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Habitat Utilization and Feeding Pattern of Avifauna in Goalpara College Campus, Goalpara, Assam, India

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ABSTRACT

A study on habitat utilization and feeding pattern of avian diversity was carried out in Goalpara College campus of Goalpara District, Assam. A total of 44 species of birds belonging to 30 families were recorded and studied. Based on food type eaten, the birds were categorized into seven categories. Variation in number of species based on food type was tested and variation was found insignificant (P=2.22). However, insectivorous category was found to be dominating over other categories. The habitat selection of avian fauna of the campus was also analyzed, and the habitat type H-1 was found to be species rich (38.6%, 17 species) and H-4 type as species-poor habitat (13.6%, 6 species). The order of habitats in terms of species richness is H-1(38.6%, 17 species) > H-3 (27.3%, 12 species) > H-2 (20.5%, 9 species) > H-4 (13.6%, 6 species). The Shannon index for the recorded species showed highest diversity in the habitat type H-1 (*H*'=1.053) and least diversity in habitat type H-4 (*H*'=0.577). The study indicates that the college campus provide a suitable habitat for the birds species providing food materials, water, shelters, roosting, and nesting sites. Since birds play a vital role in the ecosystem as pollinators, seed dispersers and help in regeneration of flowering plants and thereby reforestation, therefore an attempt has been made to determine the avian diversity of the college campus with special reference to their habitat utilization and feeding pattern. This study highlights the role of modified habitats to maintain the urban biodiversity. This study will provide base line information on avifauna of Goalpara town which could be useful for management of their habitats.

Keywords Diet, Habitat, Least concerned, IUCN, Passeriformes, Ardeidae, Cuculidae.

INTRODUCTION

Natural habitats are key centers for inhabitation and rehabilitation of biological diversity. The remnants of natural habitat created due to urbanization however may be viable alternate for promoting biodiversity (Alvey 2006, Gallo *et al.* 2017). Urban forests are important social ecological indicators of human health and well being, and ecosystem benefits. The urban landscapes carry inherent value of biodiversity conservation and tangible societal benefits (Sjoman *et al.* 2016). Diversity of tree population in urban forest play a key role for maintaining faunal diversity and creating opportunity for local communities to make a greater connection with nature (Livesly *et al.* 2016).

Birds and arboreal fauna are major occupants of

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trees for various purposes and are key indicators of habitat health and biodiversity. Rampant change in forest types due to large scale anthropogenic activities leading to loss of biodiversity is a global phenomenon. Small patches of forest has been created due to faster urbanization which has developed a mosaic of habitat that also serves as valuable center for dispersal of certain species (Opdam *et al.* 2003, Fernández and Simonetti 2013). Urban and semi-urban green forest patches often serves as surrogate and refuge habitat, dispersal and movement corridors for birds and many small to medium- sized mammals. Competition and availability of food are other influential factors for species distribution in a fragmented habitat (Purvis *et al.* 2000). The role of degraded forest landscapes and patches within the campus of academic institutions as potential habitat for small mammals and birds has also been acknowledged in some studies (Vallejo *et al.* 2008, Voon *et al.* 2014, Nerlekar *et al.* 2016, Sailo *et al.* 2019, Gouda *et al.* 2020).

Species diversity is an indicator of stable and sustainable ecosystem (Edison *et al.* 2016). But in present time avian diversity has been decreasing due to habitat degradation and destruction as a result of various human activities. The State of India's Birds, 2020 highlights that Indian avian diversity has suffered a long-term decline over the last 25 years (SoIB 2020). Since the avian diversity is very important to maintain the overall health of an ecosystem, therefore its conservation is an important objective not only in protected areas and other natural habitats but also in areas where human activities are intensive. Recent finding reveals that semi-urban areas and campuses of educational institutions can be the rich sources of biodiversity (Singh 2011). Therefore, an attempt has been made to document the avian diversity of the Goalpara College Campus along with their habitat utilization and feeding pattern. The college is situated in the state of Assam, the part of the Eastern Himalayan biodiversity hotspot region, has a rich heritage of avian biodiversity and is one of the 'Endemic Bird Areas' in the world. The college campus provides micro habitats for a large number of bird species. This study will provide baseline information on avian diversity of semi-urban areas of Goalpara town in general and of the College campus in particular which could be helpful for management of such habitats.

