

## Seasonal Variation in Avian Diversity and Guild Composition at Gamela Pond and its Wetland, Sagwara (Dungarpur District, Rajasthan)

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### Abstract

This study examined seasonal changes in avian diversity and feeding guild structure at Gamela Pond, a semi-arid wetland in Sagwara, Dungarpur District, Rajasthan. Over a 12-month period (2021–2022), standardized point-counts and transect surveys documented 86 bird species, with diversity peaking during the monsoon (83 species) and declining in winter (86 species). Insectivores dominated (26.74%), followed by piscivores and omnivorous (20.93% each) Frugivorous are very least (3.94%). Habitat degradation from agriculture and water extraction were identified as major threats. The findings highlight the ecological significance of Gamela Pond for both resident and migratory birds and emphasize the need for targeted conservation actions.

**Keywords:** Wetland, Gamela pond, Avian diversity, Abundance, Anthropogenic threat

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### I. Introduction

Wetlands serve as a connection between aquatic and terrestrial ecosystems, characterised by a water table that is typically at or near the land's surface, accompanied by shallow water (Mitsch and Gosselink, 1986). Wetlands exhibit remarkable productivity and possess distinct biological characteristics globally, yet they maintain exceptionally fragile ecosystems. Wetlands provide essential habitats for biota and play a very important role in protection of biodiversity, especially rare and endangered species (Dai et al., 2019; Na et al., 2018). Habitat suitability is an essential and sensitive index explaining local habitat use (Coppes et. al., 2018). India is home to approximately 67,429 wetlands, encompassing an area of roughly 4.1 million hectares. Among these, there are 2,175 that are natural, while the total reaches 65,254. are created by humans. In India, wetlands (excluding rivers) comprise 18.4% of the nation's geographic area, with 70% of this area dedicated to paddy cultivation (MoEF, 1990; Parekh & Gadhvi, 2013). Wetlands provide a habitat for a significant variety of wildlife including mammals, fish, birds, insects, frogs, and plants (Buckton, 2007). The wetland environment hosts a diverse array of species, with birds playing a crucial role by occupying multiple trophic levels within the nutrient cycles. This indicates their significant cultural and social importance to local communities (Green, 2014). Wetlands serve as a habitat for birds, primarily for nesting, roosting, breeding, feeding, shelter, resting, social interaction, and various other activities (Stewart, 2007). Wetlands facilitate the congregation of numerous migratory birds due to their high nutritional value and productivity (Paracuellos, 2006).

Avian diversity is very important to attract people and tourists towards natural habitats. Waterbirds are intricately linked to freshwater and marine environments, contributing significantly to ecosystem health (Ogden et al., 2014) and serving as a source of recreational revenue (Carver, 2009).

Bird species composition and diversity are influenced by wetland habitat structures, area, and changes in adjacent land use. Understanding the bird and plant species of a specific wetland is essential for assessing habitat conditions and developing effective conservation strategies for sustainable biodiversity preservation. Wetlands represent some of the most productive ecosystems globally (Kumar and Gupta, 2009).

Birds are integral to ecosystems, delivering essential ecosystem services (MEA, 2005), including the regulation of invertebrate and vertebrate pest populations, pollination of flowers, seed dispersal, scavenging of carcasses and waste, provision of cultural services, and functioning as ecosystem engineers. Recent studies validated the notion of employing birds as markers for identifying terrestrial ecosystems abundant in biological variety (O'Connell et al., 2000; Niemi & McDonald, 2004) and assessing landscape damage (Morelli, 2015). Several studies concerning avifaunal diversity and its status have been undertaken in various wetlands of Rajasthan; however, limited research has focused on the distribution, diversity, and status of birdlife in this region.

Gamela Pond and its associated wetland in Sagwara, Dungarpur District, Rajasthan, constitute an important ecological site in the region, fostering a diverse array of bird species year-round. The ecological significance of these wetlands is highlighted by their function as transitional areas between water and land, providing a diverse array of microhabitats that support both resident and migratory bird populations.

Seasonal variation significantly impacts avian diversity and guild composition within wetland habitats. At Gamela Pond, the seasonal patterns of migratory species, especially in winter, result in significant variations in species richness and abundance. This wetland serves as a sanctuary for various migratory birds, while local species persist in their habitat throughout the entire year. The seasonal influx and turnover lead to dynamic alterations in the composition of ecological guilds—groups of species that utilise similar resources—such as insectivores, piscivores, granivores, and omnivores.

The variety and quantity of bird groups are influenced by factors such as food availability, water levels, vegetation cover, and human impacts. Human activities such as agriculture, cattle grazing, fishing, and proximity to highways can profoundly influence bird populations by changing habitat structure and resource availability. The disturbances frequently result in a decline in avifaunal diversity and can in desert areas like Rajasthan, wetlands are vital for bird biodiversity because they supply vital supplies to landscapes that would otherwise be constrained by a lack of water. Despite their significance as local refuges, rural ponds like Gamela are still under-represented in avifaunal studies, although well-known wetlands like Keoladeo National Park have received extensive study. In order to comprehend the functional responsibilities of ecosystems, this study intends to:

- Classify species by feeding guild;
- Quantify seasonal bird diversity at Gamela Pond.
- Recognise man-made hazards and suggest ways to protect them.

## **II. Method Methodology**

### **Survey Area**

The Gamela pond is 8.9667 hectares and located from 23°40'5"N to 23°68'N latitude and 74°1'28"E to 74°024"E longitude. Its proximity to the Gameraashwar Temple and National Highway 927A, which links Ratlam and Swaroopganj, shows its accessibility and possible influence on the local ecology and residents. The pond supplies irrigation for Patelwara and Sagwara's agricultural land and other residential and business needs. Locals use its waters to wash clothes, highlighting its importance in daily life. Local livelihoods and regional food security may improve with fish cultured in the pond. Its usefulness in communal animal husbandry is that it provides drinking water for nearby cattle. This wetland's biological health and water quality affect nearby residents and the environment.

### **III. Methodology**

The data about the variety of numerous bird species were gathered using the point count technique, transect method, and linear approach. 24 field trips (two visits each month) were made to assess the status and variety of birds over this period. Birds were spotted in the morning from 06:00AM to 10:00AM and in the evening from 4:30PM to 7:00PM in summer and from 06:30AM to 11:00AM and from 4:00PM to 6:00PM in summer. The identification of these birds was conducted via Olympus binoculars (10x50) and field guides (Ali & Ripley 1983; Grimmett & Inskipp, 2007), with standardised common and scientific nomenclature following Pande et al. 2016 and Praveen et al. 2016.

