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COMMUNITY STRUCTURE AND FORAGING GUILDS OF WINTER AVIFAUNA OF AN URBAN, PERENNIAL WETLAND OF WEST BENGAL, INDIA

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Abstract

The present study was conducted to record the abundance and richness of waterbirds wintering at Saheb bandh, Purulia, India with special reference to community structure and foraging guilds. 24 different bird species that belonged to 9 families were recorded from the wetland during the study period (from October, 2017 through February, 2018). A modified point count method was used to measure the abundance of the waterbirds. The wetland was dominated by Lesser whistling duck (Dendrocygna javanica). Based on accessibility and types of resources this physical habitat had been divided into 4 distinct foraging habitats. As many as 11 different foraging techniques which were most prominent were recorded by diurnal ad libitum study of the waterbirds. Based on these two parameters total 9 feeding guilds of waterbirds were identified. Due to growing urbanization, increasing anthropogenic threats and altered land use pattern of the surrounding areas of the habitat, effective foraging and roosting areas of the birds were decreasing sharply. Sustainable and multiprong conservation measures will help the wetland to render its ecosystem services and help the dependent avifauna to flourish.

Keywords*: Waterbirds; Foraging habitat; Foraging technique; Feeding guild; Community structure; Niche breadth*

Introduction

Community structure and dynamics mainly depend on the inter and intra-specific interactions of constituent populations. Habitat attributes and quality play additional roles in structuring communities [1-3]. Accordingly, effective conservation approaches primarily put focus on the profound knowledge of habitat quality and community structures [4]. Waterbirds are no exception in this regard. Their community structures are immensely influenced by the interaction of the constituent species [5, 6] and available resources [7, 8]. However, in recent past the global population of several waterbird species have been noted to face a sharp decline mainly due to anthropogenic interventions and unsustainable urbanization [9-11]. Consequently, there is an urgent need to acquire information regarding the ecology of waterbird communities along with various attributes of their habitats. These are useful in understanding the interactions of waterbirds along with resource partitioning among them.

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Based on resource utilization of the species, the community can be usually divided into distinct species groups and these ecological units are called ‘guilds’ [12]. These are composed of species that use similar resources (food and nutrition) within a defined physical habitat. Studying guilds therefore, can provide important information not only on community structure, but also on interactions determining the community structure and resource partitioning [13, 14]. Again, studying foraging habitat and foraging techniques are imperative to understand resource partitioning. Various studies around the globe focusing on foraging habitat and foraging techniques of waterbirds to understand resource partitioning are on record [8, 15-17].

The present study was undertaken focusing on the community structure and foraging guilds of the wintering avifauna of an urban, perennial wetland of West Bengal, India. Waterbirds use this wetland both as roosting and wintering ground. However, the wetland is facing enormous anthropogenic pressure mainly due to its location amidst the Purulia town. A detailed study of community structure, feeding habitats and feeding techniques of the waterbirds will help in sustainable future management of the wintering birds as well as the wetland.

Experimental

Study area

The present study was conducted at Sahebbandh wetland (23°20'23.10"N, 86°21'37.90"E) of Purulia District which is a part of Chhotanagpur plateau in West Bengal, India. This wetland is roughly rectangular in shape and encompasses an area of 31.3ha with mean depth of 2.5m. Located amidst the heart of the Purulia town this man-made lake is supposed to be maintained by Purulia Municipality. However, during the present study we found untreated municipal sewage water inlet, solid waste dumping in and around the wetland, unregulated anthropogenic activities including boat rides for tourism purposes and rapid physical changes of the surroundings of the wetland through fast urbanization. These activities were identified as the major causes of habitat degradation at this site. Water hyacinth (*Eichhornia crassipes*) and lotus (*Nelumbo nucifera*) were the two main floating vegetation recorded from the present study site (Fig. 1).

Fig. 1. Map of the study site showing the location of Saheb Bandh amidst Purulia town. (Image source: Google Earth)

Methods

Water depth calculation

Water depth of the wetland was calculated using measured ropes from various points of the wetland. Based on these measurements open water area of this wetland was divided into two types: shallow water (0-2m) and deep water (2-10m).

