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## HABITAT UTILIZATION BY WETLAND BIRDS OF MUNDERIKADAVU, A PROPOSED BIRD SANCTUARY IN NORTHERN KERALA, INDIA

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### OPEN ACCESS

**Abstract:** Munderikadavu is rich in avifaunal diversity. A total of 82 species of birds from 36 families belonging to 13 orders were recorded in the wetland including wetland dependant species. Lowland vegetation had the highest species richness (46 species) followed by upland (41 species), aerial (38 species), emergent vegetation (22 species) and paddy fields (21 species). Open water had the lowest species richness. Upland vegetation had the highest species diversity ( $H' = 3.19$ ) followed by aerial ( $H' = 2.52$ ). There was more species overlap between emergent and low land vegetations ( $Cm = 0.7$ ). The threats in Munderikadavu wetland were dumping of waste and conversion of cultivation land into shrimp farming area. Thus land use changes need to be regulated in order to conserve the wetland and bird community.

**Keywords:** Diversity, habitat, Kattampally, Munderikadavu, threats, vegetation, wetland.



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Author Contribution: RR was involved in designing the study, field survey, gathering and analyzing the data and writing the Manuscript. VS was involved in framing the study and conducting the field survey.

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## INTRODUCTION

Birds are an important component of a wetland ecosystem and their presence or absence can reflect the condition of this ecosystem (Siriwardena et al. 1998; Weller 1999). Wetlands are characterized by shallow overlying water logged soil with submerged and emergent vegetation. Wetlands are one of the most productive ecosystems due to their habitat diversity, productivity and avifaunal diversity. The Ramsar convention (1971) defines wetlands as 'area of marsh, fen, peatland or water whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salty including areas of marine water, the depth of which at low tide does not exceed six meters. It may also incorporate riparian and coastal zones adjacent to the wetlands and islands or bodies of marine water deeper than six meters at low tide lying within the wetland'.

Birds are good bio-indicators of wetland-habitat quality, productivity and stability because birds respond quickly to change in the habitat (Seymour & Simmons 2008). The distribution of birds in a wetland is determined by its vegetation type, water depth, water quality (salinity, pollution), human disturbance or alteration due to different agricultural practices. In such a habitat, vegetation, food resources and habitat structure can be directly associated with the relative abundance of bird species (Wines 1992; Caziani & Derlindati 2000). Species abundance, habitat preference

and their correlations can provide basic information for determining factors causing population fluctuation of a bird species state in an ecosystem, impact of disturbance and the value of a habitat (Norvell 2003). These can lead to future conservation and management of the ecosystem and bird species.

Wetland systems are important as they directly and indirectly support lakhs of people, providing goods and services to them. They help check floods by storing water, prevent coastal erosion and is a highly productive ecosystem supporting large aquatic fauna and flora. Hence wetlands play a crucial role in an ecosystem. This short term study was carried out to find different bird species which utilize different niches in a wetland habitat.

## METHODS

### Study site

Munderikadavu is situated in Kannur District, Kerala between latitude 11.89N and longitude 75.38E and covers an area of 157.99 hectares (Image 1). It is a part of Kattampally wetlands, one of the 24 Important Bird Areas (IBA) in Kerala (Islam & Rahmani 2004). The Kattampally River is a tributary of Valapattanam River, the biggest drainage system (110km long) in northern Kerala. The Kattampally project was the first major irrigation scheme proposed in northern Kerala designed as a multi-purpose scheme for irrigation, prevention of