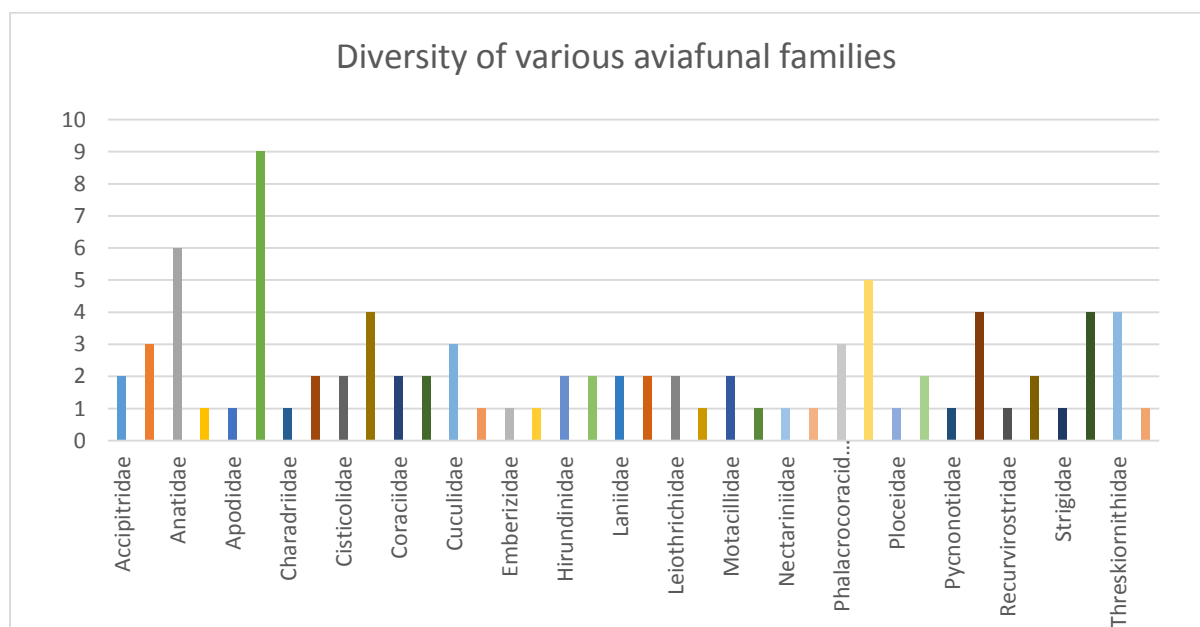
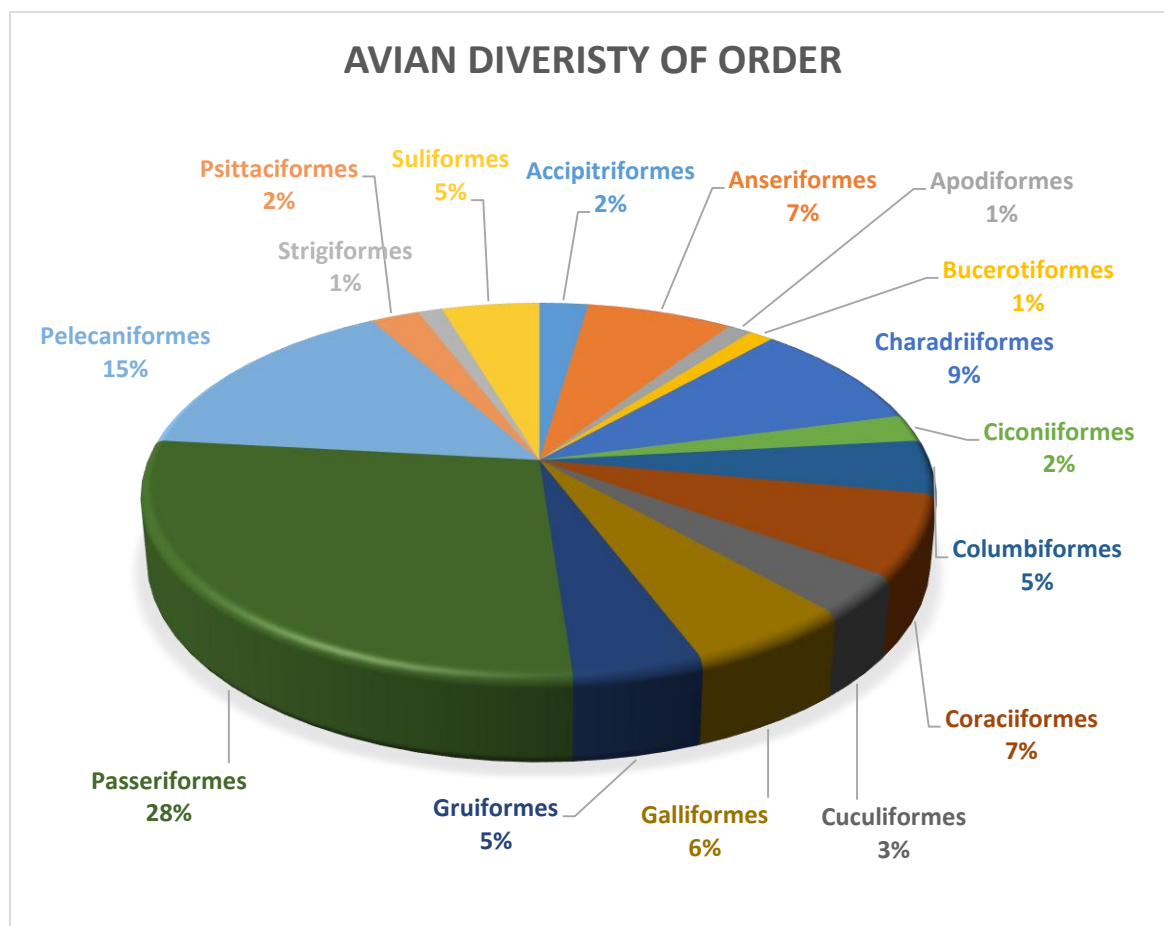
## **IV. Results :**

### **Observation and Discussion**

The research recorded notable avian diversity within the wetland, identifying 86 bird species across 38 families and 16 orders. The 16 orders are listed here as Passeriformes, Pelecaniformes, Charadriiformes, Anseriformes, Coraciiformes, Galliformes, Columbiformes, Gruiformes, Suliformes, Cuculiformes, Accipitriformes, Ciconiiformes, , Psittaciformes, Apodiformes, Bucerotiformes, and Strigiformes.

The 38 Families are listed here as Ardeidae Anatidae, Phasianidae

Columbidae, Rallidae, Sturnidae, Threskiornithidae, Alcedinidae, Cuculidae, Phalacrocoracidae Accipitridae, Ciconiidae, Cisticolidae, Coraciidae, Corvidae, Hirundinidae, Jacanidae, Laniidae, Leiothrichidae, Motacillidae, Psittaculidae, Scolopacidae, Anhingidae, Apodidae, Charadriidae, Dicruridae, Emberizidae, Estrildidae, Meropidae, Muscicapidae, Nectariniidae, Passeridae, Ploceidae, Pycnonotidae, Recurvirostridae, Strigidae, and Upupidae.



| Sr. No. | Common Name    | Scientific Name         | Pre Monsoon | Monsoon | Post Monsoon | Guild Status |
|---------|----------------|-------------------------|-------------|---------|--------------|--------------|
| 1       | Black Kite     | <i>Milvus migrans</i>   | 59          | 55      | 54           | Carnivore    |
| 2       | Shikra         | <i>Accipiter badius</i> | 7           | 7       | 7            | Carnivore    |
| 3       | Common Pochard | <i>Aythya ferina</i>    | 35          | -       | 39           | Piscivorous  |