Four types of possible foraging habitats were identified in this study site- (i) shallow open water area (SOWA), (ii) Deep open water area (DOWA), (iii) Hydrophytic vegetation (HV) and (iv) Muddy shoreline (MS).

Bird abundance calculation and Feeding behaviour study

Point transect method was used to record the species richness and diversity [18]. The order of sampling was random; however, each of the 4 sides of the wetland was traversed during each sampling time. Observations were made during 06:00-08:00h, 11:00-13:00h, and 16:00-17:00h twice a month, in the winter season (from October 2017 to February 2018). Birds that were seen flying over the census area (aerial species) were recorded separately. For a more robust estimate of the populations, random hand-frame and binocular-frame counts [19] of birds in 3 selected distance ranges of 30, 50, and 100m were conducted. Standardization of areas of both the hand-frame and binocular-frame by averaging three measurements were done following suitable literature [20]. Such frame-counts encompassed all avian species, either resting on the bank or islands, or wandering on the water surface. Individual counts, taken twice during each month were averaged at 3-time intervals to obtain the representative data of a particular month [21]. Nikon Fieldscope (25–75 x 82 ED) and Olympus (8 X 40) binoculars were used for spotting the character details and foraging techniques of the birds in sight. Standard manual of field identification of birds [22, 23] were followed for avifauna identification and nomenclature. Diurnal ad libitum study was also conducted during each sampling to record details of feeding techniques of the waterbirds.

Statistical Analysis

According to a previous study [24], 30 foraging observations were the minimum number for analysing feeding behaviour. So, waterbird species with minimum 30 foraging behaviour observations were considered. Subsequently, the data were ordered in 2 matrices, following [25]. These were foraging habitat and feeding technique. The calculation of foraging niche breadth (FNB) and niche overlap for each bird species were done according to Levins' formula [26]:

$$B = Y^2/\sum p_j^2 \quad (1)$$

where: Y is the total number of individual birds. p_j is the proportion of observations in each category (j) within a particular niche dimension (i.e., foraging habitat).

Results and discussion

A total 24 species of waterbirds were recorded during the present study which belonged to 8 families. Highest number of species (7) belonged to Anatidae family, followed by Ardeidae family (6) and Rallidae family (4). Jacanidae, Phalacrocoracidae, and Motacillidae family were represented by two species each and a single species belonged to Podicipedidae family (Table 1).

Out of the 24 species 9 species were winter migrant to this part of West Bengal, rest were resident. All the species belonged to Least Concern (LC) category of IUCN red list.

Like several other wetlands of south-western West Bengal, this wetland was also dominated by Lesser whistling duck (*Dendrocygna javanica*). This finding corroborated the findings made by other researchers [27, 28]. Abundance of Gadwall (*Mareca strepera*) and Red-crested pochard (*Netta rufina*), both winter migrants, was also higher in the study site. Higher abundance of species belonging to Rallidae family was also noted. Moorhens and Swamphens showed their preference for lotus swamp and other floating vegetations. Other studies [29, 30] also recorded the common pattern of habitat preference of these birds. Abundance of Pheasant-tailed jacana (*Hydrophasianus chirurgus*) was higher compared to that of Bronze-winged jacana (*Metopidius indicus*). The only member of Podicipedidae family, Little grebe (*Tachybaptus ruficollis*), showed preference for open shallow water areas. Members of Motacillidae family showed their preference for muddy shorelines, which corroborated well with the findings made by other reserchers [31].

Table 1. Monthly average abundance of birds recorded during the study period. Population trends: D - decreasing, I - Increasing, S - Stable, U - Unknown. Migration status: WM - Winter Migratory, R - Resident

