

A COMPREHENSIVE SURVEY OF AVIFAUNAL DIVERSITY OF CENTRAL UNIVERSITY OF ODISHA

Abstract:

This paper is a comprehensive survey of avian diversity in the Central University of Odisha, situated in the Sunabeda of the Koraput district and epitomizes different ecosystems over 450 acres. The survey was conducted over a period of 12 months from September 2023 to August 2024, dealing with species of birds, seasonal population dynamics, and habitat associations across this ecologically important region. Observations were conducted at peak bird activity hours on grasslands, forests, agricultural land, and water bodies with the observations recorded systematically. A total of 117 species of birds were recorded comprising 16 orders and 51 families, with Passeriformes having the highest number of species richness, reflecting that perching birds are well adapted to all kinds of habitats. Some of the notable families were Muscicapidae and Corvidae, which obviously accounted for a major influence on ecosystem functions in the area of study. The study represented various feeding guilds among the avian species. More species were insectivorous, followed by omnivorous and granivorous. Patterns in habitat preferences also emerged, where grasslands and agricultural lands provided a high number of species, reflecting their suitability as foraging and nesting grounds. Piscivorous species were mainly confined to water bodies while forest habitats supported all sorts of specialized feeding behaviours. The results of this survey will fill base data for the development of conservation strategies that lie in consonance with the ecological needs of avian populations in the Sunabeda region and thus will contribute towards regional as well as national avian conservation efforts.

Comment [1]: It would be nice to succinctly state the hour

Keywords:

Avian diversity, species richness, habitat preferences, bird conservation, habitat heterogeneity, habitat distribution

Introduction:

Birds belong to the class Aves, and by any measure, these birds represent some of the most ecologically important and visually diverse organisms on Earth. Its diversity encompasses approximately 10,000 species that range across nearly every habitat on Earth—from coastal wetlands and arid deserts to the lush forests and the Polar Regions (BirdLife International, 2021). This global diversity therefore represents different adaptations like birds' ability to fly, highly elevated metabolic rates, and specialized feeding mechanisms that have enabled them to occupy distinct ecological niches. However, the past few decades saw bird populations in almost all parts of the globe experience increased human impacts that are now causing declines in their populations along with range contractions in many species (Rosenberg et al., 2019). According to the International Union for Conservation of Nature, about 13% of all species of birds are currently facing the threat of extinction. Habitat destruction, climate change, invasive species, and pollution are the major causes, IUCN, 2021.

India alone is home to nearly 1,300 species of birds, making it one of the top countries with 13% of the world's avifaunal diversity. From the Himalayas in the north to the coastal ecosystems in the south, mountains within this country provide varied land-scapes, harboring a variety of habitats that support endemic, migratory, and resident bird species (Chettri et al., 2018; Sohil & Sharma, 2020, and Acharya et al., 2011). This diversity is an integral source of national pride and ecological value, but Indian bird populations have undergone significant pressure with nearly 100 species categorized in the endangered or vulnerable list of the IUCN (BirdLife International, 2021). Some of the primary threats to India's avifauna include habitat fragmentation, agricultural expansion, urbanization, pollution, and climate change. The Ministry of Environment, Forest and Climate Change has instituted several bird conservation initiatives in India, but the latter depend on strong baseline data and ongoing monitoring efforts (Bird Count India, 2021).

Odisha is a coastal Indian state located on the eastern seaboard and covers a wide range of ecosystems, from coastal wetlands to mangroves, forests, and agricultural landscapes, collectively supporting a tremendous diversity of bird species (Venkatraman et al., 2016). This is a state with more than 500 documented species of birds with the migratory waterfowl that decorate the wetlands along Asia's largest brackish water lagoon Chilika Lake, which is a Ramsar site (Mohapatra et al., 2014). Birds in Odisha face regional threats from conditions such as deforestation, industrialization, and encroachment on the wetland habitats. Seasonal studies and ecological monitoring within the state continue to be of immense importance for understanding diversity patterns and population dynamics in birds, and are used in framing conservation measures. The specific avifauna of Odisha calls for region-specific conservation measures so that critical habitats, migration routes, and breeding grounds are protected.

Birds play significant roles in maintaining ecological balance and biodiversity. They contribute to a well balanced ecosystem in several functions such as in pollination, seed dispersal, ~~being~~ controlling ~~of~~ pests control, nutrient cycling, and ~~being~~ serve as bioindicators for environmental change (Sekercioglu, 2006). Hummingbirds, honeyeaters, and sunbirds are very important

pollinators for many ecosystems, whereas frugivorous birds aid in seed dispersal; therefore, they give rise to plant regeneration and forest structure (Sekercioglu, 2010). Other ecological roles played by insectivorous species include the regulation of pests, hence improving natural as well as agricultural systems (Mols&Visser, 2002). Scavenging species such as vultures and a few raptors play essential functions with regard to removal of carcass and disinfection of ecosystems from pathogens (Ogada et al., 2012). Ecological roles played by bird communities seem to highlight the need and significance of these communities not just in intrinsic biodiversity but also with regard to an ecosystem's resilience and productivity.

University campuses are special landscapes with diverse green spaces, water bodies, and relatively undisturbed habitats within an urban or peri-urban context. Such can easily become biodiversity hotspots by providing necessary habitats for different avian species. Campuses act as both nesting sites and foraging grounds for resident and migratory birds but also as a living laboratory for studying ecological interactions, species behavior, and conservation practices (Mannan et al., 2000). Campuses can host a wide range of bird species, thereby enhancing biodiversity in the region, and therefore can host different types of ecological studies on campus that both students and academic staff can carry out. The birds in campuses of universities can also be the center for education outreach activities to foster stewardship of the environment among the students and the community at large as awareness on the conservation of birds is raised (Anand et al., 2020). Preserving and enriching campus biodiversity may strengthen the educational and ecological value of university environments toward both conservation and environmental education efforts.