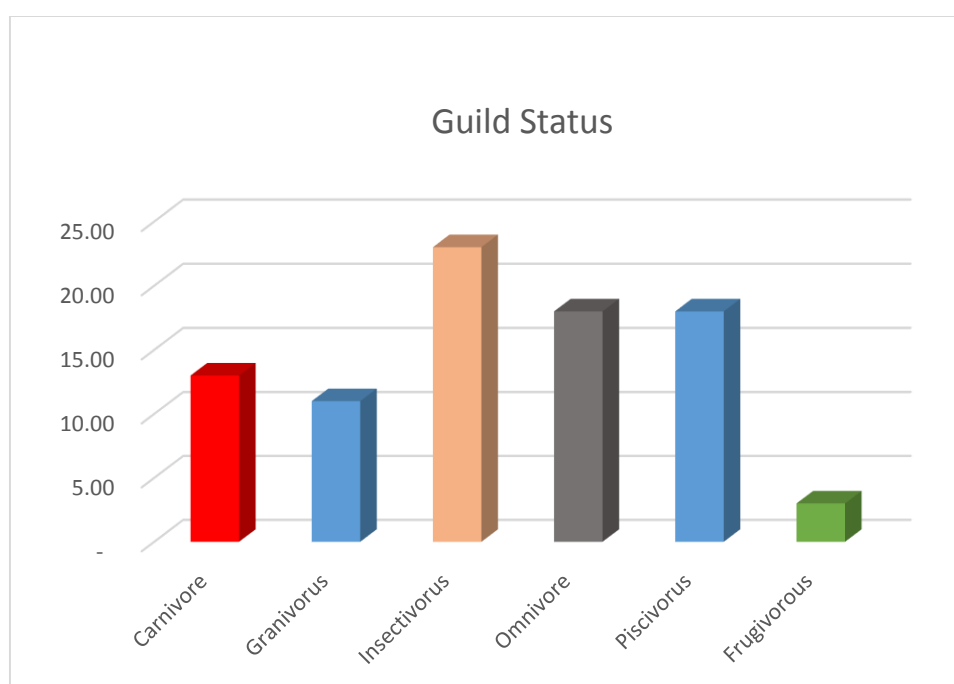
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|    |                            |                                  |     |     |     |                          |
|----|----------------------------|----------------------------------|-----|-----|-----|--------------------------|
| 4  | Cotton pygmy Goose(Teal)   | <i>Nettapus coromandelianus</i>  | 106 | 81  | 98  | Omnivorus                |
| 5  | Garganey                   | <i>Spatula querquedula</i>       | 74  | -   | 71  | Omnivorus                |
| 6  | Indian Spot billed Duck    | <i>Anas poecilorhyncha</i>       | 29  | 27  | 31  | Omnivorus                |
| 7  | Knob billed Duck           | <i>Sarkidiornis melanotos</i>    | 23  | 56  | 21  | Piscivorus               |
| 8  | Lesser Whistling Duck      | <i>Dendrocygna javanica</i>      | 28  | 23  | 33  | Omnivorus                |
| 9  | House Swift                | <i>Apus nipalensis</i>           | 67  | 56  | 75  | Insectivorus             |
| 10 | Eurasian Hoopoe            | <i>Upupa epops</i>               | 17  | 16  | 11  | Insectivorus             |
| 11 | Little Ringed Plover       | <i>Charadrius dubius</i>         | 17  | 18  | 15  | Insectivorus             |
| 12 | Bronze winged Jacana       | <i>Metopidius indicus</i>        | 67  | 113 | 85  | Insectivore, Granivore   |
| 13 | Pheasant tailed Jacana     | <i>Hydrophasianus chirurgus</i>  | 67  | 113 | 88  | Insectivorus             |
| 14 | River Tern                 | <i>Sterna aurantia</i>           | 23  | 20  | 33  | Piscivorus               |
| 15 | Wiskered Turn              | <i>Chlidonias hybrida</i>        | 12  | 15  | 11  | Piscivorus               |
| 16 | Black winged Stilt         | <i>Himantopus himantopus</i>     | 22  | 11  | 29  | Insectivorus             |
| 17 | common redshank            | <i>Tringa totanus</i>            | 7   | -   | 21  | Carnivore                |
| 18 | Common Sandpiper           | <i>Actitis hypoleucos</i>        | 11  | 19  | 38  | Carnivore                |
| 19 | Asian Openbill             | <i>Anastomus oscitans</i>        | 158 | 744 | 90  | Piscivorus               |
| 20 | Painted Stork              | <i>Mycteria leucocephala</i>     | 64  | 249 | 510 | Piscivorus               |
| 21 | Euression collared Dove    | <i>Streptopelia decaocto</i>     | 29  | 35  | 31  | Granivorus               |
| 22 | Laughing Dove              | <i>Spilopelia senegalensis</i>   | 46  | 54  | 62  | Granivorus               |
| 23 | Rock Pigeon                | <i>Columba livia</i>             | 54  | 57  | 49  | Granivorus               |
| 24 | Spotted Dove               | <i>Spilopelia chinensis</i>      | 36  | 36  | 33  | Granivorus               |
| 25 | Common Kingfisher          | <i>Alcedo atthis</i>             | 4   | 8   | 7   | Piscivorus               |
| 26 | Pied Kingfisher            | <i>Ceryle rudis</i>              | 8   | 9   | 17  | Piscivorus               |
| 27 | White Throated King Fisher | <i>Halcyon smyrnensis</i>        | 17  | 21  | 18  | Piscivorus               |
| 28 | Euression Roller           | <i>Coracias garrulus</i>         | 8   | 6   | 15  | Insectivorus             |
| 29 | Indian Roller              | <i>Coracias benghalensis</i>     | 12  | 9   | 11  | Insectivorus             |
| 30 | Green Bee eater            | <i>Merops orientalis</i>         | 30  | 53  | 79  | Insectivorus             |
| 31 | Asian Koel                 | <i>Eudynamis scolopaceus</i>     | 36  | 32  | 21  | Frugivorus, Insectivorus |
| 32 | Common Cuckoo              | <i>Cuculus canorus</i>           | 2   | 5   | 4   | Insectivorus             |
| 33 | Pied Cuckoo                | <i>Clamator jacobinus</i>        | -   | 16  | 12  | Insectivorus             |
| 34 | Common Quail               | <i>Coturnix coturnix</i>         | 53  | 56  | 53  | Granivorus               |
| 35 | Gray Francolin             | <i>Francolinus pondicerianus</i> | 68  | 67  | 73  | Insectivorus             |
| 36 | Indian Peafowl             | <i>Pavo cristatus</i>            | 30  | 42  | 35  | Omnivorus                |
| 37 | Painted Francolin          | <i>Francolinus pictus</i>        | 10  | 9   | 7   | Granivorus               |
| 38 | Rain Quail                 | <i>Coturnix coromandelica</i>    | 16  | 32  | 17  | Omnivorus                |
| 39 | Comman Moorhen             | <i>Gallinula chloropus</i>       | 58  | 54  | 56  | Omnivorus                |