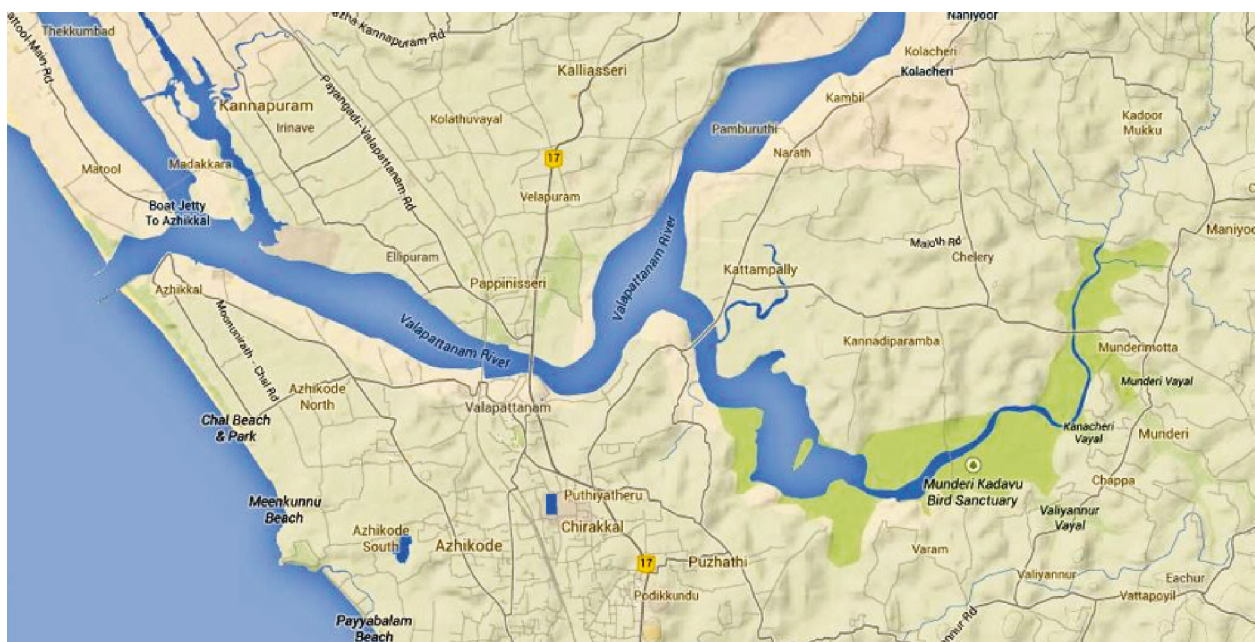


Image 1. Munderikadavu Wetland in Kerala

salt water intrusion, reclamation of paddy land, flood control, navigation and transportation (Leneesh 2011).

In the Budget Proposal of March 2012, the Finance Minister of Kerala announced the Government's intention of declaring the part of the Munderikadavu Wetland, located within the Munderi Grama Panchayath, as a bird sanctuary.

### Surveys

A bird species inventory survey was carried out from January to March (2013), twice a week from 07.30–11.00 hr. and 16.00–18.00 hr. The direct observation method and total count method (Bibby et al. 1998) were used to estimate the abundance of birds in a particular habitat. Birds were surveyed on foot, identified and counted with the help of binoculars (8x45 X Crown) and a field guide (Ali 2003).

Vegetation and habitat were categorized into six types, they are:

1. Upland vegetation: The banks of the wetland which are away from any water source and could never get filled with water even at high tide. The dominant tree species were *Macaranga peltata*, *Peltophorum ferrugineum*, *Ficus racemosa*, *Cocos nucifera*, *Mangifera indica*, *Acacia auriculiformis* with underground herbs such as *Heliotropium indicum*, *Mimosa invisa*, *Mimosa pudica*, *Sida acuta*, *Sida alnifolia* and creepers like - *Ipomoea* sp., *Merremia vitifolia*.

2. Lowland vegetation: The vast marshy area adjoining the water, dominated by grass and sedge species such as *Cymbopogon* sp., *Axonopus compressus*, *Derris trifolata*, *Fimbristylis ferruginea*, *Ischaemum* sp. *Kyllinga nemoralis*, *Cyperus castaneus*, *Cyperus distans* and mangrove species like *Bruguiera cylindrical*. Soil was always moist. Lowland vegetation used to be flooded during the monsoons or when the shutters of the Kattampally dam were opened.

3. Emergent Vegetation: A small islet-like patch of lowland vegetation having submerged soil with erect herbaceous hydrophytes which grow upward above the water surface. Dominant species were *Fuirena umbellata*, *Eleocharis dulcis* and *Eleocharis geniculata*.

4. Paddy fields: Moist and marshy cultivable land, mainly brackish water paddy cultivation (Kaipadu krishi) was practiced here.

5. Open water: Area covered by water having submerged vegetation (dominated by *Hydrilla verticillata*) and with a water depth more than two meters.