The Central University of Odisha, located in the Sunabeda region of Odisha, is bordered by ecologically diverse habitats that offer an unusually rich habitat for avian fauna. The area consists of unique landscapes that provide sites for breeding, foraging, and stopping over for different bird species during migration. Thus, awareness about avian diversity plays a vital role in the assessment of local biodiversity and planning of conservation strategies in tandem with the ecological requirements and environmental hurdles. This region is of huge ecological importance, but hardly any baseline data on the avifaunal species composition, their seasonal population dynamics, or those environmental factors influencing the occurrences of various species are yet available.

This study involved a broad avian diversity survey conducted at the Central University of Odisha and the surrounding settings. The major objectives included documenting the diversity of bird species across seasons and evaluating statuses in relation to species occurrence within the study area. Additionally, it may be an important addition of foundational data on local avian biodiversity towards understanding seasonal dynamics and habitat associations of bird populations. The findings are meant to assist in continuing and future conservation efforts by providing a scientific basis for managing and protecting avian species and their habitats in this ecologically significant region.

Study Area:

The Central University of Odisha, the only central university within the state, is located in the Sunabeda region of Koraput District at a geographical point of 18.7392° N latitude and 82.8104° E longitude. The total land area that the university campus covers is approximately 450 acres, therefore offering a highly appropriate landscape for the study of ecology. The campus and its surroundings reflect a blend of natural and semi-natural landscapes, rich in a diversity of vegetation types, water bodies, and varied topographical features that together support a rich array of flora and fauna including a number of bird species.

The region of Koraput, where Sunabeda is located, normally has a tropical climate-affected altitude and monsoonal patterns. The region is entitled to three comparatively definite seasons: summer, monsoon, and winter. The high temperatures during summer range from March to June, and the typical ranges are usually between 25°C and 35°C though at times it may reach even more temperatures sometimes. The monsoon season, falling between June and September captures most yearly rainfall with an average annual sum of 1,300 to 1,600 mm, mainly provided by the southwest monsoon. This season of rain supports rich vegetation development, refills water bodies, and improves habitat quality for wildlife. The winters, that is, November to February, are mild to cool. Temperatures drop sharply to 10°C to 20°C. It would be productive for the residents as well as the migrants coming there. There is vegetation in the Central University, Odisha campus, from native forested areas and shrubs to grasslands and aquatic vegetation around the water bodies. This Koraput region falls under the ecological zone of Eastern Highlands Moist Deciduous Forests which is mainly represented by deciduous tree species which drop their leaves seasonally according to climatic changes. Some of the tree species of the area include Sal (*Shorea_robusta*), Teak (*Tectona_grandis*), and Bamboo (*Dendrocala_musstrictus*) along with several shrubs and understory species grows well in the very-drained soils and rain season during the monsoon. Grasslands are also scattered on the campus grounds and are alternated with scrublands, which contribute to the additional foraging and nesting areas available for ground-landed and migratory birds.

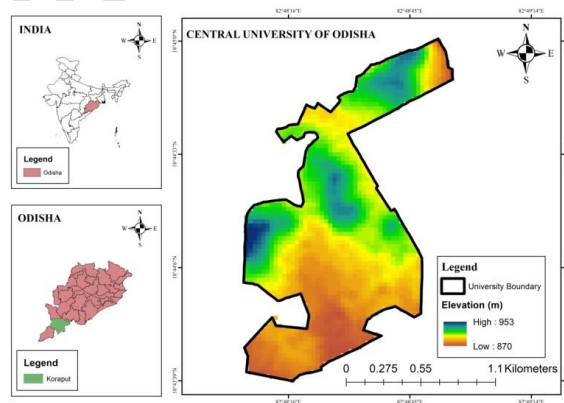


Figure 1: Map of the Study Area

In addition to land vegetation, there are small water bodies and seasonal streams around the campus, which provide resources useful to resident and migrant birds through all the dry season period. The latter support aquatic plants, which act as drinking, nesting, and feeding sites, thus adding to the heterogeneity of the environment. The combination of the mix of forest patches, open grasslands, and aquatic habitats within and outside the university campus offers an incredible mosaic of vegetation types that support diverse bird populations throughout the year.

Materials and Methods

The avian diversity survey was conducted for 12 months from the months of September 2023 to August 2024. Observations were carried out every Saturday and Sunday at two major time slots of 7:00 am to 8:30 am and 5:00 pm to 6:30 pm, when the peak level of bird activity was observed. The regular time gaps ensured that systematic observations were made across the seasons, so data collected at both periods is reliable and more representative.

Birds are naturally dynamic, and identification required continuous keen observation, including observation of shape and behavior. The birds were therefore identified through careful monitoring of their movements, vocalizations, feeding behaviors, and general appearance. Some species had unique vocalizations, which included characteristic calls and songs, as additional identifiers. Other morphological characters noted are size, shape, crown stripes, eye lines, nape colour, eye arcs, bill size, wing bars, colour patches, and legs and feet. To achieve a thorough observation of their physical characteristic, observations were carried out with the birds either in flight or at rest. The species identification was tested by consulting the standard field guides by Ali (2006), *The Book of Indian Birds*, and Grimmett et al. (1990) *Birds of the Indian Subcontinent*. High-resolution images of birds were taken using a Nikon P1000 camera. These images have served as visual records for documentation and aided in confirming species identity. Furthermore, a Nikon 10-60 zoom binocular was provided with good view over remote birds to be identified or photographed at longer distances. All observation data were taken with a notepad and pen for detailed annotation of field notes.

All data analyses were performed using Microsoft Excel and PAST software (Version-4.03).

Results:

The research entailed the recording and categorizing of a total of 117 species distributed into 16 orders, and 51 families. This scope of biodiversity says a lot about the richness of the spectrum of ecosystem variation and may imply good ecological health through support for a variety of species.

