Salchakra in September 2015 (Choudhury, 2015). However, the species is rarely seen in Barak Valley these days. Apart from that, an individual White-Browed Piculet (*Sasia ochracea*) was recorded, which is not common to the area. Previously, the bird was recorded in Durbin Tilla area of Cachar district in December 2014 (Hussain et al., 2022). This bird was photographed and identified based on its small stature during the encounter. Two Hooded Pitta (*Pitta sordida*) individuals listed as 'Least Concern' by IUCN were also sighted and photographed during the study. They are mostly resident of north east India and Bangladesh and are visitors during the summer, too (Grimmett et al., 2014). Calls of the birds were heard mostly in the morning hours. They performed brief flights and sat on low branches when approached. An individual Watercock (*Gallixrex cinerea*) was also recorded in a small wetland neighboring the paddy field in Chotto Jalenga area in the early hours of the day. It is a large, distinctive marsh dweller, elusive and often difficult to see in the heavily vegetated wet

fields and marshes it inhabits (Grimmett et al., 2014). Also, an adult Brown Fish-Owl (*Ketupa zeylonensis*) listed as 'Least Concern' by IUCN was recorded during the study with two juveniles. They inhabit waterside wooded areas from lowlands up into the mountains and feed by dropping down into and wading around in water bodies. The species is threatened by habitat degradation in the region (Vyas et al., 2013).

Paddy fields, a semi-aquatic ecosystem used for rice cultivation, are heavily infested by insect pests. These fields attract waterfowls, wading birds, shorebirds, and other waterbirds for migratory movements and foraging. As recorded in the present study, insectivorous bird species are attracted to these fields, highlighting their significant roles in eradicating pests (Ahmed and Dey, 2014).

The Barak Valley hosts an extraordinarily diverse bird population, including a number of threatened species. The high avian diversity of the Borail hill range was documented long ago (by Hume, 1877). The diversity of birds and their distribution in the paddy field and its surrounding habitats highlight the significance of the habitats in relation to one another. Cattle Egret, Little Egret, Intermediate Egret, Cinnamon Bittern, Asian Green Bee-Eater, Chestnut-Headed Bee-Eater, Black Drongo, Indian Pond Heron, Common Myna, Pied Starling, Indochinese Roller, Common Sandpiper, Paddy Field Pipit, White-Throated Kingfisher, Common Hoopoe, Bengal Bush-Lark, Oriental Magpie Robin, Baya Weaver, Red Collared Dove, Spotted Dove, Barn Swallow are the birds mainly found in large numbers in paddy fields. The lesser Adjutant Stork is mostly found foraging on paddy fields, a vulnerable species. Other species from the nearby habitats frequently visit the paddy fields because they provide breeding grounds for birds and a variety of food sources, including seeds, fruits, grains, lush vegetation in the form of grasses or crop plants, and arthropods, especially insects and rodents found in the soil and crop (Rahalker and Patel, 2015).

Paddy fields (typically in flooded circumstances) are a man-made semi-aquatic ecosystem maintained to cultivate rice crops that are highly infested by insect pests that are used by waterfowl, wading birds, shorebirds, and other waterbirds for staging during migratory movements as well as foraging on a variety of prey (Elphick, 2010). Insects prefer the damp surroundings and lush vegetation found in paddy fields to reproduce and complete their life cycles. Thus, insectivorous bird species are attracted, and due to their ability to eradicate insect pests, they are considered beneficial to farmers during cultivation. The

habitat guild in earlier studies in the area showed a similar pattern to the studies in the agroforestry system, which recorded the highest number of insectivores and generalist bird species (Ahmed and Dey, 2014).

A previous study by Hussain (2015) identified the primary and irreversible threat of habitat alteration and destruction. Unsustainable exploitation of natural resources counts as the second-largest threat. This includes illegal felling, firewood collection, drainage, and poaching. Important habitats are being threatened by excessive firewood collection, slash-and-burn (*jhum*) farming, and the expansion of agricultural areas after forcibly destroying the native vegetation. The most recent challenges include industrialization, agricultural intensification, and the rapid conversion of wetlands and natural grasslands for agriculture and fish farming. Farmland biodiversity increased as the number of trees increased but declined as the number of houses increased (Katuwal et al., 2022). Therefore, farmers should be encouraged to plant a variety of crops (mostly native) on their land in order to increase bird richness.