MATERIALS AND METHODS

Study area : The Goalpara College Campus is a 68 year old institute situated at the heart of the district headquarters of Goalpara town in state of Assam (Fig. 1). The geographical location is between 26.170223 N latitude and 90.626617E longitude and elevation of 41 meters above sea level. The campus covers an area of around 35.28 acres. The vegetation of the district falls under tropical mixed deciduous forest type. The college campus is mainly planted with some native tree species like *Neolamarckia cadamba, Tamarindus indica, Bischofia javanica, Dalbergia sissoo*, *Ficus rumphii, Syzygium cumini*. The climate of the study area is warm and temperate. The average annual temperature is 24.2°C. The warmest month of the year is August, with an average temperature of 28°C and January is the coldest month of the year (12.7ºC). The annual rainfall is 3805 mm. The driest month is December, with 9 mm rainfall and the wettest month is June with an average rainfall of 771 mm (Fig. 2).

The avian diversity profile, their habitat and feeding pattern was studied for a period of 12 months from January 2019 to December 2019. Direct observation method was employed for recording the species of birds. The college campus was walked several times during the study period. While walking, the species encountered were recorded and their habitat preference and feeding pattern was studied. The bird species were observed with field binoculars from 0530 h to 0830 h in the morning and from 1530 h to 1730 h in the evening when the birds are most active. In addition to the fixed walking hours, opportunistic sightings of the birds were also recorded. As soon as a bird was observed photograph was taken and the local name is recorded in the field record book immediately. An Olympus (8×40) binocular was used for observing the birds located in far distance and a Nikon digital camera model Coolpix 5x wide zoom, 16.1 Mega-pixels, 4.6–23.0 mm, was used to take photographs of the birds. The bird species were identified with the help of 'A pictorial guide to the Birds of Indian sub-continent' (Ali and Ripley 1995) and 'Birds of the Indian subcontinent' (Grimmett *et al.* 2014) and other local references material.The recorded species were divided into seven categories based on their diet and feeding habits as insectivorous, carnivorous, om-