Table 1: List of Bird Species in Central University of Odisha Campus

Common Name	Scientific Name	Order	Family	Feeding Habitat	General Habitat	IUCN Status
Little Cormorant	<i>Microcarboniger</i>	Suliformes	Phalacrocoracidae	Piscivorous	Waterbodies	Least Concern (LC)
Indian Cormorant	<i>Phalacrocorax fuscescens</i>	Suliformes	Phalacrocoracidae	Piscivorous	Waterbodies	Least Concern (LC)
Greater Cormorant	<i>Phalacrocorax carbo</i>	Suliformes	Phalacrocoracidae	Piscivorous	Waterbodies	Least Concern (LC)
Indian Pond Heron	<i>Ardeolagrayii</i>	Pelecaniformes	Ardeidae	Piscivorous, Insectivorous	Waterbodies, Wetlands	Least Concern (LC)
Cattle Egret	<i>Bubulcus ibis</i>	Pelecaniformes	Ardeidae	Insectivorous	Grassland, Agricultural Land, Urban	Least Concern (LC)
Little Egret	<i>Egretta garzetta</i>	Pelecaniformes	Ardeidae	Piscivorous	Waterbodies, Wetlands	Least Concern (LC)
Intermediate Egret	<i>Ardea intermedia</i>	Pelecaniformes	Ardeidae	Piscivorous	Waterbodies, Wetlands	Least Concern (LC)
Great Egret	<i>Ardea alba</i>	Pelecaniformes	Ardeidae	Piscivorous	Waterbodies, Wetlands	Least Concern (LC)
Red-naped Ibis	<i>Pseudibis papillosa</i>	Pelecaniformes	Threskiornithidae	Omnivorous	Grassland, Agricultural Land	Least Concern (LC)
Ruddy Shelduck	<i>Tadorna ferruginea</i>	Anseriformes	Anatidae	Omnivorous	Waterbodies	Least Concern (LC)
Lesser Whistling-duck	<i>Dendrocygna javanica</i>	Anseriformes	Anatidae	Omnivorous	Waterbodies	Least Concern (LC)
Osprey	<i>Pandion haliaetus</i>	Accipitriformes	Pandionidae	Piscivorous	Waterbodies	Least Concern (LC)
Shikra	<i>Accipiter badius</i>	Accipitriformes	Accipitridae	Carnivorous	Forest, Urban	Least Concern (LC)
Black Kite	<i>Milvus migrans</i>	Accipitriformes	Accipitridae	Carnivorous	Urban, Agricultural Land	Least Concern (LC)
Black-shouldered Kite	<i>Elanus caeruleus</i>	Accipitriformes	Accipitridae	Carnivorous	Grassland, Agricultural Land	Least Concern (LC)

Peregrine Falcon	<i>Falco peregrinus</i>	Falconiformes	Falconidae	Carnivorous	Urban, Forest	Least Concern (LC)
Common Kestrel	<i>Falco tinnunculus</i>	Falconiformes	Falconidae	Carnivorous	Grassland, Agricultural Land	Least Concern (LC)
Grey Francolin	<i>Francolinus pondicerianus</i>	Galliformes	Phasianidae	Omnivorous	Grassland, Agricultural Land	Least Concern (LC)
Barred Buttonquail	<i>Turnix suscitator</i>	Charadriiformes	Charadriiformes	Omnivorous	Grassland, Agricultural Land	Least Concern (LC)
Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriiformes	Charadriidae	Omnivorous	Waterbodies, Grassland, Agricultural Land	Least Concern (LC)
Yellow Wattled Lapwing	<i>Vanellus malabaricus</i>	Charadriiformes	Charadriidae	Omnivorous	Grassland, Agricultural Land	Least Concern (LC)
Little Ringed Plover	<i>Charadrius dubius</i>	Charadriiformes	Charadriidae	Insectivorous	Waterbodies	Least Concern (LC)
Common Greenshank	<i>Tringanebularia</i>	Charadriiformes	Scolopacidae	Piscivorous, Insectivorous	Waterbodies	Least Concern (LC)
Wood Sandpiper	<i>Tringaglareola</i>	Charadriiformes	Scolopacidae	Insectivorous	Waterbodies	Least Concern (LC)
Rock Pigeon	<i>Columba livia</i>	Columbiformes	Columbidae	Granivorous, Omnivorous	Urban, Agricultural Land	Least Concern (LC)
Laughing Dove	<i>Spilopelia senegalensis</i>	Columbiformes	Columbidae	Granivorous, Omnivorous	Urban, Grassland, Agricultural Land	Least Concern (LC)
Yellow Footed Green Pigeon	<i>Treron phoenicoptera</i>	Columbiformes	Columbidae	Omnivorous, Frugivorous	Forest	Least Concern (LC)
Spotted Dove	<i>Spilopelia chinensis</i>	Columbiformes	Columbidae	Granivorous, Omnivorous	Urban, Forest	Least Concern (LC)
Greater Coucal	<i>Centropus sinensis</i>	Cuculiformes	Cuculidae	Omnivorous	Forest, Grassland	Least Concern (LC)
Common Hawk Cuckoo	<i>Hierococcyx varius</i>	Cuculiformes	Cuculidae	Insectivorous	Forest, Urban	Least Concern (LC)

Grey Bellied Cuckoo	<i>Cacomantispasserinus</i>	Cuculiformes	Cuculidae	Insectivorous	Forest	Least Concern (LC)
Pied Cuckoo	<i>Clamatorjacobinus</i>	Cuculiformes	Cuculidae	Insectivorous	Grassland, Forest	Least Concern (LC)
Asian Koel	<i>Eudynamysscolopaceus</i>	Cuculiformes	Cuculidae	Frugivorous	Urban, Forest	Least Concern (LC)
Indian Cuckoo	<i>Cuculusmicropterus</i>	Cuculiformes	Cuculidae	Insectivorous	Forest	Least Concern (LC)
Rose-ringed Parakeet	<i>Psittaculakrameri</i>	Psittaciformes	Psittaculidae	Frugivorous	Urban, Agricultural Land	Least Concern (LC)
Alexandrine Parakeet	<i>Psittaculaeupatria</i>	Psittaciformes	Psittaculidae	Frugivorous	Forest, Urban	Near Threatened (NT)
Asian Palm Swift	<i>Cypsiurusbalasien sis</i>	Caprimulgiformes	Apodidae	Insectivorous	Urban	Least Concern (LC)
Little Swift	<i>Apus affinis</i>	Caprimulgiformes	Apodidae	Insectivorous	Urban	Least Concern (LC)
Barn Owl	<i>Tyto alba</i>	Strigiformes	Tytonidae	Carnivorous	Forest, Urban	Least Concern (LC)
Common Kingfisher	<i>Alcedoathis</i>	Coraciiformes	Alcedinidae	Piscivorous	Waterbodies	Least Concern (LC)
Pied Kingfisher	<i>Cerylerudis</i>	Coraciiformes	Alcedinidae	Piscivorous	Waterbodies	Least Concern (LC)
White-throated Kingfisher	<i>Halcyon smymensis</i>	Coraciiformes	Alcedinidae	Piscivorous, Carnivorous	Waterbodies, Grassland, Urban	Least Concern (LC)
Green Bee-eater	<i>Meropsorientalis</i>	Coraciiformes	Meropidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Indian Roller	<i>Coraciasbenghalensis</i>	Coraciiformes	Coraciidae	Insectivorous	Forest, Grassland, Urban	Least Concern (LC)
Eurasian Hoopoe	<i>Upupaepops</i>	Bucerotiformes	Upupidae	Insectivorous	Grassland, Urban, Agricultural Land	Least Concern (LC)
Coppersmith Barbet	<i>Psilopogonhaemacephalus</i>	Piciformes	Megalaimidae	Frugivorous	Urban, Forest	Least Concern (LC)