6. Aerial: Open area above the wetland, where most aerial foragers like raptors, kingfishers and terns are

seen.

Based on the data obtained the species diversity within each habitat was calculated using the Shannon-Weiner index.

The Shannon-Weiner index of species diversity ( $H'$ ) is given as

$$H' = -\sum [(p_i) \times \ln(p_i)]$$

where

$p_i$  = proportion of total sample represented by species  $i$  (Divide number of individuals of species  $i$  by total number of samples)  
 $S$  = number of species, = species richness

We evaluated habitat similarity and the level of overlap in the species composition by using Pianka's index

$$C_m = 2\sum(p_x p_y) / (\sum p_x^2 + \sum p_y^2)^{1/2}$$

where  $p_i$  is the frequency of occurrence of species  $i$  in the habitat of  $x$  and  $y$  (Pianka 1973). Pianka's index ( $c_m$ ) varies between 0 (total separation) and 1 (total overlap).

### RESULTS

A total of 82 species under 36 families belonging to 13 orders (Table 1) were observed and recorded. The daily bird count varied from 56 to 4652 individual observations. Both diversity and number of species was higher in lowland vegetation (46 species) followed by upland vegetation (41 species) and aerial (38 species). The number of species was low in emergent vegetation (22 species) and paddy fields (21 species) and open water (10 species). Open water had the lowest species richness and diversity with only 10 species which were composed of mainly ducks, cormorants and coots (Fig. 1). Although lowland vegetation had the highest number of species, the diversity was low ( $H'$ -1.71) when compared to upland vegetation ( $H'$ -3.19) and aerial ( $H'$ -2.52). Species area curve for Emergent vegetation, Paddy field and open water were highly stable by the end of the study period, whereas lowland, upland and aerial habitat were less stable due to the presence of migratory birds (Fig. 2).

In Upland vegetation the White-headed Babbler was relatively more abundant (15.93%) than other species like Common Myna (6.86%), Red-whiskered Bulbul (6.64%), Green Bee-Eater (5.53%), White Cheeked Barbet (5.53%), Racket-tailed Drongo (5.31%) and Indian Golden Oriole (4.87%), among 14 species observed (Table 1).

The Purple Moorhen was the most abundant species

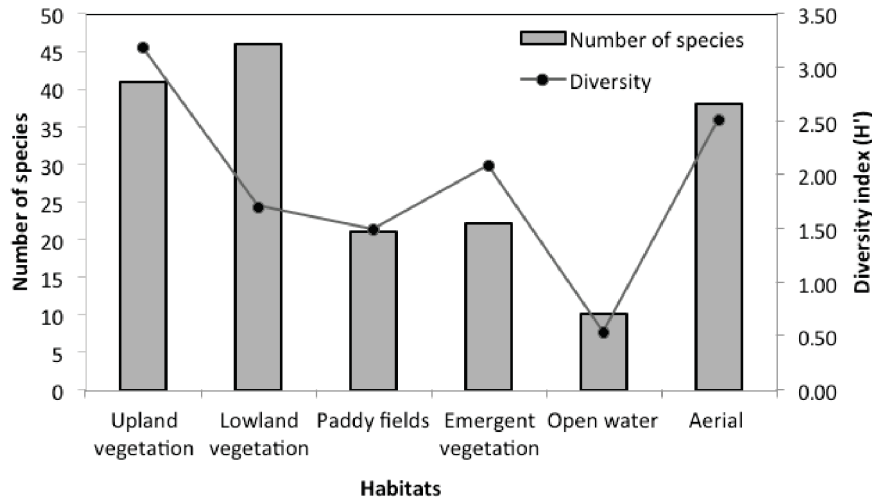


Figure 1. Chart showing Species Richness and Diversity index (Shannon -Weiner) in Munderikadavu wetlands.