Common name and Alpha codes	Scientific name	Monthly average abundance	Population trends	Migration status
Lesser whistling duck [LWDU]	*Dendrocygna javanica*	980±456	D	R
Fulvous whistling duck [FWDU]	*Dendrocygna bicolor*	2±1	D	R
Gadwall [GADW]	*Mareca strepera*	105±57	U	WM
Red-crested pochard [RCPO]	*Netta rufina*	98±34	U	WM
Northern pintail [NOPI]	*Anas acuta*	45±12	D	WM
Northern shoveler [NOSH]	*Spatula clypeata*	4±1	D	WM
Cotton pygmy goose [CPGO]	*Nettapus coromandelianus*	44±7	S	R
Eurasian coot [EUCO]	*Fulica atra*	111±23	D	R
Common moorhen [COMO]	*Gallinula chloropus*	87±45	-	R
Purple Swamphen [PUSW]	*Porphyrio porphyrio*	42±8	U	R
White- breasted water hen [WBWH]	*Amaurornis phoenicurus*	23±4	U	R
Bronze-winged jacana [BWJA]	*Metopidius indicus*	14±7	U	R
Pheasant tailed jacana [PTJA]	*Hydrophasianus chirurgus*	37±33	D	R
Little cormorant [LICO]	*Phalacrocorax niger*	14±7	-	R
Indian cormorant [INCO]	*Phalacrocorax fuscicollis*	11±2	U	WM
White wagtail [WHWA]	*Motacilla alba*	1±1	S	WM
Citrine wagtail [CIWA]	*Motacilla citreola*	4±1	S	WM
Black bittern [BLBI]	*Ixobrychus flavicollis*	2±1	D	WM
Indian pond heron [IPHE]	*Ardeola grayii*	14±9	U	R
Black-crowned night heron [BCNH]	*Nycticorax nycticorax*	21±12	D	R
Purple heron [PUHE]	*Ardea purpurea*	1±1	D	WM
Little egret [LIEG]	*Egretta garzetta*	23±17	I	R
Cattle egret [CAEG]	*Bubulcus ibis*	14±4	I	R
Little grebe [LIGR]	*Tachybaptus ruficollis*	42±33	D	R

During ad libitum study 11 prominent and different types of feeding behaviours were identified for the waterbirds. In previous studies [16, 17] similar kind of feeding behaviours in water birds were also observed. Feeding behaviours that were recorded during the present study were diving [DI] (birds dive into shallow or deep water in searching of food), upending [UP] (bird's body partially submerged while the tail pointed upwards), filtering [FI] (beak placed in the plane of water surface to strain food items), probing [PR] (exploring or searching food resources), picking [PI] (picking food items from muddy shorelines and hydrophytic vegetations), striking [ST] (usually birds with long beak use striking as feeding technique), pecking [PE] (strike its prey with beak), grazing [GR] (herbivores birds use this technique in

vegetation zones), head-dipping [HD] (feed by dipping the head), beak-dipping [BD] (feed by dipping the beak) and neck-dipping [ND] (feeding by dipping the neck).

Based on these 11 feeding techniques and 4 suitable foraging habitats, feeding guilds of the species were constructed (Table 2, Fig. 2).

Table 2. Based on the foraging habitats and feeding techniques nine main feeding guilds was prepared. Shallow open water area (SOWA), Deep open water area (DOWA), Hydrophytic vegetation (HV) and Muddy shoreline (MS)

Foraging habitat	Feeding technique	Feeding guild	Example
SOWA	Diving	Shallow water divers	Little grebe, Little cormorant, Indian cormorant.
	Dabbling (upending, filtering), Head-neck-beak dipping	Shallow water generalists	Cotton pygmy goose
DOWA	Diving	Deep water divers	Red-crested pochard, Eurasian coot.
	Upending	Deep water upenders	Gadwall, Northern pintail
	Filtering, Head-neck-beak dipping	Deep water generalists	Northern shoveler.
HV	Striking	Striking	Purple heron, Cattle egret, Little egret, Black bittern, Black-crowned night heron, Indian pond heron.
	Grazing	Grazers	Lesser whistling duck
	Picking and Pecking	Hydrophytic generalists	Common moorhen, Purple swamphen, Bronze-winged jacana, Pheasant-tailed jacana, White-breasted waterhen.
MS	Picking	Mud pickers	White wagtail, Citrine wagtail