Brown-headed Barbet	<i>Psilopogonzeylanicus</i>	Piciformes	Megalaimidae	Frugivorous	Forest	Least Concern (LC)
Yellow-crowned Woodpecker	<i>Leiopicusmahrattensis</i>	Piciformes	Picidae	Insectivorous, Carnivorous	Forest	Least Concern (LC)
Indian Paradise Flycatcher	<i>Terpsiphoneparadisii</i>	Passeriformes	Monarchidae	Insectivorous	Forest	Least Concern (LC)
Gray-necked Bunting	<i>Emberizabuchanani</i>	Passeriformes	Emberizidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
Indian Yellow Tit	<i>Machlolophusaplonotus</i>	Passeriformes	Paridae	Insectivorous	Forest	Least Concern (LC)
Barn Swallow	<i>Hirundorustica</i>	Passeriformes	Hirundinidae	Insectivorous	Urban, Grassland	Least Concern (LC)
Red-rumped Swallow	<i>Cecropisdaurica</i>	Passeriformes	Hirundinidae	Insectivorous	Grassland, Urban	Least Concern (LC)
Ashy Wood Swallow	<i>Artamusfuscus</i>	Passeriformes	Artamidae	Insectivorous	Grassland, Urban	Least Concern (LC)
Wire-tailed Swallow	<i>Hirundosmithii</i>	Passeriformes	Hirundinidae	Insectivorous	Waterbodies, Urban	Least Concern (LC)
Black Drongo	<i>Dicrurusmacrocerus</i>	Passeriformes	Dicruridae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
White-bellied Drongo	<i>Dicruruscaerulescens</i>	Passeriformes	Dicruridae	Insectivorous	Forest, Grassland	Least Concern (LC)
Bronzed Drongo	<i>Dicrurusaeneus</i>	Passeriformes	Dicruridae	Insectivorous	Forest	Least Concern (LC)
Black-headed Cuckoo-shrike	<i>Lalagemelanoptera</i>	Passeriformes	Campephagidae	Insectivorous	Forest	Least Concern (LC)
Large Cuckoo-shrike	<i>Coracinamacei</i>	Passeriformes	Campephagidae	Insectivorous	Forest	Least Concern (LC)
Small Minivet	<i>Pericrocotuscinnamomeus</i>	Passeriformes	Campephagidae	Insectivorous	Forest, Grassland	Least Concern (LC)
Long-tailed Shrike	<i>Laniusschach</i>	Passeriformes	Laniidae	Carnivorous	Grassland, Agricultural Land	Least Concern (LC)

Brown Shrike	<i>Laniuscristatus</i>	Passeriformes	Laniidae	Carnivorous	Grassland, Agricultural Land	Least Concern (LC)
Indian Golden Oriole	<i>Orioluskundoo</i>	Passeriformes	Oriolidae	Frugivorous, Insectivorous	Forest	Least Concern (LC)
Black-hooded Oriole	<i>Oriolusxanthornus</i>	Passeriformes	Oriolidae	Frugivorous, Insectivorous	Forest, Urban	Least Concern (LC)
Jerdon's Leafbird	<i>Chloropsisjerdoni</i>	Passeriformes	Chloropseidae	Frugivorous, Insectivorous	Forest	Least Concern (LC)
Chestnut-tailed Starling	<i>Sturnusmalabaricus</i>	Passeriformes	Sturnidae	Omnivorous, Frugivorous	Forest, Urban	Least Concern (LC)
Asian Pied Starling	<i>Gracupica contra</i>	Passeriformes	Sturnidae	Omnivorous, Frugivorous	Urban, Agricultural Land	Least Concern (LC)
Common Myna	<i>Acridotherestrictis</i>	Passeriformes	Sturnidae	Omnivorous	Urban, Agricultural Land	Least Concern (LC)
Bank Myna	<i>Acridotheresginginianus</i>	Passeriformes	Sturnidae	Omnivorous	Urban, Agricultural Land	Least Concern (LC)
Brahminy Starling	<i>Sturniapagodarum</i>	Passeriformes	Sturnidae	Omnivorous, Frugivorous	Grassland, Agricultural Land	Least Concern (LC)
Jungle Myna	<i>Acridotheresfuscus</i>	Passeriformes	Sturnidae	Omnivorous, Frugivorous	Forest, Urban	Least Concern (LC)
Red-vented Bulbul	<i>Pycnonotuscafer</i>	Passeriformes	Pycnonotidae	Omnivorous, Frugivorous	Urban, Grassland	Least Concern (LC)
Red-whiskered Bulbul	<i>Pycnonotusjocosus</i>	Passeriformes	Pycnonotidae	Omnivorous, Frugivorous	Urban, Forest	Least Concern (LC)
Black-crested Bulbul	<i>Pycnonotusflaviventris</i>	Passeriformes	Pycnonotidae	Omnivorous, Frugivorous	Forest	Least Concern (LC)
Oriental Magpie Robin	<i>Copsychussaularis</i>	Passeriformes	Muscicapidae	Insectivorous	Urban, Forest	Least Concern (LC)
Indian Robin	<i>Copsychusfulicatus</i>	Passeriformes	Muscicapidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Bluethroat	<i>Lusciniasvecica</i>	Passeriformes	Muscicapidae	Insectivorous	Grassland, Waterbodies	Least Concern (LC)