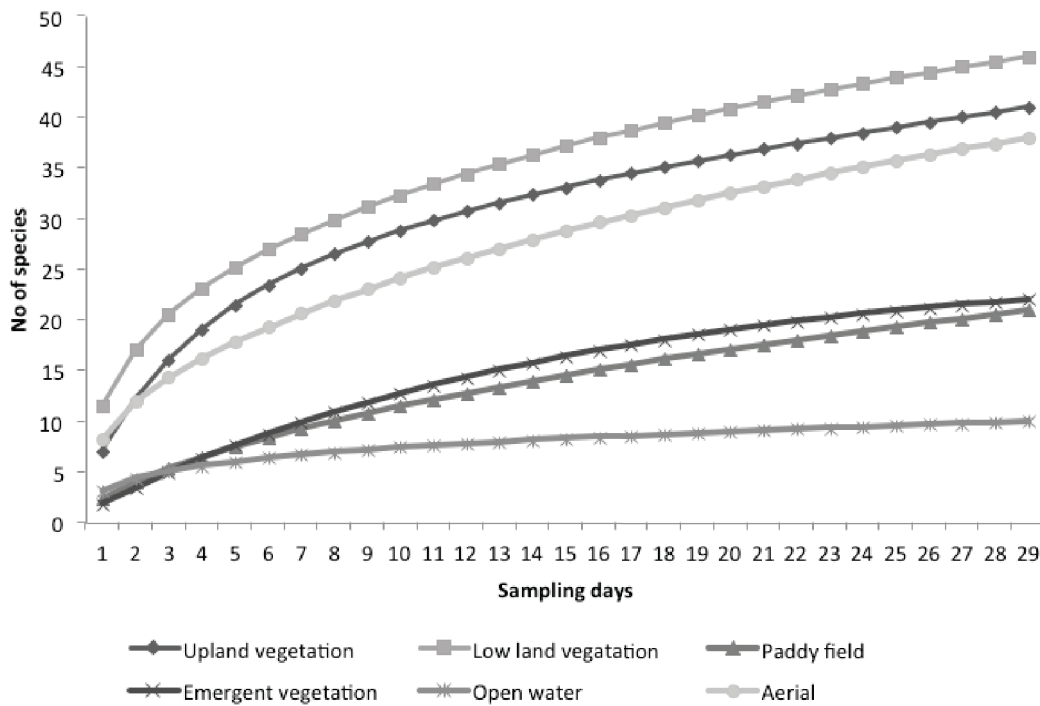


Figure 2. Species - Area curve for different habitats in Munderikadavu wetlands

(58.79%) in lowland vegetation. Among 46 species recorded family Ardeidae—the Large Egret (12.08%), Cattle Egret (4.79%), Little Egret (3.03%), Median Egret (2.84%), and Pond Heron (2.49%)—were more abundant. Migratory duck species the Northern Pintails (3.39%) and divers such as the Little Cormorant (4.09%) were also present.

In paddy fields flooded with water, dabbling ducks such as the Northern Pintail were abundant (53.13%). This migratory duck basically migrating from North

Europe and Central Asia was seen in the greatest numbers (3,800 individuals) on 9 February 2013. Cattle Egret (27.31%), Pond Heron (5.42%), Blue Rock Pigeon (2.13%), Green Bee eater (2.02%), and White-rumped Munia (1.59%) were also sighted in this niche.

The species in emergent vegetation were similar in composition with Low land vegetation. The Large Egret (35.59%) was the highest in abundance in the emergent vegetative type followed by Purple Moorhen (22.64%), Northern Pintail (7.58%), Median Egret (6.18%), Little

Habitat	Aerial	Upland	Lowland	Paddy field	Open water	Emergent
Aerial		0.089	0.217	0.110	0.202	0.127
Upland			0.240	0.229	0.000	0.101
Lowland				<b>0.530</b>	0.248	<b>0.735</b>
Paddy field					0.025	<b>0.276</b>
Open water						0.185
Emergent						

**Figure 3. Habitat overlaps in the species composition (Pianka's index)**

Egret (5.37%), Lesser Whistling Ducks (4.78%), Cattle Egret (4.20%), Common Sandpiper (2.80%) and Little Cormorant (2.68%).

The Northern Pintail was the highest in abundance (88.04%) among the 10 species that were sighted in open water habitat. Lesser Whistling Duck (6.02%), Common Coot (2.54%), Little Cormorant (1.09%), Garganey (0.94%) and Little Grebe (0.83%) were observed to forage in the open water niche.