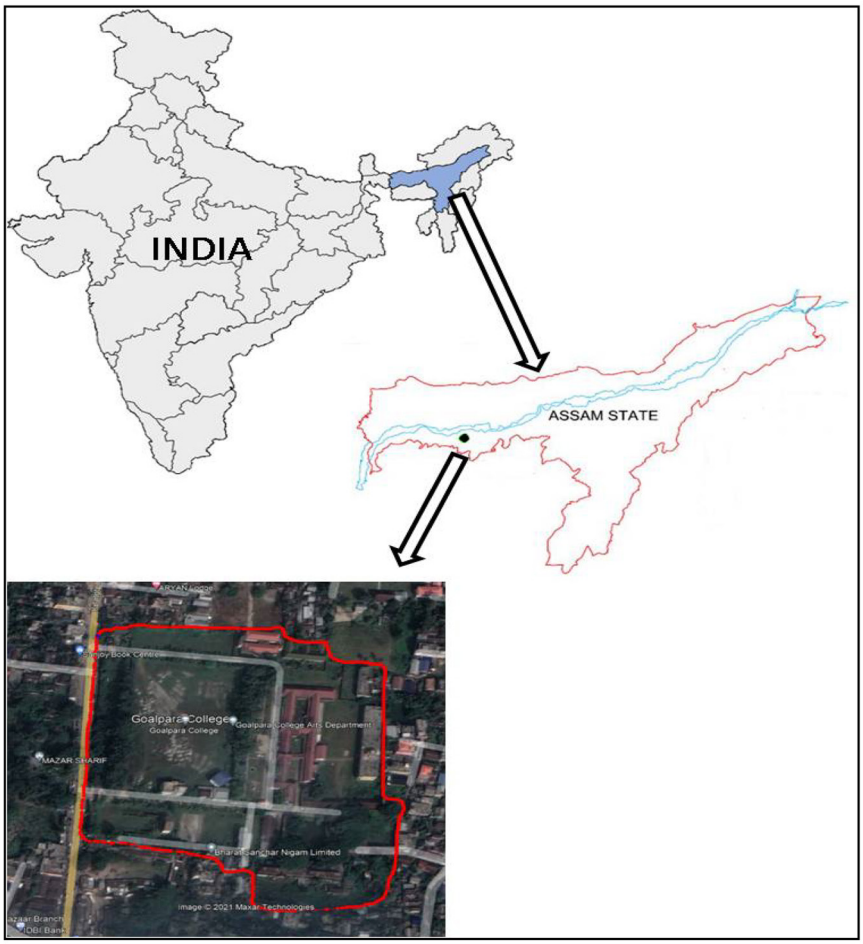

Fig. 1. Map of the study area.

nivorous, granivorous, frugivorous, piscivorous, and nectarivorous (DeGraaf *et al.* 1985, Gray *et al.* 2007). Variation in the number of categories based on diet

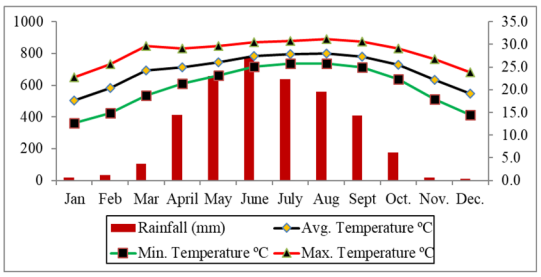

Fig. 2. Climate data of Goalpara district, 2019 (https://en.climate-data.org/asia/india/assam/goalpara).

were tested using two way ANOVA (Simpson *et al.* 1960). The birds observed in the college campus were further categorized based on their habitat preference and occurrences into four habitat types namely H-1 (Tall trees, plantation, well wooded areas, scattered trees), H-2 (Pond, marshy area, ditch), H-3 (Gardens, bushes, thickets, light scrub) and H-4 (Lawn, roof top, field, grassland). Biodiversity indices were calculated for Shannon index (H'), Eveness index (J'), Berger-Parker index (d), Simpson index (D) and Margaleff index (M) (Magurran 2004).

RESULTS

A total of 44 species of birds belonging to 30 families under 13 orders were recorded during the study

Table 1. List of bird species recorded in Goalpara college campus.