Siberian Stonechat	<i>Saxicolamaurus</i>	Passeriformes	Muscicapidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Blue Rock Thrush	<i>Monticolasolitarius</i>	Passeriformes	Muscicapidae	Insectivorous	Forest, Rocky areas	Least Concern (LC)
Black Redstart	<i>Phoenicurusochros</i>	Passeriformes	Muscicapidae	Insectivorous	Grassland, Rocky areas	Least Concern (LC)
Pied Bush Chat	<i>Saxicolacaprata</i>	Passeriformes	Muscicapidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Common Iora	<i>Aegithinathia</i>	Passeriformes	Aegithinidae	Insectivorous	Forest, Urban	Least Concern (LC)
White Wagtail	<i>Motacilla alba</i>	Passeriformes	Motacillidae	Insectivorous	Waterbodies, Urban	Least Concern (LC)
White-browed Wagtail	<i>Motacillamaderaspatensis</i>	Passeriformes	Motacillidae	Insectivorous	Waterbodies	Least Concern (LC)
Paddyfield Pipit	<i>Anthusrufulus</i>	Passeriformes	Motacillidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Tree Pipit	<i>Anthustrivialis</i>	Passeriformes	Motacillidae	Insectivorous	Forest, Grassland	Least Concern (LC)
Yellow-eyed Babbler	<i>Chrysommasinense</i>	Passeriformes	Sylviidae	Omnivorous	Grassland, Agricultural Land	Least Concern (LC)
Jungle Babbler	<i>Argyastriata</i>	Passeriformes	Leiothrichidae	Omnivorous	Forest, Urban	Least Concern (LC)
Common Babbler	<i>Argyacaudata</i>	Passeriformes	Leiothrichidae	Omnivorous	Grassland, Agricultural Land	Least Concern (LC)
Puff-throated Babbler	<i>Pellorneumruficeps</i>	Passeriformes	Pellorneidae	Insectivorous	Forest	Least Concern (LC)
Grey-breasted Prinia	<i>Priniahodgsonii</i>	Passeriformes	Cisticolidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Plain Prinia	<i>Priniaornata</i>	Passeriformes	Cisticolidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Ashy Prinia	<i>Priniasocialis</i>	Passeriformes	Cisticolidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)

Jungle Prinia	<i>Priniasylvatica</i>	Passeriformes	Cisticolidae	Insectivorous	Grassland, Forest	Least Concern (LC)
Common Tailorbird	<i>Orthotomussutorius</i>	Passeriformes	Cisticolidae	Insectivorous	Urban, Grassland	Least Concern (LC)
House Crow	<i>Corvussplendens</i>	Passeriformes	Corvidae	Omnivorous, Carnivorous	Urban, Agricultural Land	Least Concern (LC)
Large-billed Crow	<i>Corvusmacrorhynchos</i>	Passeriformes	Corvidae	Omnivorous, Carnivorous	Urban, Forest	Least Concern (LC)
Rufous Treepie	<i>Dendrocittavagabunda</i>	Passeriformes	Corvidae	Omnivorous	Forest, Urban	Least Concern (LC)
Thick-billed Flowerpecker	<i>Dicaeum agile</i>	Passeriformes	Dicaeidae	Frugivorous	Forest	Least Concern (LC)
Oriental White-eye	<i>Zosterospalpebrus</i>	Passeriformes	Zosteropidae	Frugivorous, Insectivorous	Forest, Urban	Least Concern (LC)
Purple Sunbird	<i>Cinnyrisasiaticus</i>	Passeriformes	Nectariniidae	Nectivorous	Urban, Forest	Least Concern (LC)
Purple-rumped Sunbird	<i>Leptocomazeylonica</i>	Passeriformes	Nectariniidae	Nectivorous, Insectivorous	Urban, Forest	Least Concern (LC)
Ashy-crowned Sparrow-Lark	<i>Eremopterixgriseus</i>	Passeriformes	Alaudidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
Oriental Skylark	<i>Alaudagulgula</i>	Passeriformes	Alaudidae	Omnivorous	Grassland, Agricultural Land	Least Concern (LC)
Zitting Cisticola	<i>Cisticolajuncidis</i>	Passeriformes	Cisticolidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Common Chiffchaff	<i>Phylloscopuscollybita</i>	Passeriformes	Phylloscopidae	Insectivorous	Forest, Grassland	Least Concern (LC)
Greenish Warbler	<i>Phylloscopustrochiloides</i>	Passeriformes	Phylloscopidae	Insectivorous	Forest, Urban	Least Concern (LC)
Sykes's Warbler	<i>Idunarama</i>	Passeriformes	Acrocephalidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)
Booted Warbler	<i>Idunacaligata</i>	Passeriformes	Acrocephalidae	Insectivorous	Grassland, Agricultural Land	Least Concern (LC)

Scaly-breasted Munia	<i>Lonchurapunctulata</i>	Passeriformes	Estrildidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
Tricolored Munia	<i>Lonchuramalacca</i>	Passeriformes	Estrildidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
White-rumped Munia	<i>Lonchura striata</i>	Passeriformes	Estrildidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
Indian Silverbill	<i>Euodice malabarica</i>	Passeriformes	Estrildidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
Red Avadavat	<i>Amandava amandava</i>	Passeriformes	Estrildidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
Baya Weaver	<i>Ploceus philippinus</i>	Passeriformes	Ploceidae	Granivorous	Grassland, Agricultural Land	Least Concern (LC)
House Sparrow	<i>Passer domesticus</i>	Passeriformes	Passeridae	Granivorous, Omnivorous	Urban, Agricultural Land	Least Concern (LC)

Figure 2 shows the composition of documented bird species by avian order; variation in richness among orders is quite substantial. The Passeriformes is compositionally unique due to a rather high species count that is significantly higher than all other orders. Dominance by Passeriformes reflects the usual high diversity of Passeriformes in most ecosystems and contributes most to the bulk of species diversity.