Among aerial foragers the Whiskered Tern was the most abundant (15.55%). House Swift (10.81%), Black Kite (4.81%), Brahminy Kite (4.18%) and Wire-tailed Swallow (4.18%) were also sighted.

Species overlap (Fig. 3) was more between emergent vegetation and low land vegetation (Cm-0.735) indicating that bird species composition was similar in both vegetative types. Species from the family Ardeidae and Purple Moorhen were common to both vegetation types. Species overlap was moderate between paddy field and lowland vegetation (Cm-0.530).

## DISCUSSION

### Birds as indicators

A Wetland ecosystem supports a variety of bird species like waterfowl, waders, divers, raptors, song birds, flycatchers, etc. This study also revealed that the diversity and abundance of the bird community varied within a wetland according to vegetation type which was in accordance with other studies (Rajpar & Zakaria 2011; Jorgensen & Nauman 1993). The maximum number of species was observed in lowland vegetation followed by upland and emergent vegetation. The high species richness in the lowland vegetation can be attributed to the fact that lowland vegetation acts as a transitional

zone or an ecotone between terrestrial and aquatic habitats and can harbor species that occur in both vegetation types. Lowland vegetation mainly included members of the family Ardeidae and Purple Moorhen which can be considered as indicator species of such vegetation in a wetland.

Lowland and emergent vegetations were found to have the highest habitat overlap in terms of species composition than other types of vegetation. The results also indicate moderate overlap between species in lowland-paddy field and paddy field-emergent vegetation types. This overlap in species composition between habitats may be due to the persistence of moist soil which supports the grassy type of vegetation which dominates all the three vegetation types. The level of similarities and dissimilarities in the plant communities present in the three vegetation types may influence the spatial segregation of bird species and determine the species composition in a wetland ecosystem. Terns, swifts and raptors were the main aerial foragers observed at Munderikadavu. However, during the survey period large flocks of Glossy Ibis (15.55%), Little Cormorant (15.06%) and Northern Pintail (13.81%) were observed flying above water, though they were not aerial foragers they were sighted frequently and thus included in the aerial type. But there was no significant overlap between aerial and lowland vegetation.

Several species of migratory birds were observed in the Munderikadavu wetland. The Northern Pintail that breeds in the northern areas of Eurasia and south to about Poland, Mongolia (Robinson 2002) and north and central Asia are winter migrants in the area. A total of 3800 individuals were spotted during the study period. The Northern Shoveller (7nos) which was first reported from this area in Kannur (Sashikumar 2004) and Gargeny (148) which is known to breed in the Palearctic region (Clements 2007) are also regular winter visitors of Munderikadavu. Common Sandpiper, Common Greenshank, Little Stint, Wood Sandpiper were the other wintering waders (Ali 2003). Local migrants like Glossy Ibis, Oriental White Ibis, Asian Open-billed Stork, and Woolly-necked Stork were also sighted. Black Stork (3) was seen for the first time in this area during March 2013. The Greater Spotted Eagle is a regular winter visitor in this area (Sashikumar 2004). Other wintering raptors were the Osprey and Western Marsh Harrier. During the study period 15 species of migratory birds were observed.

Presence or absence of a particular type of vegetation can cause proportional increase in species that prefer it. The presence of birds species like grebes