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|    |                            |                                  |       |     |       |                         |
|----|----------------------------|----------------------------------|-------|-----|-------|-------------------------|
| 40 | Eurasian Coot              | <i>Fulica atra</i>               | 95    | 74  | 85    | Omnivorus               |
| 41 | Purple Moorhen             | <i>Porphyrio porphyrio</i>       | 81    | 91  | 89    | Granivorus              |
| 42 | White Breasted Water Heron | <i>Amaurornis phoenicurus</i>    | 49    | 49  | 47    | Omnivorus               |
| 43 | Ashy Prinia                | <i>Prinia socialis</i>           | 32    | 36  | 35    | Insectivorus            |
| 44 | common tailorbird          | <i>Orthotomus sutorius</i>       | 28    | 33  | 43    | Insectivorus            |
| 45 | House Crow                 | <i>Corvus splendens</i>          | 12    | 23  | 20    | Omnivorus, varnivorus   |
| 46 | Jungle Crow                | <i>Corvus macrorhynchos</i>      | 9     | 12  | 14    | Carnivore               |
| 47 | Black Drongo               | <i>Dicrurus macrocercus</i>      | 104   | 93  | 96    | Insectivorus            |
| 48 | Gray necked Bunting        | <i>Emberiza buchanani</i>        | 35    | 47  | 57    | Omnivorus               |
| 49 | Indian Silverbill          | <i>Euodice malabarica</i>        | 130   | 107 | 128   | Granivorus              |
| 50 | Dusky Creg Martin          | <i>Ptyonoprogne concolor</i>     | 13    | 11  | 15    | Insectivorus            |
| 51 | Wire Tailed swallow        | <i>Hirundo smithii</i>           | 65    | 73  | 69    | Insectivorus            |
| 52 | Bay backed Shrike          | <i>Lanius vittatus</i>           | 30    | 77  | 43    | Carnivore               |
| 53 | Long tailed Shrike         | <i>Lanius schach</i>             | 6     | 6   | 7     | Carnivore               |
| 54 | Jungle Babbler             | <i>Turdoides striata</i>         | 180   | 169 | 177   | Insectivorus            |
| 55 | Large Grey Babbler         | <i>Argya malcolmi</i>            | 80    | 86  | 72    | Omnivorus, Insectivorus |
| 56 | white Browed Wegtail       | <i>Motacilla maderaspatensis</i> | 9     | 14  | 12    | Insectivorus            |
| 57 | White Wagtail              | <i>Motacilla alba</i>            | 23    | 22  | 18    | Insectivorus            |
| 58 | Indian Robin               | <i>Copsychus fulicatus</i>       | 89    | 83  | 82    | Insectivorus            |
| 59 | Purple Sunbird             | <i>Cinnyris asiaticus</i>        | 58    | 56  | 56    | Frugivorus              |
| 60 | House sparrow              | <i>Passer domesticus</i>         | 53    | 51  | 46    | Omnivorus               |
| 61 | Baya weaver                | <i>Ploceus philippinus</i>       | 69    | 51  | 76    | Granivorus              |
| 62 | Red Vented Bulbul          | <i>Pycnonotus cafer</i>          | 41    | 44  | 46    | Omnivorus, Insectivorus |
| 63 | brahminy starling          | <i>Sturnia pagodarum</i>         | 41    | 41  | 42    | Insectivorus            |
| 64 | Common Maina               | <i>Acridotheres tristis</i>      | 69    | 70  | 73    | Omnivorus, Insectivorus |
| 65 | Paid Starling              | <i>Gracupica contra</i>          | 14    | 3   | 18    | Insectivorus            |
| 66 | Rosy Starling              | <i>Pastor roseus</i>             | 1,540 | 770 | 2,010 | Omnivorus               |
| 67 | Cattle Egret               | <i>Bubulcus ibis</i>             | 210   | 425 | 319   | Piscivorus              |
| 68 | Gray Heron                 | <i>Ardea cinerea</i>             | 16    | 31  | 34    | Piscivorus              |
| 69 | Great Egret                | <i>Ardea alba</i>                | 99    | 105 | 93    | Insectivorus            |
| 70 | Indian Pond Heron          | <i>Ardeola grayii</i>            | 69    | 73  | 73    | Granivorus              |
| 71 | Intermediate Egret         | <i>Ardea intermedia</i>          | 44    | 54  | 59    | Carnivore               |
| 72 | Little Egret               | <i>Egretta garzetta</i>          | 56    | 138 | 118   | Piscivorus              |
| 73 | Night heron                | <i>Nycticorax nycticorax</i>     | 70    | 65  | 72    | Carnivore               |
| 74 | Pond Heron                 | <i>Ardeola grayii</i>            | 60    | 57  | 58    | Granivorus              |
| 75 | Purple Heron               | <i>Ardea purpurea</i>            | 54    | 72  | 65    | Carnivore               |

|    |                      |                                    |     |     |     |            |
|----|----------------------|------------------------------------|-----|-----|-----|------------|
| 76 | Black Ibis           | <i>Plegadis falcinellus</i>        | 23  | 21  | 15  | Piscivorus |
| 77 | Black headed Ibis    | <i>Threskiornis melanocephalus</i> | 156 | 203 | 155 | Carnivore  |
| 78 | Eurasian Spoonbill   | <i>Platalea leucorodia</i>         | 28  | 27  | 28  | Carnivore  |
| 79 | Glossy Ibis          | <i>Plegadis falcinellus</i>        | 395 | 150 | 253 | Piscivorus |
| 80 | Plum Headed Parakeet | <i>Psittacula cyanocephala</i>     | 89  | 111 | 104 | Frugivorus |
| 81 | Rose Ring Parakeet   | <i>Psittacula krameri</i>          | 136 | 152 | 145 | Frugivorus |
| 82 | Spotted Owlet        | <i>Athene brama</i>                | 8   | 14  | 8   | Carnivore  |
| 83 | Oriental Darter      | <i>Anhinga melanogaster</i>        | 32  | 29  | 34  | Piscivorus |
| 84 | Great Cormorant      | <i>Phalacrocorax carbo</i>         | 27  | 14  | 27  | Piscivorus |
| 85 | Indian Cormorant     | <i>Phalacrocorax fuscicollis</i>   | 48  | 51  | 102 | Piscivorus |
| 86 | Little Cormorant     | <i>Microcarbo niger</i>            | 393 | 370 | 583 | Piscivorus |



In Gamela Pond, Rajasthan, India, wetland bird species were classified by their main food sources to explore their fostering guild structure. Carnivorous, granivorous, omnivorous, insectivorous, piscivorous, and frugivorous were the main feeding guilds. A quantitative analysis of bird species' dietary preferences showed a variable distribution among guilds. The majority of species were insectivorous, with 23 species (26.74%). This dominance shows insects are a major food resource in the studied region.

Omnivorous and piscivorous species made up 20.93% of the total with 18 each. This implies a large population of omnivorous and piscivorous birds. 13 vertebrate-eating carnivorous species made up 15.12% of the total. 11 species—12.79%—were granivorous, eating seeds and grains.

Only 3 frugivorous species (3.48% of the total) eat fruit.

This research shows Gamela Pond Sagwara wetlands birds' various eating methods. Distribution of species across feeding guilds indicates environmental diversity and richness of food supplies.

Insects are essential to marsh trophic dynamics because to their frequency. The low number of frugivorous species may imply that fruit supplies are few or that the local avifauna is less fruit-dependent. These findings illuminate wetland habitat ecological interactions and help explain animal community structure.