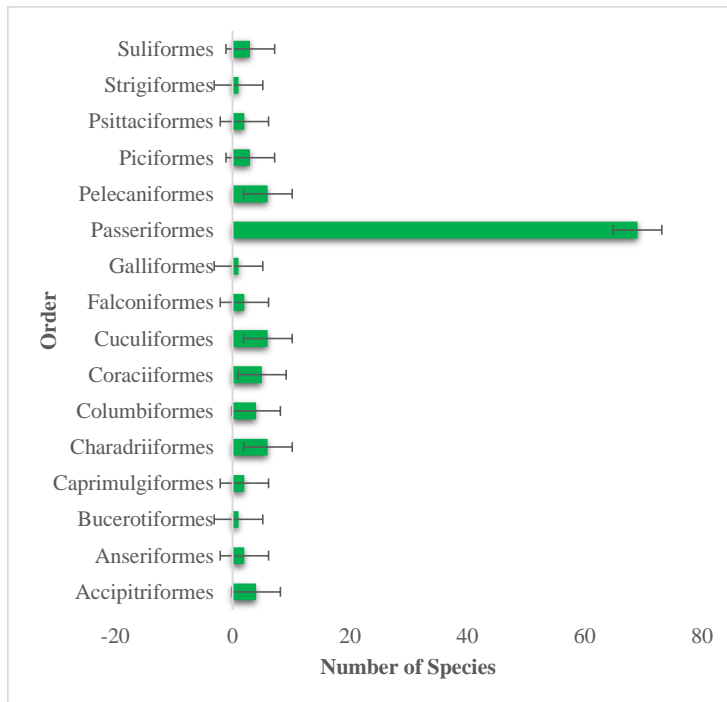


Figure 2: Distribution of bird species across different orders

Other such orders include Pelecaniformes, Charadriiformes, and Accipitriformes, adding to species richness in smaller counts as compared to those of the Passeriformes. Orders like Galliformes, Piciformes, Suliformes, Strigiformes, and Psittaciformes are even much lower, which means the composition of these types of birds is more restricted in the recorded ecosystem. Several families have a relatively high species count. It consists of families like Muscicapidae, which the family of Old World flycatchers and Corvidae that comprises the crows, ravens, and jays and is notably represented. This means that these families are part of the ecosystem players and may be able to occupy any number of ecological niches.

There are also moderately species-rich families like Columbidae, pigeons and doves, and Accipitridae, hawks, eagles, and their allies. These families are typically ordinary representatives of adaptable feeding and habitat behaviors, thereby helping the presence of different species in certain settings.

The smaller families, like Zosteropidae (white-eyes) or Pellorneidae (small birds), seem to contain fewer species. Diversity here could be limited by niche specialisation or palaeoecological restriction. Species numbers are in the middle rank with Falconidae (falcons) and Phasianidae

(pheasants and allies). Is this perhaps a sign of specific ecological roles or specific habitat requirements?.

Comment [2]: Why is this paragraph in red? Be consistent with font colour.

Comment [3]: This information will be better understood if presented in a tabular form

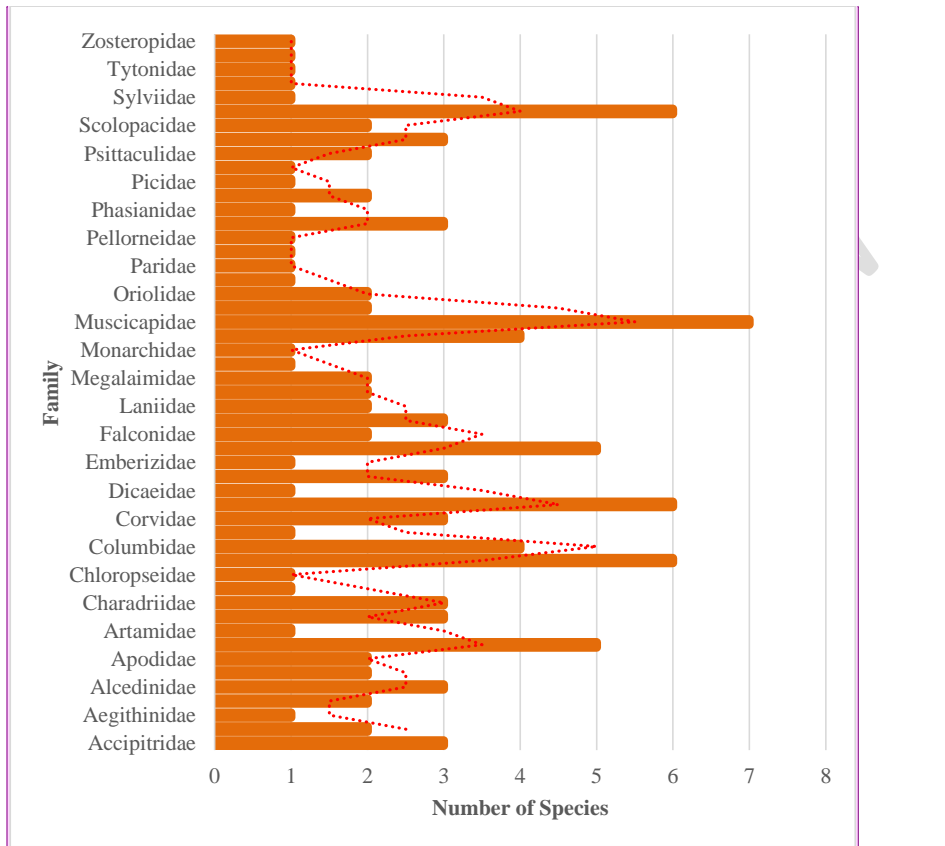


Figure 3: Distribution of species across various families

The diet of the species shows a wide range of feeding strategies indicating an extensive adaptability to different ecological niches. Among 117 species examined, most preferred insectivory: 47 species were found as primarily insectivorous. Omnivorous species total 15 species, though many of these have combinations of omnivory with other diets: eight are both omnivorous and frugivorous, and two are both omnivorous and carnivorous. Eight are carnivorous, but some also have piscivory and omnivory in their diet in lower numbers.