**Table 1. Checklist of birds of Munderikadavu wetland and their frequency of occurrence in different vegetations.**

Order and Family	Common name	Scientific name	Frequency					
			UV	LV	PF	EV	OW	AR
<b>Podicepediformes</b>								
Podicipitidae	Little Grebe	<i>Podiceps ruficollis</i>					0.8	
<b>Pelicaniformes</b>								
Phalacrocoracidae	Little Cormorant	<i>Phalacrocorax niger</i>		4.1		2.7	1.1	15.1
	Great Cormorant	<i>Phalacrocorax carbo</i>					0.0	0.1
	Oriental Darter	<i>Anhinga melanogaster</i>		0.0				
<b>Ciconiiformes</b>								
Ardeidae	Little Egret	<i>Egretta garzetta</i>		3.0	0.6	5.4		0.1
	Median Egret	<i>Mesophoyx intermedia</i>		2.8		6.2		
	Large Egret	<i>Casmerodius albus</i>	0.9	12.1	0.9	35.6		
	Cattle Egret	<i>Bubulcus ibis</i>	0.9	4.8	27.3	4.2		1.0
	Indian Pond Heron	<i>Ardeola grayii</i>	2.0	2.5	5.4	1.3		1.3
	Purple Heron	<i>Ardea purpurea</i>		1.0		0.5		1.1
	Grey Heron	<i>Ardea cinerea</i>		0.5	0.1	0.4		
Ciconiidae	Asian Openbill-Stork	<i>Anastomus oscitans</i>		0.0				
	Black Stork	<i>Ciconia nigra</i>						0.2
	Woolly -Necked Stork	<i>Ciconia episcopus</i>		0.1		0.4		0.1
Threskiornithidae	Oriental White Ibis	<i>Threskiornis melanocephalus</i>		0.4	0.4	0.7		0.9
	Glossy Ibis	<i>Plegadis falcinellus</i>	0.9			2.5		15.6
<b>Anseriformes</b>								
Dendrocygnidae	Lesser Whistling- Duck	<i>Dendrocygna javanica</i>				4.8	6.0	
Anatidae	Northern Pintail	<i>Anas acuta</i>		3.9	53.1	7.6	88.0	13.8
	Garganey	<i>Anas querquedula</i>			0.3		0.9	
	Northern Shoveller	<i>Anas clypeata</i>					0.0	
<b>Falconiformes</b>								
Accipitridae	Black Kite	<i>Milvus migrans</i>	0.4					4.8
	Brahminy Kite	<i>Haliastur indicus</i>	0.2	0.0				4.2
	Western Marsh Harrier	<i>Circus aeruginosus</i>						0.1
	Booted Eagle	<i>Hieraetus pennatus</i>						0.3
	Greater Spotted Eagle	<i>Aquila clanga</i>						0.1
Pandionidae	Osprey	<i>Pandion haliaetus</i>						0.1
<b>Gruiformes</b>								
Rallidae	White-Breasted Waterhen	<i>Amaurornis phoenicurus</i>		0.8		0.2		0.2
	Purple Moorhen	<i>Porphyrio porphyrio</i>		58.8	1.1	22.6	0.5	
	Common Moorhen	<i>Gallinula chloropus</i>		0.1				
	Common Coot	<i>Fulica atra</i>				0.6	2.5	
<b>Charadriiformes</b>								
Glariolidae	Small Pranticole	<i>Glareola lacteal</i>		0.0				
Charadriidae	Red-Wattled Lapwing	<i>Vanellus indicus</i>	0.2	0.3				
Scolopacidae	Common Greenshank	<i>Tringa nebularia</i>		0.1		0.2		
	Wood Sandpiper	<i>Tringa glareola</i>		0.1		0.1		
	Common Sandpiper	<i>Actitis hypoleucos</i>		0.3		2.8		
	Little Stint	<i>Calidris minuta</i>		0.0				
Laridae	Whiskered Tern	<i>Chlidonias hybrida</i>						15.6
<b>Columbiformes</b>								
Columbidae	Rock Pigeon	<i>Columba livia</i>	1.3		2.1			0.8
	Spotted Dove	<i>Streptopelia chinensis</i>	1.5					0.1
<b>Psittaciformes</b>								