As a result, wetland birds use a range of habitats and are reliant on a mosaic of microhabitats to survive. For the marsh birds, paddy fields with stray trees and a dispersed vegetative cover may have provided comfortable cover and ideal feeding areas. Wetland bird diversity is further increased by this habitat's support of a variety of food sources, including fish, crabs, invertebrates, water plants, and planktons (Basavarajappa, 2004). With a rise in the number of food layers, the number of possible niches for birds likewise increases, leading to a corresponding increase in the diversity of avian species. The reason for this is the distinct eating behavior of birds, which results in the partitioning of ecological niches (MacArthur, 1964).

### Seasonal variation of Bird

| Sr. no | COMMON NAME               | SCIENTIFIC NAME                    | Pre Monsoon | Monsoon | Post Monsoon | GM    | SE   | CD5  | CD1   | CV    |
|--------|---------------------------|------------------------------------|-------------|---------|--------------|-------|------|------|-------|-------|
| 1      | Rosy Starling             | <i>Pastor roseus</i>               | 461.25      | 242.5   | 354.38       | 352.7 | 28.2 | 83.7 | 114.7 | 22.58 |
| 2      | Painted Stork             | <i>Mycteria leucocephala</i>       | 94.5        | 60.88   | 35           | 63.46 | 10.6 | 31.5 | 43.16 | 47.22 |
| 3      | Little Cormorant          | <i>Microcarbo niger</i>            | 93.75       | 101     | 122          | 105.6 | 11.2 | 33.4 | 45.73 | 30.07 |
| 4      | Cattle Egret              | <i>Bubulcus ibis</i>               | 83.75       | 78.13   | 70.5         | 77.46 | 3.78 | 11.2 | 15.4  | 13.81 |
| 5      | Glossy Ibis               | <i>Plegadis falcinellus</i>        | 76.38       | 44.38   | 80           | 66.92 | 3.16 | 9.38 | 12.87 | 13.35 |
| 6      | Asian Openbill            | <i>Anastomus oscitans</i>          | 69.38       | 74.88   | 107.5        | 83.92 | 12.9 | 38.5 | 52.73 | 43.63 |
| 7      | Black-headed Ibis         | <i>Threskiornis melanocephalus</i> | 43.75       | 39.5    | 45.25        | 42.83 | 1.91 | 5.67 | 7.78  | 12.6  |
| 8      | Rose Ring Parakeet        | <i>Psittacula krameri</i>          | 37          | 35.13   | 35.88        | 36    | 0.74 | 2.19 | 3     | 5.78  |
| 9      | Indian Silverbill         | <i>Euodice malabarica</i>          | 29.38       | 28.5    | 29.25        | 29.04 | 1.02 | 3.04 | 4.16  | 9.95  |
| 10     | Little Egret              | <i>Egretta garzetta</i>            | 27.75       | 23.88   | 25.13        | 25.58 | 1.21 | 3.6  | 4.93  | 13.38 |
| 11     | Jungle Babbler            | <i>Turdoides striata</i>           | 27.38       | 26.38   | 28.5         | 27.42 | 0.76 | 2.26 | 3.1   | 7.86  |
| 12     | Black Drongo              | <i>Dicrurus macrocercus</i>        | 24.75       | 24.63   | 24           | 24.46 | 0.67 | 1.99 | 2.73  | 7.75  |
| 13     | Plum Headed Parakeet      | <i>Psittacula cyanocephala</i>     | 24.63       | 26.38   | 24.75        | 25.25 | 0.67 | 2    | 2.75  | 7.55  |
| 14     | Great Egret               | <i>Ardea alba</i>                  | 24.38       | 23.75   | 25.38        | 24.5  | 0.67 | 2    | 2.74  | 7.76  |
| 15     | Cotton pygmy Goose (Teal) | <i>Nettapus coromandelianus</i>    | 22.88       | 25.13   | 22.38        | 23.46 | 0.88 | 2.6  | 3.56  | 10.55 |
| 16     | Pheasant-tailed Jacana    | <i>Hydrophasianus chirurgus</i>    | 22.13       | 22.63   | 25.5         | 23.42 | 1.14 | 3.39 | 4.64  | 13.76 |
| 17     | Indian Robin              | <i>Copsychus fulicatus</i>         | 21.25       | 21.88   | 18.38        | 20.5  | 1.19 | 3.53 | 4.84  | 16.4  |
| 18     | Eurasian Coot             | <i>Fulica atra</i>                 | 21          | 23.5    | 19.13        | 21.21 | 0.75 | 2.22 | 3.04  | 9.96  |
| 19     | Bronze-winged Jacana      | <i>Metopidius indicus</i>          | 20.63       | 22.13   | 24.13        | 22.29 | 0.85 | 2.52 | 3.45  | 10.74 |
| 20     | Large Grey Babbler        | <i>Argya malcolmi</i>              | 20.25       | 20.13   | 18.75        | 19.71 | 0.63 | 1.87 | 2.56  | 9.01  |
| 21     | Indian Pond-Heron         | <i>Ardeola grayii</i>              | 18.5        | 17.25   | 17.63        | 17.79 | 0.33 | 0.97 | 1.33  | 5.17  |
| 22     | Common Maina              | <i>Acridotheres tristis</i>        | 18.5        | 18      | 16.75        | 17.75 | 0.61 | 1.8  | 2.47  | 9.67  |
| 23     | Purple Moorhen            | <i>Porphyrio porphyrio</i>         | 18.5        | 20.75   | 22.25        | 20.5  | 0.77 | 2.28 | 3.12  | 10.57 |
| 24     | Gray Francolin            | <i>Francolinus pondicerianus</i>   | 17.75       | 18.25   | 17.63        | 17.88 | 0.6  | 1.79 | 2.45  | 9.53  |
| 25     | Jungle Babbler            | <i>Argya striata</i>               | 17.5        | 15.25   | 12.75        | 15.17 | 0.83 | 2.46 | 3.37  | 15.42 |
| 26     | Wire Tailed swallow       | <i>Hirundo smithii</i>             | 17.13       | 17.13   | 17.38        | 17.21 | 0.65 | 1.92 | 2.63  | 10.63 |
| 27     | House Swift               | <i>Apus nipalensis</i>             | 16.25       | 16.63   | 15.38        | 16.08 | 0.71 | 2.12 | 2.9   | 12.52 |
| 28     | Night heron               | <i>Nycticorax nycticorax</i>       | 16.13       | 17.5    | 15.88        | 16.5  | 0.81 | 2.41 | 3.3   | 13.89 |
| 29     | Baya weaver               | <i>Ploceus philippinus</i>         | 15.13       | 16.38   | 14.25        | 15.25 | 0.61 | 1.81 | 2.48  | 11.31 |
| 30     | Indian Cormorant          | <i>Phalacrocorax fuscicollis</i>   | 15          | 20.13   | 14.38        | 16.5  | 0.96 | 2.85 | 3.91  | 16.44 |
| 31     | Purple Heron              | <i>Ardea purpurea</i>              | 14.88       | 15.75   | 15.63        | 15.42 | 0.49 | 1.44 | 1.98  | 8.91  |
| 32     | Purple Sunbird            | <i>Cinnyris asiaticus</i>          | 14.5        | 13.75   | 13           | 13.75 | 0.47 | 1.39 | 1.91  | 9.62  |