Frugivorous species are underrepresented, with only six species strictly exhibiting frugivory and four other species both being frugivorous and insectivorous. Eight species were proven to be primarily granivorous, and four other species were a combination of granivorous and

omnivorous. Piscivorous species represent nine cases, while some species-combining piscivory with carnivory or insectivory-occurred in three species. Lesser represented diet types include nectivory that is recorded in one species and one species that combines nectivory with insectivory. The species distribution by habitat type reflects the fact that quite a high number of species exists for a variety of habitats, indicating that the species is ecologically versatile. The highest species diversity is found in grasslands, with as many as 53 species recorded in grassland habitats. This is likely because in open environments, there are plenty of food and nesting sites. Agricultural land follows closely with 44 species, implying that these areas, however human-inducedly modified, can produce food and shelter for a high species richness. Equally, forest habitats are as rich in species, recording 45 species, indicating the critical role of forests in maintaining biodiversity through such complex ecological structures that support varied diets and nesting options.

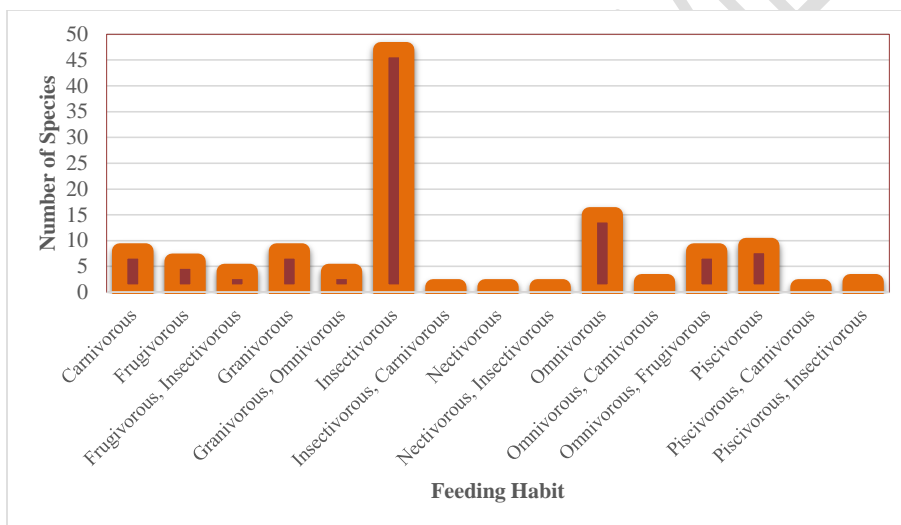
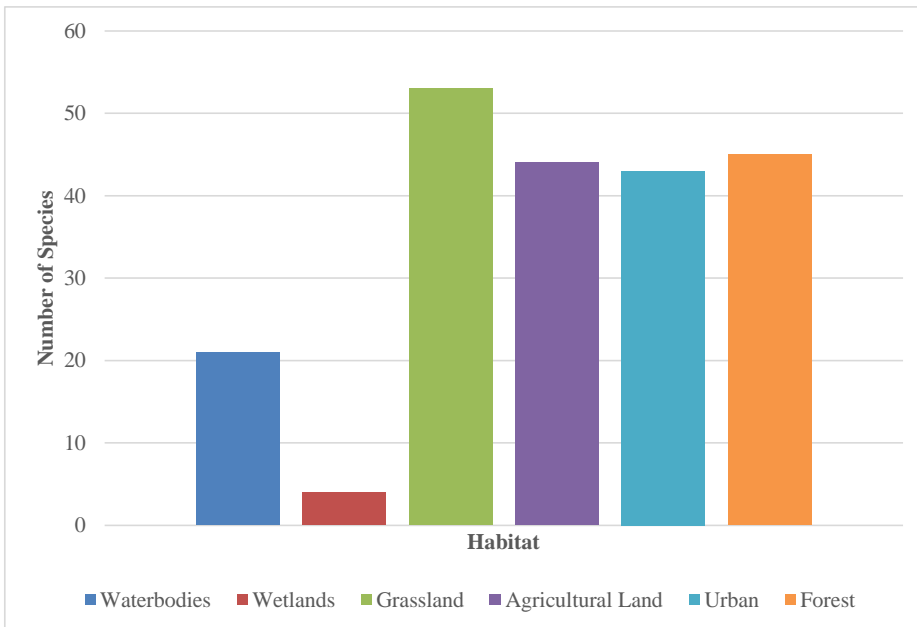


Figure 4: Feeding habit of species

Comment [4]: I suggest you replace this with GUILD

Contrary to expectations, a large proportion of species was found supported by urban habitats. Up to 43 species adapted well to the human-dominated landscapes, and this might indicate the adaptability of certain species towards the resources and the habitats available within the cities. Waterbodies housed 21 species, whereas wetlands held just four species, although much smaller in number, probably due to the high degree of adaptation required to survive in those environments. Generally, this distribution underlines the importance of habitat diversity to support species richness; grasslands, agricultural lands, forests, and urban areas should be given key habitats roles in sustaining biodiversity across diverse ecological contexts.



Comment [5]: You can present this information in a table and even incorporate functional diversity as well to see which habitat supports a more diverse array of functional or feeding guilds

Figure 5: Bird species across different habitat

A heat map (Figure 6) clearly reveals great patterns of habitat preference among different feeding birds, how resource availability may be driving habitat selection. Insectivorous birds are quite widely distributed, especially within forests and grasslands, with a peak frequency for "Forest, Grassland". This implies that these habitats provide rich food sources in terms of insects; thus, it is easily preferred by insectivorous species. Granivorous birds are primarily concentrated in agricultural lands; this concentration reflects the fact that granivorous birds rely heavily on seed-rich environments, which are less available in other habitats. Omnivorous birds have a greater adaptability across landscapes, such as forested, urban, and agricultural settings, and probably for the same reasons, that their diet comprises variety of resources. Piscivorous species are predictably associated with waterbody habitats, which afford them the critical access to fish and other aquatic prey, with notable occurrences in "Waterbodies, Urban" and "Waterbodies, Grassland" areas. Carnivorous birds, although fewer in number, can be seen across several habitats, often being found in forested and grassland environments where hunting opportunities are more abundant.