Order and Family	Common name	Scientific name	Frequency					
			UV	LV	PF	EV	OW	AR
Psittacidae	Rose- Ringed Parakeet	<i>Psittacula krameri</i>			1.4			
<b>Cuculiformes</b>								
Cuculidae	Asian Koel	<i>Eudynamis scolopacea</i>	1.8	0.0				
Centropodidae	Greater Coucal	<i>Centropus sinensis</i>	2.2					
<b>Apodiformes</b>								
Apodidae	House Swift	<i>Apus affinis</i>	0.2	0.0				10.8
<b>Coraciformes</b>								
Alcedinidae	Lesser Pied Kingfisher	<i>Ceryle rudis</i>		0.0			0.0	2.6
	White Breasted Kingfisher	<i>Halcyon smyrnensis</i>		0.3	0.1	0.4		2.0
	Small Blue Kingfisher	<i>Alcedo atthis</i>		0.0				0.1
Meropidae	Blue Tailed Bee- Eater	<i>Merops philippinus</i>	1.1	0.1				
	Small Green Bee-Eater	<i>Merops orientalis</i>	5.5	0.7	2.0			0.1
Megalaimidae	White Cheeked Barbet	<i>Megalaima viridis</i>	5.5	0.2				0.1
<b>Passeriformes</b>								
Hirundinidae	Common Swallow	<i>Hirundo rusica</i>						2.9
	Wire-Tailed Swallow	<i>Hirundo smithii</i>						4.2
	Red-Rumped Swallow	<i>Hirundo daurica</i>						0.3
Artamidae	Ashy Wood Swallow	<i>Artamus fuscus</i>	0.4					0.4
Oriolidae	Black Naped Oriole	<i>Oriolus chinensis</i>	4.6	0.0				0.1
	Eurasian Golden Oriole	<i>Oriolus oriolus</i>	4.9	0.1				0.1
	Black Headed Oriole	<i>Oriolus xanthornus</i>	0.2					
Dicruridae	Greater Racket -Tailed Drongo	<i>Dicrurus paradiseus</i>	5.3					0.1
	Ashy Drongo	<i>Dicrurus leucophaeus</i>	2.2	0.5	0.6	0.9		0.3
	Black Drongo	<i>Dicrurus macrocerus</i>	1.1		0.5			
Sturnidae	Common Myna	<i>Acridotheres tristis</i>	6.9	0.1	0.4			0.2
Corvidae	Indian Treepie	<i>Dendrocitta vagabunda</i>	4.0					
	Jungle Crow	<i>Corvus leucogastra</i>	0.4					
	House Crow	<i>Corvus splendens</i>						0.1
Pycnonotidae	Red Whiskered Bulbul	<i>Pycnonotus jocosus</i>	6.6	0.5	0.5			
	Red Vented Bulbul	<i>Pycnonotus cafer</i>	0.4	0.1				
	Yellow Browed Bulbul	<i>Icthyophaga indus</i>	3.1					
Sylviinae	Indian Great Reed Warbler	<i>Acrocephalus stentoreus</i>	0.4	0.1				
	Greenish Leaf Warbler	<i>Phylloscopus trochiloides</i>	0.4	0.0				
	Common Tailor Bird	<i>Orthotomus sutorius</i>	0.2					
Monarchidae	Asian Paradise Flycatcher	<i>Terpsiphone paradise</i>	1.3					
Muscicapidae	White Headed Babbler	<i>Turdoides affinis</i>	15.9					
	Ashy Prinia	<i>Prinia socialis</i>		0.9				
	Grey Breasted Prinia	<i>Prinia hodgsonii</i>	0.2					
	Oriental Magpie Robin	<i>Copsychus saularis</i>	2.2	0.2	0.5			
Motacillidae	Paddyfield Pipit	<i>Anthus rufulus</i>		0.1	0.6	0.1		
	Large Pied Wagtail	<i>Motacilla maderaspatensis</i>	3.8	0.3	0.2			
Nectariniidae	Purple Rumped Sunbird	<i>Nectarinia zeylonica</i>	2.7	0.0				0.1
	Lotens Sunbird	<i>Nectarinia lotenia</i>	3.1	0.1				
	Purple Sunbird	<i>Nectarinia asiatica</i>	3.8	0.0				
	Pale-Billed Flower Pecker	<i>Dicaeum erythrorhynchos</i>	0.2					
Estrildinae	White Rumped Munia	<i>Lonchura striata</i>			1.6			
	House Sparrow	<i>Passer domesticus</i>	0.7					

UV - Upland Vegetation; LV - Lowland Vegetation; PF - Paddy Fields; EV - Emergent Vegetation; OW - Open Water; AR - Aerial Habitat 0.0 represent single observation