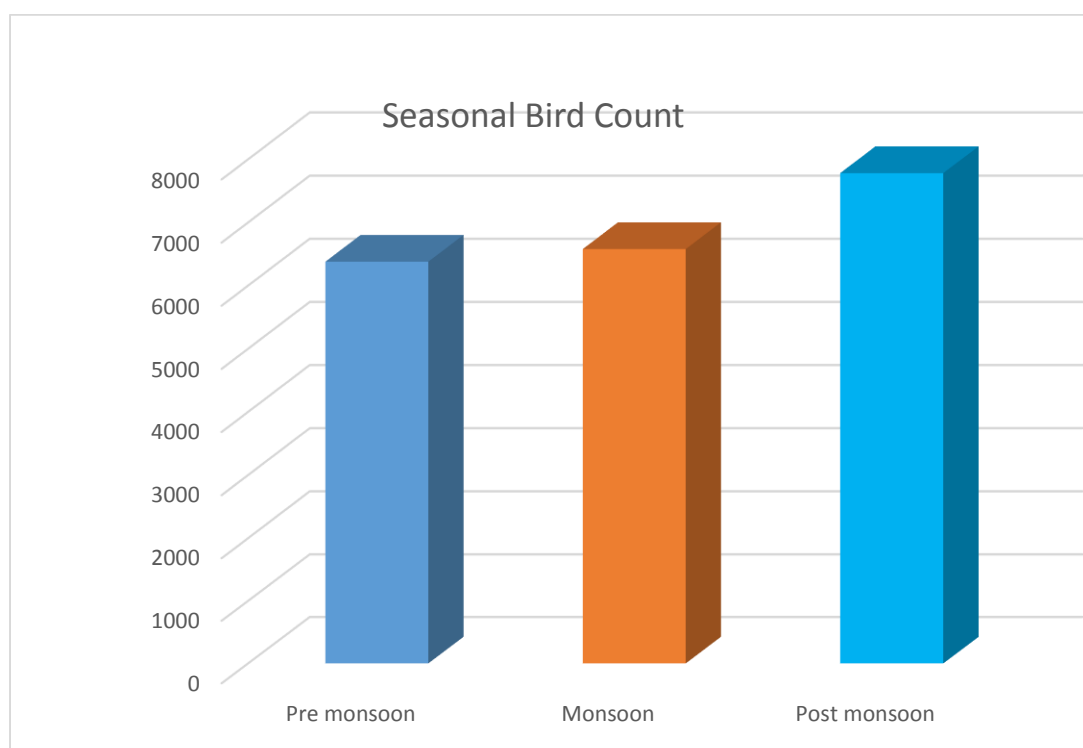
*Seasonal Variation in Avian Diversity and Guild Composition at Gamela Pond and its ..*

|    |                            |                                |       |       |       |       |      |      |       |       |
|----|----------------------------|--------------------------------|-------|-------|-------|-------|------|------|-------|-------|
| 33 | Black Kite                 | <i>Milvus migrans</i>          | 14.38 | 13.25 | 13.25 | 13.63 | 0.59 | 1.75 | 2.4   | 12.2  |
| 34 | Common Moorhen             | <i>Gallinula chloropus</i>     | 14.25 | 12.88 | 13.13 | 13.42 | 0.54 | 1.6  | 2.19  | 11.32 |
| 35 | Common Quail               | <i>Coturnix coturnix</i>       | 13.38 | 14    | 13.13 | 13.5  | 0.76 | 2.25 | 3.08  | 15.86 |
| 36 | Laughing Dove              | <i>Spilopelia senegalensis</i> | 13.25 | 13.75 | 13.25 | 13.42 | 0.66 | 1.97 | 2.71  | 14    |
| 37 | House sparrow              | <i>Passer domesticus</i>       | 13.13 | 12.25 | 12.13 | 12.5  | 0.42 | 1.25 | 1.71  | 9.52  |
| 38 | Rock Pigeon                | <i>Columba livia</i>           | 13    | 13.88 | 13.13 | 13.33 | 0.45 | 1.32 | 1.81  | 9.44  |
| 39 | Green Bee-eater            | <i>Merops orientalis</i>       | 12.88 | 16.63 | 9.88  | 13.13 | 0.62 | 1.84 | 2.52  | 13.35 |
| 40 | Intermediate Egret         | <i>Ardea intermedia</i>        | 12.75 | 12.75 | 13.13 | 12.88 | 0.63 | 1.86 | 2.55  | 13.73 |
| 41 | White Breasted Water Heron | <i>Amaurornis phoenicurus</i>  | 12.5  | 12.38 | 12.5  | 12.46 | 0.67 | 1.99 | 2.73  | 15.22 |
| 42 | Bay-backed Shrike          | <i>Lanius vittatus</i>         | 11.88 | 12.5  | 11.25 | 11.88 | 1.07 | 3.19 | 4.38  | 25.59 |
| 43 | Knob-billed Duck           | <i>Sarkidiornis melanotos</i>  | 11    | 6     | 9.88  | 8.96  | 1.18 | 3.51 | 4.82  | 37.33 |
| 44 | brahminy starling          | <i>Sturnia pagodarum</i>       | 10.5  | 11.38 | 9     | 10.29 | 0.65 | 1.93 | 2.65  | 17.85 |
| 45 | Red Vented Bulbul          | <i>Pycnonotus cafer</i>        | 10.25 | 11    | 11.25 | 10.83 | 0.44 | 1.31 | 1.8   | 11.51 |
| 46 | Gray-necked Bunting        | <i>Emberiza buchanani</i>      | 9.38  | 11.13 | 10.38 | 10.29 | 0.7  | 2.08 | 2.85  | 19.2  |
| 47 | Black-winged Stilt         | <i>Himantopus himantopus</i>   | 8.63  | 4.13  | 5.88  | 6.21  | 0.77 | 2.3  | 3.15  | 35.26 |
| 48 | Common Sandpiper           | <i>Actitis hypoleucos</i>      | 8.63  | 6.13  | 6.25  | 7     | 1.03 | 3.07 | 4.21  | 41.72 |
| 49 | Spotted Dove               | <i>Spilopelia chinensis</i>    | 8.63  | 9     | 8.38  | 8.67  | 0.4  | 1.2  | 1.65  | 13.18 |
| 50 | common tailorbird          | <i>Orthotomus sutorius</i>     | 8.63  | 9.75  | 7.88  | 8.75  | 0.57 | 1.71 | 2.34  | 18.57 |
| 51 | River Tern                 | <i>Sterna aurantia</i>         | 8.5   | 6.38  | 6.5   | 7.13  | 0.81 | 2.41 | 3.31  | 32.2  |
| 52 | Garganey                   | <i>Spatula querquedula</i>     | 8.25  | 8.38  | 18.88 | 11.83 | 3.95 | 11.7 | 16.09 | 94.41 |
| 53 | Oriental Darter            | <i>Anhinga melanogaster</i>    | 8.13  | 7.75  | 7.75  | 7.88  | 0.32 | 0.95 | 1.3   | 11.5  |
| 54 | Indian Spot-billed Duck    | <i>Anas poecilorhyncha</i>     | 8     | 9.5   | 7.13  | 8.21  | 0.71 | 2.11 | 2.89  | 24.41 |
| 55 | Eurasian collared Dove     | <i>Streptopelia decaocto</i>   | 7.88  | 8.25  | 7.88  | 8     | 0.47 | 1.4  | 1.92  | 16.67 |
| 56 | Ashy Prinia                | <i>Prinia socialis</i>         | 7.88  | 8.25  | 8.88  | 8.33  | 0.41 | 1.21 | 1.66  | 13.86 |
| 57 | Asian Koel                 | <i>Eudynamis scolopaceus</i>   | 7.75  | 7.5   | 7     | 7.42  | 0.34 | 1.02 | 1.4   | 13.1  |
| 58 | Lesser Whistling-Duck      | <i>Dendrocygna javanica</i>    | 7     | 8     | 7     | 7.33  | 1.1  | 3.26 | 4.46  | 42.28 |
| 59 | Eurasian Spoonbill         | <i>Platalea leucorodia</i>     | 6.63  | 6.88  | 6.88  | 6.79  | 0.4  | 1.19 | 1.64  | 16.73 |
| 60 | Great Cormorant            | <i>Phalacrocorax carbo</i>     | 6.38  | 6.88  | 5.38  | 6.21  | 0.78 | 2.33 | 3.19  | 35.67 |
| 61 | Indian Peafowl             | <i>Pavo cristatus</i>          | 5.75  | 7.25  | 11.13 | 8.04  | 1.19 | 3.53 | 4.83  | 41.73 |
| 62 | White Wagtail              | <i>Motacilla alba</i>          | 5.25  | 5.38  | 4.63  | 5.08  | 0.29 | 0.86 | 1.18  | 16.06 |
| 63 | Gray Heron                 | <i>Ardea cinerea</i>           | 5     | 8.5   | 6.5   | 6.67  | 0.37 | 1.11 | 1.52  | 15.81 |
| 64 | Black Ibis                 | <i>Plegadis falcinellus</i>    | 4.88  | 5.25  | 5     | 5.04  | 0.35 | 1.04 | 1.43  | 19.7  |
| 65 | Rain Quail                 | <i>Coturnix coromandelica</i>  | 4.75  | 4.63  | 5.75  | 5.04  | 0.48 | 1.44 | 1.97  | 27.16 |
| 66 | White Throated King Fisher | <i>Halcyon smyrnensis</i>      | 4.5   | 5     | 3.75  | 4.42  | 0.34 | 1.02 | 1.4   | 22    |
| 67 | Common Pochard             | <i>Aythya ferina</i>           | 4     | 5.13  | 9.88  | 6.33  | 2.25 | 6.7  | 9.18  | 100.7 |
| 68 | Little Ringed Plover       | <i>Charadrius dubius</i>       | 3.63  | 4.13  | 4.38  | 4.04  | 0.28 | 0.83 | 1.14  | 19.56 |
| 69 | Eurasian Hoopoe            | <i>Upupa epops</i>             | 3.63  | 8     | 3.13  | 4.92  | 1.04 | 3.08 | 4.22  | 59.59 |
| 70 | Dusky Creg Martin          | <i>Ptyonoprogne concolor</i>   | 3.25  | 3     | 2.5   | 2.92  | 0.28 | 0.82 | 1.13  | 26.8  |
| 71 | Wiskered Turn              | <i>Chlidonias hybrida</i>      | 3.13  | 2.88  | 3.38  | 3.13  | 0.38 | 1.14 | 1.56  | 34.77 |
| 72 | House Crow                 | <i>Corvus splendens</i>        | 3     | 4.75  | 5.13  | 4.29  | 0.31 | 0.92 | 1.26  | 20.37 |