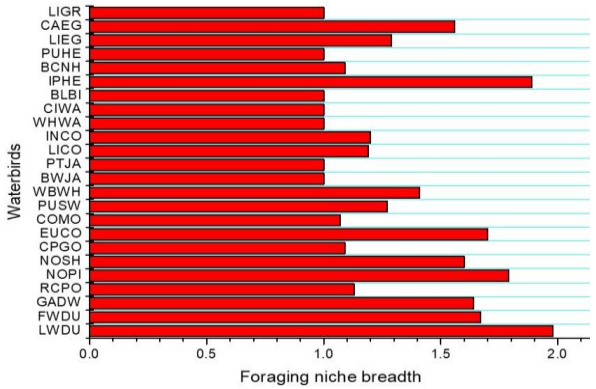

Fig. 2. Comperative account of foraging niche breadth of different waterbirds found during the present study

Waterbirds used several arrays of foraging habitats and techniques in different times of day according to their physiological need [32]. So, these feeding guild structure only represented the community structure and habitat use patterns of the birds during active foraging period. However, some birds, like Lesser whistling duck (*Dendrocygna javanica*) and Fulvous whistling duck (*Dendrocygna bicolor*) were mostly nocturnal feeders [33]. Thus, by diurnal ad libitum behavioural study their primary feeding techniques and preferable foraging habitats could not be entirely depicted. Most species used the HV as their roosting and feeding ground.