Common name	Scientific name	Order	Family	IUCN status	Feeding habit	Habitat Type
Black Kite	*Milvus migrans*	Accipitriformes	Accipitridae	LC	Carnivorous	H-1
Crested Serpent eagle	*Spilornischeela*	Accipitriformes	Accipitridae	LC	Carnivorous	H-1
Asian open bill	*Anastomusoscitans*	Ciconiiformes	Ciconiidae	LC	Carnivorous	H-2
Rock pigeon	*Columba livia*	Columbiformes	Columbidae	LC	Granivorous	H-4
Spotted dove	*Spilopelia chinensis*	Columbiformes	Columbidae	LC	Granivorous	H-4
Common kingfisher	*Alcedoatthis*	Coraciiformes	Alcedinidae	LC	Piscivorous	H-2
Indian Roller	*Coracias benghalensis*	Coraciiformes	Coraciidae	LC	Insectivorous	H-1
White-throated kingfisher	*Halcyon smyrnensis*	Coraciiformes	Alcedinidae	LC	Carnivorous	H-2
Chesnut headed Bee-eater	*Meropsleschenaulti*	Coraciiformes	Meropidae	LC	Insectivorous	H-1
Green Bee-eater	*Meropsorientalis*	Coraciiformes	Meropidae	LC	Insectivorous	H-3
Asian Koel	*Eudynamysscolopaceus*	Cuculiformes	Cuculidae	LC	Frugivorous	H-1
Common Hawk-cuckoo	*Hierococcyxvarius*	Cuculiformes	Cuculidae	LC	Insectivorous	H-1
Southern Coucal	*Centropusparroti*	Cuculiformes	Cuculidae	LC	Carnivorous	H-3
White breasted water hen	*Amaurornisphoenicurus*	Gruiformes	Rallidae	LC	Omnivorous	H-2
Black drongo	*Dicrurusmacrocercus*	Passeriformes	Dicruridae	LC	Insectivorous	H-1
Black hooded Oriole	*Oriolusxanthornus*	Passeriformes	Oriolidae	LC	Insectivorous	H-1
Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	LC	Omnivorous	H-4
Common Tailor Bird	*Orthotomussutorious*	Passeriformes	Cisticotidae	LC	Insectivorous	H-3
Great tit	*Parus major*	Passeriformes	Paridae	LC	Insectivorous	H-1
House crow	*Corvus splendens*	Passeriformes	Corvidae	LC	Omnivorous	H-1
Rufous treepie	*Dendrocittavagabunda*	Passeriformes	Corvidae	LC	Omnivorous	H-1
Jungle babbler	*Turdoides striata*	Passeriformes	Leiothrichidae	LC	Omnivorous	H-3
Long tailed Shrike	*Laniusschach*	Passeriformes	Laniidae	LC	Carnivorous	H-3
Long-tailed minivet	*Pericrocotusethologus*	Passeriformes	Campephagidae	LC	Insectivorous	H-1
Oriental Magpie Robin	*Copsychussaularis*	Passeriformes	Muscicapidae	LC	Insectivorous	H-3
Asian pied starling	*Gracupica contra*	Passeriformes	Sturnidae	LC	Omnivorous	H-4
Purple rumped sunbird	*Leptocomazeylonica*	Passeriformes	Nectariniidae	LC	Nectarivorous	H-3
Purple sunbird	*Cinnyris asiaticus*	Passeriformes	Nectariniidae	LC	Nectarivorous	H-3
Red vented Bulbul	*Pycnonotuscafer*	Passeriformes	Pycnonotidae	LC	Omnivorous	H-3
Scaly breasted munia	*Lonchurapunctulata*	Passeriformes	Estrildidae	LC	Granivorous	H-3
House Sparrow	*Passer domesticus*	Passeriformes	Passeridae	LC	Granivorous	H-4
White wagtail	*Motacilla alba*	Passeriformes	Motacillidae	LC	Insectivorous	H-2
White-rumped Munia	*Lonchura striata*	Passeriformes	Estrildidae	LC	Granivorous	H-3
Cattle egret	*Bubulcus ibis*	Pelecaniformes	Ardeidae	LC	Insectivorous	H-2
Great egret	*Ardea alba*	Pelecaniformes	Ardeidae	LC	Carnivorous	H-2
Indian Pond Heron	*Ardeolagrayii*	Pelecaniformes	Ardeidae	LC	Carnivorous	H-2
Black rumpedflameback	*Dinopiumbenghalense*	Piciformes	Picidae	LC	Insectivorous	H-1
Blue throated Barbet	*Psilopogon asiaticus*	Piciformes	Megalaimidae	LC	Insectivorous	H-1
Copper smith Barbet	*Psilopogonhaemacephalus*	Piciformes	Megalaimidae	LC	Frugivorous	H-1
Fulvous-breasted Woodpecker	*Dendrocoposmacei*	Piciformes	Picidae	LC	Insectivorous	H-1
Rose-ringed Parakeet	*Psittaculakrameri*	Psittaciformes	Psittaculidae	LC	Frugivorous	H-1
Spotted owlet-	*Athene brama*	Strigiformes	Strigidae	LC	Insectivorous.	H-3
Little cormorant	*Phalacrocorax niger*	Suliformes	Phalacrocoracidae	LC	Piscivorous	H-2
Eurassian Hoopoe	*Upupa epops*	Upupiformes	Upupidae	LC	Insectivorous	H-4