The ecosystem's biodiversity has been negatively impacted by the increasing use of pesticides in agriculture, especially paddy cultivation. In turn, this causes the food web in the paddy fields to become weaker due to the extinction of organisms at different trophic levels, like raptors and other predators. The study turned up very few raptor species, suggesting that natural biological control agents are not sufficiently used in these paddy fields. It is necessary to prohibit harmful pesticides and use them responsibly and safely at appropriate concentrations. The best alternative to overcome the hazardous effects of chemical pesticides may be biological insecticides (biocontrol agents), such as birds that eat insects that predominate in agroecosystems, followed by omnivorous and granivorous birds (Dahiya, et al., 2022).

Plantations of trees surrounding the rice fields for perching and roosting are also essential in order to support particular populations of birds in the paddy fields, especially raptors as well as insectivorous and frugivorous species that could help manage pests in the paddy field (Kamaruddin and Mohd-Taib, 2018). Therefore, habitat heterogeneity should be maintained to preserve species' diversity in environments threatened by human activity. Habitat heterogeneity can be maintained by limiting development in certain areas and conserving particular habitats that sustain high species diversity. It is presumed that further research and monitoring of the bird population on different paddy field sites with various stages of growing rice and the implementation of multiple

conservation strategies will ultimately help the farmer and birds in the long run.

In terms of its native flora and fauna, Barak Valley has enormous potential with more than 300 species of birds already recorded. If the right measures are not taken right now, we may lose many species without knowing their distribution or status in the Valley (Hussain et al., 2018). Other than the protected areas of the Valley, no scientific research or analysis has been done to systematically identify and monitor threatened bird species or the most important sites for the conservation of avian diversity. The current study also demonstrates that the agroecosystem may be in some danger regarding its habitat and overall biodiversity. Therefore, proper documentation of the avian diversity of the paddy fields should be encouraged, and specific immediate actions are required to reduce the potential for a decline in specific habitats. A participatory approach is crucial for effective conservation wherein the public participates in government initiatives for the conservation of landscapes. Additionally, through awareness efforts, farmers and other members of society should be made aware of hazards and feasible alternatives to future problems.

### Conclusion

The study undertaken in the paddy ecosystem surrounding around the Assam University campus in Silchar has shown a notable range of bird species, consisting of 95 species from 37 families and 14 orders. The results emphasise the significant importance of the paddy fields in the Barak Valley as a crucial ecosystem for a diverse range of avian fauna, encompassing both migratory and non-migratory bird species. The ecosystem's importance extends beyond its function as a bird habitat, as the paddy fields also play a crucial role in absorbing carbon dioxide, acting as temporary reservoirs for rains, and providing protection against soil erosion. Moreover, cultivating rice in these agricultural areas is a source of nourishment for various avian species. It contributes to pest management by attracting many ducks and shorebirds. The urgent necessity to execute comprehensive conservation measures in the region is highlighted by identifying many species of conservation concern. The lack of available data on bird populations in paddy fields and their relationship to various stages of the rice growing cycle necessitates prioritizing thorough monitoring and conservation initiatives. These efforts are crucial to safeguard the abundant avian variety in the Barak Valley region. The active involvement of the public in awareness campaigns and conservation projects

will have a crucial impact on preserving the intricate equilibrium within the paddy field ecosystem.

By acknowledging the significant interconnectedness between bird populations and the well-being of the paddy fields, it is possible to cultivate a sustainable agricultural strategy that not only supports the livelihoods of local farmers but also safeguards the enduring preservation of avian biodiversity within the area. To ensure the conservation of the unique avifauna inside the eco-sensitive landscape of Barak Valley, it is imperative to establish a eco-sensitive landscape of Barak Valley that involves stakeholders, researchers, and local populations.

### Conflict of interest

Nil

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#### How to cite this Article:

Hemanta Gogoi, Jayaditya Purkayastha and Shubhadeep Roychoudhury (2023). Avian diversity in the paddy field ecosystem surrounding the Assam University campus in Silchar during the rainy season. *International Journal of Experimental Research and Review*, 34(Spl.), 120-137.

DOI : <https://doi.org/10.52756/ijerr.2023.v34spl.011>



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