|    |                         |                                  |      |      |      |      |      |      |      |       |
|----|-------------------------|----------------------------------|------|------|------|------|------|------|------|-------|
| 73 | white Browed<br>Wegtail | <i>Motacilla maderaspatensis</i> | 2.88 | 2.63 | 2.5  | 2.67 | 0.29 | 0.88 | 1.2  | 31.25 |
| 74 | Jungle Crow             | <i>Corvus macrorhynchos</i>      | 2.75 | 2.25 | 3    | 2.67 | 0.24 | 0.7  | 0.96 | 25    |
| 75 | Indian Roller           | <i>Coracias benghalensis</i>     | 2.63 | 2.63 | 2.63 | 2.63 | 0.35 | 1.03 | 1.41 | 37.29 |
| 76 | Eureasion Roller        | <i>Coracias garrulus</i>         | 2.5  | 2    | 2    | 2.17 | 0.39 | 1.15 | 1.57 | 50.44 |
| 77 | Pied Kingfisher         | <i>Ceryle rudis</i>              | 2.38 | 2.63 | 2.25 | 2.42 | 0.34 | 1.01 | 1.38 | 39.62 |
| 78 | Spotted Owlet           | <i>Athene brama</i>              | 2.38 | 3.25 | 2    | 2.54 | 0.43 | 1.27 | 1.74 | 47.51 |
| 79 | Paid Starling           | <i>Gracupica contra</i>          | 2.13 | 2    | 3.63 | 2.58 | 0.64 | 1.89 | 2.6  | 69.78 |
| 80 | Shikra                  | <i>Accipiter badius</i>          | 1.88 | 1.75 | 1.5  | 1.71 | 0.31 | 0.92 | 1.26 | 51.16 |
| 81 | Painted Francolin       | <i>Francolinus pictus</i>        | 1.88 | 1.88 | 1.63 | 1.79 | 0.3  | 0.9  | 1.24 | 47.89 |
| 82 | Common Kingfisher       | <i>Alcedo atthis</i>             | 1.75 | 1.75 | 1.63 | 1.71 | 0.27 | 0.81 | 1.11 | 45.24 |
| 83 | Pied Cuckoo             | <i>Clamator jacobinus</i>        | 1.75 | 2.63 | 1.63 | 2    | 0.35 | 1.04 | 1.42 | 49.3  |
| 84 | Long-tailed Shrike      | <i>Lanius schach</i>             | 1.63 | 1.63 | 1.5  | 1.58 | 0.18 | 0.53 | 0.72 | 31.58 |
| 85 | common redshank         | <i>Tringa totanus</i>            | 1.38 | 2.75 | 3.25 | 2.46 | 0.42 | 1.26 | 1.72 | 48.65 |
| 86 | Common Cuckoo           | <i>Cuculus canorus</i>           | 0.88 | 1.38 | 1    | 1.08 | 0.19 | 0.55 | 0.76 | 48.65 |

Pre Monsoon, Monsoon, Post Monsoon: Average abundance or count of each species in the respective season. GM (Geometric Mean): Central tendency of abundance across seasons. SE (Standard Error): Indicates variability or precision of the sample mean. CD5, CD1: Critical Differences at 5% and 1% significance levels, respectively, for comparing means. CV (Coefficient of Variation %): Relative variability in abundance, expressed as a percentage.



Field data gathered in the existing study regarding population abundance, species richness, species diversity, and species evenness were aggregated according to three seasons: pre-monsoon (March-June), monsoon (July-October), and post-monsoon (October-February) to determine the seasonal pattern of wetland bird assemblages in the study area. During the post-monsoon season, a maximum of 86 species were seen, although the pre-monsoon season recorded 85 species and the monsoon season recorded 83 species.