period (Table 1). All the species recorded are listed as Least Concerned (LC) category as per the IUCN red list 2019. The Ardeidae and Cuculidae were the most dominant family with 3 species each followed by Accipitridae, Alcedinidae, Columbidae, Corvidae, Estrildidae, Megalaimidae, Meropidae, Nectariniidae, Picidae and Sturnidae with 2 species each and 18 families were limited to one species only. The order Passeriformes had the highest number of species (19 species) followed by Coraciiformes (5 species)

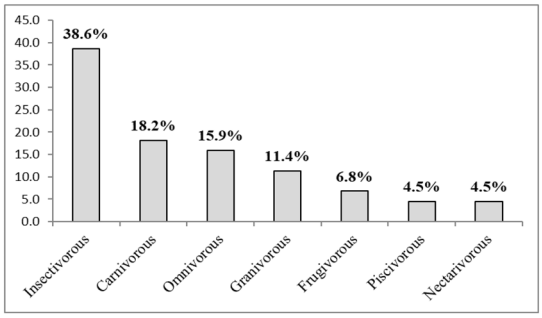

Fig. 3. Feeding habits of the birds recorded in Goalpara college campus.

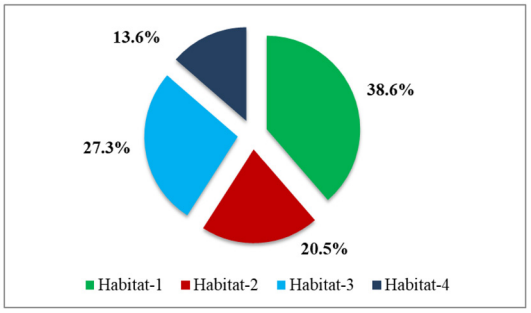

Fig. 4. Habitat preference of the birds in the study area.

and Piciformes (4 species). Based on feeding habits, birds were categorized in to seven categories namely, insectivorous, carnivorous, omnivorous, granivorous, frugivorous, piscivorous and nectarivorous. The insectivorous species were highest in number (38.6%, 17 species) followed by carnivorous (18.2%, 8 species), omnivorous (15.9%, 7 species), granivorous (11.4%, 5 species) and frugivorous (6.8%, 3 species). The lowest number of species based on feeding habits were the piscivorous and nectarivorous with only two species each (4.5%) (Fig. 3, Table 2). Feeding habit-based bird categories were tested for variation in number of species and variation was found insignificant (P=2.22). However, insectivorous category was found to be dominating over other categories.

Among the habitats, the habitat type H-1 was found to be species rich (38.6%, 17 species) and H-4 type as species-poor habitat (13.6%, 6 species). The order of habitats in terms of species richness is H-1(38.6%, 17 species) > H-3 (27.3%, 12 species) > H-2 (20.5%, 9 species) > H-4 (13.6%, 6 species)

Table 2. Number of species in terms of feeding habits and habitat preference.

Feeding habits	Habitat type				No. of species
	H-1	H-2	H-3	H-4	
Insectivorous	10	2	4	1	**17**
Carnivorous	2	4	2	0	**8**
Omnivorous	2	1	2	2	**7**
Granivorous	0	0	2	3	**5**
Frugivorous	3	0	0	0	**3**
Piscivorous	0	2	0	0	**2**
Nectarivorous	0	0	2	0	**2**
No. of species	17	9	12	6	**44**