Low in numbers but widespread across urban and forested habitats, frugivorous and nectivorous birds perhaps indicate favorability of these habitats for fruiting and flowering plants. They are scarce in grassland or agricultural areas, which would not likely support the herbaceous vegetation cover that marks these and other feeding guilds. Overall, results suggest that habitat

Comment [6]: Provide a supporting reference

diversity was an important channel for influencing composition of bird communities. Natural habitats such as forests and grassland are important for insectivorous and carnivorous birds, whereas granivorous species are attracted to agricultural lands. Aquatic habitats are important for piscivorous species. Urban landscapes can be shared by adaptive omnivorous species, provided that the right planning is in place, like the existence of green spaces and natural features. Even preserving habitats that are different in character and which especially support specialized diets is important for avian biodiversity in landscapes under increasing modification.

Comment [7]: Provide a supporting reference

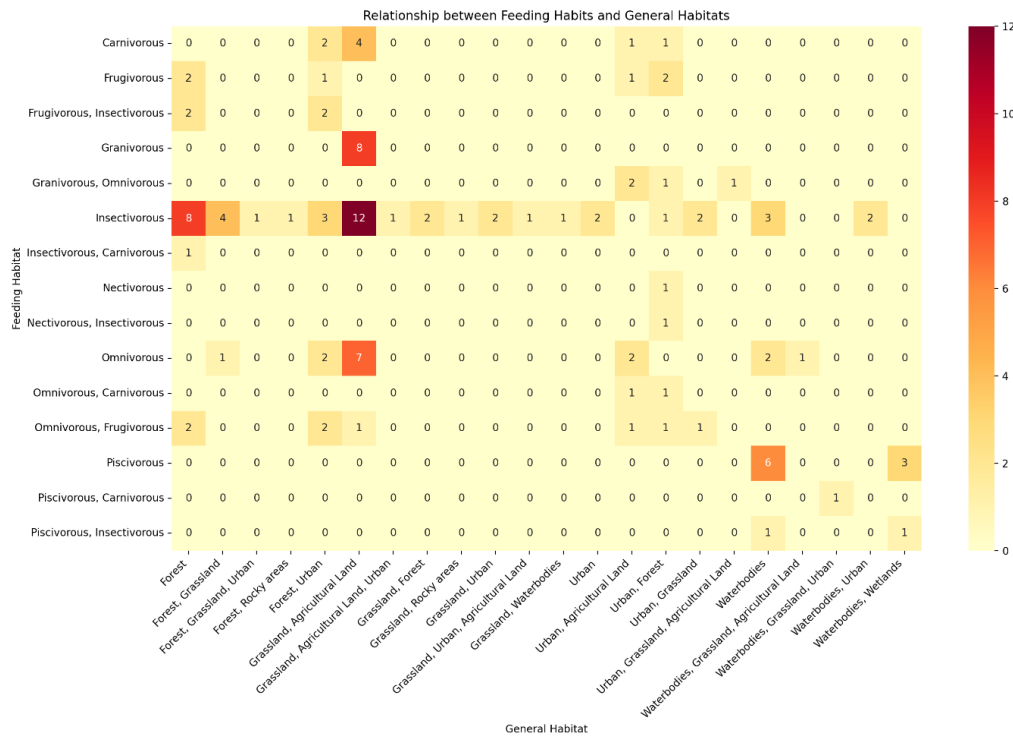


Figure 6: Relationship between feeding habit and habitats of bird species

Discussions

There is a constant observance of the richness of avifaunal diversity in research on Indian university campuses, similar to those species richnesses and ecological malleabilities you are noting in different habitats. As such, 45 bird species were recorded in the campus of Sarojini Naidu College in Kolkata, belonging to 25 families in the order Passeriformes, majorly driven by the diversity of flora and changes in the ecosystem. Human disturbances such as noise pollution

Comment [8]: Please provide a reference to back this up

and habitat disruption were reported to affect species diversity (Das&Bandyopadhyay, 2016).Shri Krishna University campus of Madhya Pradesh reported 77 species with insectivorous birds showing dominance; this indicates adaptability across landscapes within the campus proximity to National Highway 86. The presence of the Muscicapidae family highlights that bird species are adaptable to microhabitats within the campus (Shivhare et al., 2022).Anand et al., 2020 did research in Guru Ghasidas Vishwavidyalaya with 144 species shows similarity with the present study.

Chaudhary Charan Singh Haryana Agricultural University, Haryana: Out of 101 species recorded, insectivorous and omnivorous feeding habits were on the predominate list. Of interest, the species richness for farmland was the highest. It, therefore, supported the wide variety of ecological roles, both residents and migrants, to maintain healthy ecological status (Kiran et al., 2022). Jawaharlal Nehru University (JNU) in New Delhi, with its unique ridge ecosystem, had 114 species documented: 47 were insectivores, which pointed towards a robust ecosystem having high capacity for diet support. The presence of both migratory and resident species suggests that the mosaic of different habitats, such as those found on the ridge of JNU, is responsible for maintaining avifaunal diversity (Singh et al., 2017).Indian Institute of Technology (IIT) Guwahati demonstrated the value of habitat heterogeneity by counting 152 species in areas of eco-forest and waterbodies that provided adequate resources for insectivorous and omnivorous birds. This campus is one of the best educational institutions in India regarding diversity in terms of birds and is a haven for a great number of migratory species due to its diversity in habitats (Rathod & Bhaduri, 2022). These studies underline the richness of bird life within Indian university campuses by putting high emphasis on varied habitats such as forests, water bodies, and grasslands that must be maintained to ensure biodiversity and called for conservational efforts.

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Comment [9]: Italicize. Do same for all

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Comment [13]: Please ensure that all these references appear in the text, otherwise delete. Also ensure that all references cited are listed here. I have identified a few as shown above

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