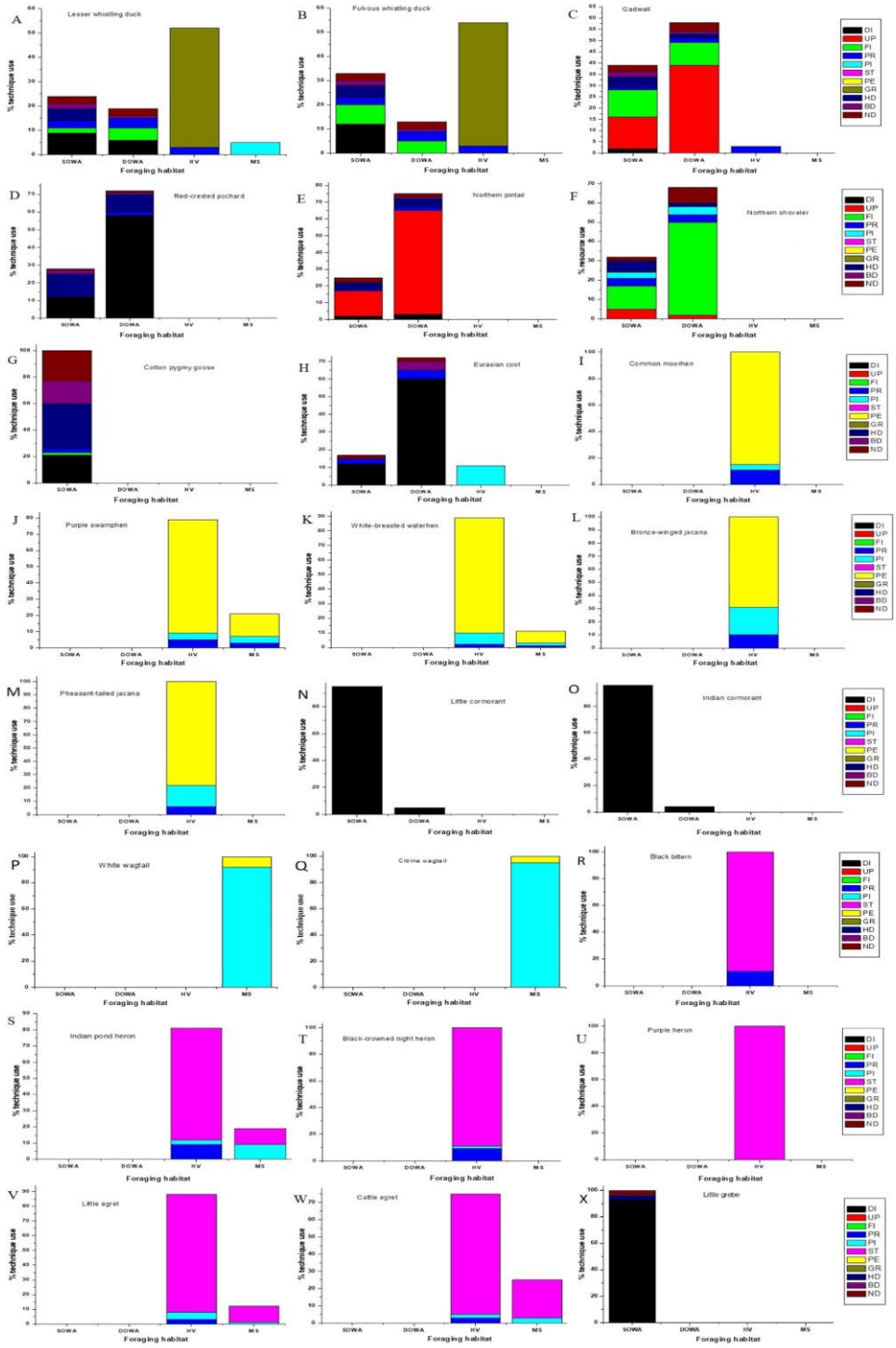

Fig. 3. Niche breadth of the study: **A** - Lesser whistling duck; **B** - Fulvous whistling duck; **C** - Gadwall; **D** - Red-crested pochard; **E** - Northern pintail; **F** - Northern shoveler; **G** - Cotton pygmy goose; **H** - Eurasian coot; **I** - **c**ommon moorhen; **J** - Purple swamphen; **K** - White-breasted waterhen; **L** - Bronze-winged jacana; **M** - Pheasant-tailed jacana; **N** - Little cormorant; **O** - Indian cormorant; **P** - White wagtail; **Q** - Citrine wagtail; **R** - Black bittern; **S** - Indian pond heron; **T** - Black-crowned night heron; **U** - Purple heron; **V** - Little egret; **W** - Cattle egret; **X** - Little grebe

Most species of Anatidae family used both SOWA and DOWA as their feeding habitat. Northern pintail (*Anas acuta*), predominantly a deep water upender also used other feeding techniques like filtering and head-dipping frequently. Wagtails were solely restricted to the MS during the present study. Members of the Rallidae and Ardeidae family were predominantly associated with the HV. Indian pond heron (*Ardeola grayii*), a species of Ardeidae family, also showed significant preference for MS.

The present study revealed substantial dependence of waterbirds on landmass adjoining vegetation areas and shorelines. Niche breadth of the waterbirds varied widely among the different species (Fig. 3A – X).

Highest niche breadth was observed for Lesser whistling duck (*Dendrocygna javanica*) followed by Indian pond heron (*Ardeola grayii*) and Northern pintail (*Anas acuta*). Lesser whistling duck (*Dendrocygna javanica*) was the most abundant species also showed highest niche breadth. Several bird species showed specialized nature of resource utilization. A wide niche breadth indicated towards a generalized feeding nature of the birds, while, a narrow niche breadth specified a specialized nature [34]. Waterbirds, that predominately used diving as their primary feeding technique, mostly had narrower niche breadths. Abundance of specialized species was lower compared to the generalized species.

Species using HV and MS mostly showed specialized nature of resource utilization. So, these species would be more vulnerable to change in habitat quality. In a previous study birds associated with shoreline and landmass adjoining water vegetation have been found more prone to disturbance due to high anthropogenic pressure and recreational use [35]. Rapid urbanization and altered land use pattern of surrounding areas in Purulia Sahebbandh might be two major reasons behind rapid declination of bird population in this urban wetland. Moreover, reduction of foraging habitat can lead to greater competition for limited resources thus a lower population size and per-capita birth rate and this has been already reported in studies made by other reserchers [36].

Conclusions

Globally, freshwater wetlands are facing enormous pressure mainly due to anthropogenic intervention and rapid urbanization.

Though the present wetland is located inside a town and facing various threats, still it harbours a decent number of waterbird population throughout the year.

However, due to decrease in effective foraging microhabitat, inter and intraspecific competition is increasing gradually which might be accounted for the decrease in avian populations.

A detailed future study on resource quantification and bi-dimensional feeding guilds will help in future conservation of the waterbirds.

Awareness among local people and stringent conservation measures by local and state government will help in sustainable management of the wetland.

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