(Fig. 4, Table 2). The Shannon index for the recorded species showed highest diversity in the habitat type H-1 (*H'*=1.053) and least diversity in habitat type H-4 (*H'*=0.577) (Table 3). Among the orders Passeriformes was found to be dominant in H-3 (9 species) as well as in H-1 (6 species). The data indicates that tree dominated habitat was highly preferred over other habitat types. The present study reveals that the college campus supports highest insectivorous species of birds besides providing food and habitat to diverse avifaunal species. The Species Evenness index (J) ranged from 0.979 (H-3) to 0.936 (H-2). The calculated value of Berger - Parker index (d) ranged from 0.118 (H-1) to 0.333 (H-2 and H-4). The Simpson index (D) showed highest diversity in H-4 (0.133) and lowest diversity in H-3 (0.03). Margalef Richness index (M) showed highest value (37.268) in H-4 and lowest value in H-1 (23.569).

DISCUSSION

Birds have been studied for diversity pattern at global scale (Hawkins and Porter 2001, McCain 2009, Olson *et al.* 2009, Voskamp *et al.* 2017, Somveille *et al.* 2018) as well as local spatial scales (Ruggiero and

Table 3. Comparison of diversity index for different habitats.

Habitat	Shannon index (H')	Evenness index (J')	Berger-parker index (d)	Simpsons index (D)	Margaleff index (M)
H-1	1.053	0.976	0.118	0.037	23.569
H-2	0.728	0.936	0.333	0.111	30.391
H-3	0.979	0.979	0.167	0.03	26.872
H-4	0.577	0.959	0.333	0.133	37.268

Hawkins 2008, Wu *et al.* 2013, Katuwal *et al.* 2016, Pan *et al.* 2016). The avian diversity is correlated with different environmental variables in different parts of the world (Basnet *et al.* 2016, Voskamp *et al.* 2017). Therefore, there is no single general pattern of avian species richness along geographical gradients at different areas. Several factors like land area, geometric constraints, climate, food availability, productivity, evolutionary history, habitat structure and human-induced disturbances play important role in elevational diversity patterns (Colwell *et al.* 2004, Koh *et al.* 2006, McCain 2004 2009, Sanders and Rahbek 2012, Price *et al.* 2014, Hu *et al.* 2017). The larger area harbors more species because of higher habitat heterogeneity and lower extinction rates (Hawkins and Porter 2001). Nevertheless seasonality has been explained as one of the major factors affecting the avian diversity and dynamics in several ecoregions (Gavashelishvili and McGrady 2006). Seasonal changes in abiotic (e.g. temperatures, precipitation) and biotic (e.g. food resources, species interactions) conditions that decides the distribution pattern in birds.

Birds are an essential part of nature and are used to assess the ecosystem quality (Ridley *et al.* 1984). They play significant roles in the ecosystem as pollinators, seed dispersers, scavengers and in pest control. Therefore, for the proper functioning of ecosystems, conservation of avifauna is highly essential. But they are facing severe threat due to human activities such as habitat loss and damage to ecosystems, agricultural and industrial activities and issues like pesticide poisoning and effluent discharges, urbanization and to some extent, hunting and pet trade. Therefore, their conservation has become top most priority not only in protected areas (PAs) and other natural habitats but also in the small isolated pockets like the campuses of educational institutions which provide significant habitats to the avifaunal diversity. In the state of Assam there are large numbers of educational institutions with varying areas and most of the institutions have natural vegetations and plantations. However, documentation of avifauna in these institutions are not given importance as compared to the protected areas and reserved forests.

The present study reflects the habitat diversity of Goalpara college campus which indicates the importance of educational institutions in the conservation of biodiversity in general and birds in particular. The natural or man-made ecosystems of the institutional campuses support plethora of feeding guilds and habitats for variety of avian species. In this study, 44 species were recorded which indicates that the campus harbours a significant variety of avifaunal resources. These numbers may increase further if more extensive studies are conducted. This study is first of its kind and provides baseline information on the diversity of birds species, their habitat utilization and feeding pattern in the college campus which could be helpful for management of their habitats.

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