and diving ducks indicate relatively deep water >2m depth (Fredrickson & Taylor 1982; Fredrickson & Reid 1986). Birds are also known to be sensitive to water level changes in wetland areas (Kantrud & Stewart 1984). Species that are likely to be the most sensitive indicators of change in water levels might be those that nest along water edges and feed on mudflats (e.g., shorebirds) and require a particular combination of wetland hydroperiod types in a region (Kantrud & Stewart 1984). In contrast, species that characteristically nest well above the water level might be less directly vulnerable. In the study area, the opening of Kattampally dam (about 5km from Munderikadavu) leads to flooding of the wetland, altering the population and abundance of visiting birds. During floods, small waders such as Sandpipers and Plovers and birds that feed in mudflats were recorded less. Many species of waterfowl and shorebirds, benefit from (or tolerate) reduced ground cover and increased openings in dense stands of vegetation (Keith 1961). Among waterfowl, the Northern Pintail and Northern Shoveler appear to tolerate or benefit from partial removal of cover in surrounding landscapes to a greater degree than do teal, and Gadwall (Stewart & Kantrud 1973). The Munderikadavu wetlands support a high number of Northern Pintail. This high density of Northern Pintail may be due to the reduced ground cover or dense aquatic vegetation.

Many waterfowl are also known to avoid saline wetlands unless freshwater wetlands are located in nearby places (Kantrud & Stewart 1977; Lokemoen & Woodward 1992). Salinity also influences the surrounding vegetation type and prey type in turn altering species composition. Munderikadavu, although a partial saline wetland, is located near the coastline and is susceptible to the inflow of saline brackish water from surrounding areas which further influences the bird community in the area.

Since the study site contains IUCN categorized birds such as 'Near Threatened' Oriental Darter, Oriental White Ibis (Black-headed Ibis), 'Vulnerable' Greater Spotted Eagle, and supporting 15 migratory species with large flocks of waterfowl, the area is a priority site for conservation.

### Threats

The Dumping of remains of chicken from slaughterhouses and water pollution is a major threat in Munderikadavu which have caused an increase in the population of feral dogs, crows and raptors (Kites). Dumping of waste and pollutants can degrade soil quality altering the plant community and eventually the bird

community. The conversion of paddy field (kipadukrishi) into shrimp farms in the lowland areas adjacent to water is another threat to this ecosystem. Our study reveals that the highest species richness within the wetland occurs among lowland vegetation. The mushrooming of shrimp farms in the lowland areas can disturb the bird community in lowland areas. This can cause adverse effect on bird population that rely on these fields. Birds are always considered as problematic in shrimp farms (Roshnath et al. 2014) and the mitigation strategies used by farmers may pose a threat to both resident and migrating species. Filling lands near by wetlands for construction purposes have also increased in this area causing fluctuation in the water levels that directly affect bird population.

### CONCLUSION

Munderikadavu is rich in diverse avifauna and the study indicated that within a wetland ecosystem species composition vary according to vegetation types. This study enhanced the information and knowledge available on the birds of Munderikadavu wetland which is one of the major wetlands in Kannur district supporting large flocks of migratory and resident birds. Lowland habitat is heavily utilized by the avian fauna. Open water was utilized by most of the migrants such as Northern Pintail, Northern Shoveller, Garganey and Common Coot. The Study also revealed that like all other ecosystems, the Munderikadavu wetland is also facing serious environmental issues such as the ones mentioned above, which can only be overcome with the help of local people, stake holders and the Government.

The following measures are suggested to protect Munderikadavu wetland. Proper waste disposal should be practiced with the support and initiation of Panchayath. Land fillings and land alternations should be strictly banned in low lying areas of the wetlands. Should do a rethink from the perspective of conserving birds before turning paddy fields into shrimp farms. Proper awareness among the local people and stakeholders has to be created to protect the ecosystem.

Munderikadavu, a part of Kattampally wetlands, is a priority site for conservation since it holds a considerable population of globally threatened species of birds (Islam & Rahmani 2004). A wetland is considered internationally important if it supports vulnerable, endangered or threatened species and presence of Near Threatened species like the Painted Stork *Mycteria leucocephala*, Black-headed Ibis *Threskiornis melanocephalus*, Oriental



Darter *Anhinga melanogaster* and vulnerable species like Asian Woollyneck Stork *Ciconia episcopus* and Greater Spotted Eagle *Aquila clanga* which signifies the importance of the area. Hence urgent measures are to be taken to protect this wetland as a whole along with the entire Kattampally wetland and it should be declared as a Ramsar site. The whole ecosystem should be conserved otherwise this area will degrade and will lose the density and diversity of the resident and migratory avian fauna that visit Munderikadavu.

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