The avian community at Gamela pond and its wetland demonstrates varied population dynamics, with the *Pastor roseus* predominating in the pre-monsoon phase, yet exhibiting notable seasonal variations (CV = 22.58%). This species peaks prior to the monsoon, decreases during the monsoon, and subsequently rebounds. Various species, such as the *Mycteria leucocephala*, *Microcarbo niger*, and *Bubulcus ibis*, exhibit larger populations yet demonstrate moderate to high seasonal fluctuations. The *Psittacula krameri* and *Euodice*

*malabarica* exhibit stable populations throughout the year, as evidenced by their low Coefficient of Variation (CV) values. The *Mycteria leucocephala* and *Anastomus oscitans* demonstrate high coefficients of variation (CVs) exceeding 40%, indicating significant seasonal fluctuations. The *Psittacula krameri* and *Turdoides striata* exhibit low CVs below 10%, reflecting population stability. The majority of other species are categorized within a moderate variability range of 10-30%. Species exhibiting high coefficients of variation (CVs) may demonstrate migratory behaviour, heightened sensitivity to seasonal variations, or dependence on specific seasonal resources. In contrast, species with low CVs are typically resident, well-adapted to their local environments, and less reliant on seasonal fluctuations. This data is essential for bird conservation planning, elucidating seasonal migration patterns, identifying vulnerable species requiring targeted intervention, and assessing the overall health of the ecosystem via its bird populations in Gamela pond and its wetland.

It has been claimed that water birds have exploited the availability of water as proximal signals to help in their broad-scale selection of habitat preference according to Austin, 2002. Water birds exhibit significant mobility throughout the winter season, relocating to different regions in response to several causes including low temperatures, fluctuations in water levels, and variations in food availability (Kershaw and Cranswick, 2003).

#### **Threats:**

Irrigation and agricultural water extraction near wetland boundaries limit water supply and alter hydrological regimes, thereby impacting bird habitats.

Conversion of wetland margins into agricultural land reduces breeding and feeding opportunities for insectivorous and piscivorous birds, which constitute 26.74% and 20.93% of the avian guilds, respectively. The excessive utilisation of pond water for irrigation and livestock consumption modifies water levels, particularly during arid seasons, adversely affecting shallow-water species such as shorebirds and ducks.

Noise, traffic, and habitat fragmentation caused by National Highway 927A interfere with nesting and foraging activities.

Bird populations experience stress due to cattle grazing, fishing, and washing activities, which contribute to pollution and degradation of wetland boundaries.

#### **Conservation Status**

Conserving Gamela Pond, a key wetland in Sagwara, Rajasthan, demands an integrated approach to counter ecological threats and safeguard its rich avian diversity. Effective habitat restoration-such as groundwater recharge using check dams and native vegetation replanting-will stabilize water levels and restore essential bird habitats. Community involvement is crucial; promoting sustainable agriculture, eco-tourism, and regulated water use can reduce local pressures while generating support for conservation. Legal protection, including potential designation as a Community Reserve, will help restrict harmful activities, while ongoing monitoring of bird populations and water quality will inform adaptive management. Buffer zones, fencing, and signage are necessary to mitigate disturbances from highways, agriculture, and grazing, especially during breeding seasons. Targeted actions for vulnerable feeding guilds, like protecting riparian zones for insectivores and piscivorous and restoring fruiting plants for frugivores, are vital. These coordinated strategies will help preserve Gamela Pond's ecological integrity and its role as a haven for diverse birdlife.

### **V. Conclusion:**

The examination of avian feeding guilds and population dynamics at Gamela Pond, Rajasthan, highlights the ecological intricacies and importance of this semi-arid wetland. The quantitative analysis indicated a prevalence of insectivorous species, underscoring the essential function of insects within the marsh's food web. Omnivorous and piscivorous birds constituted significant segments of the community, whereas frugivores were markedly rare, probably indicating restricted fruit availability or specific habitat requirements. Seasonal fluctuations in population, as demonstrated by coefficients of variation, differentiated migratory or seasonally sensitive species from stable, resident populations. Species like the Rosy Starling and Painted Stork displayed significant seasonal variations, indicating a dependence on particular resources or migratory patterns. In contrast, the Rose-ringed Parakeet and Jungle Babbler showed consistent populations throughout the year, reflecting a robust adaptation to their local environments. The results of this study are essential for conservation strategies, as they assist in pinpointing at-risk guilds and species that need focused management efforts. The variety and seasonal changes in bird populations act as indicators of wetland health, highlighting the importance of habitat protection, sustainable water management, and addressing human-induced threats like agriculture and

disturbances from adjacent highways. The findings establish a basis for effective conservation strategies aimed at maintaining the ecological health of Gamela Pond and its bird populations.

### References:

- [1]. Ali, S. and Ripley, S.D. (1983) A pictorial guide to the birds of the Indian subcontinent. Oxford University, Delhi.
- [2]. Basavaraja, S., Hiremath, S. M., Murthy, K. N. S., Chandrashekarappa, K. N., Anil, N. P., & Puttiah, E. T. (2011). Analysis of Water Quality Using Physicochemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India. *Global Journal of Science Frontier Research*, 1(3), 31-34.
- [3]. Carver, E. (2009) Birding in the United States: A demographic and economic analysis: Addendum to the 2006 national survey of fishing, hunting, and wildlife-associated recreation. *US Fish and Wildlife Publication*.
- [4]. Coppes, J., Nopp-Mayr, U., Gruenschachner-Berger, V., Storch, I., Suchant, R., Braunisch, V., 2018. Habitat suitability modulates the response of wildlife to human recreation. *Biol. Conserv.* 227, 56–64.
- [5]. Dai, J., Zhou, Y., Wu, H., Zhang, Y., Zhu, K., 2019. Response of phytoplankton to banana cultivation: a case study of Lancang-Mekong River, southwestern China. *Sci. Rep.* 9, 9145.
- [6]. Grimmett, R. and Inskipp, T. (2007) Birds of Southern India. Om Books International, New Delhi, India.
- [7]. Kershaw, M., & Cranswick, P. A. (2003). Deriving Population Estimates for Wintering Wildfowl in Great Britain. *Ornis Hungarica*, 12-13, 75-87.
- [8]. Kumar, P. and Gupta, S.K. (2009) Diversity and Abundance of Wetland Birds around Kurukshetra, India. *Our Nature* 7(1), 212-217. doi: <https://doi.org/10.3126/on.v7i1.2574>.
- [9]. MacArthur, R. (1964). Environmental factors affecting bird species diversity. *The American Naturalist*, 98, 387-397.
- [10]. MEA. 2005. *Millennium Ecosystem Assessment: Ecosystems and Human Well-being*. Synthesis, Island Press.
- [11]. Morelli, F. 2015. Indicator species for avian biodiversity hotspots: Combination of specialists and generalists is necessary in less natural environments. *Journal for Nature Conservation*, 27, 54–62.
- [12]. Na, X., Zhou, H., Zang, S., Wu, C., Li, W., Li, M., 2018. Maximum Entropy modeling for habitat suitability assessment of Red-crowned crane. *Ecol. Ind.* 91, 439–446.
- [13]. Niemi, G. J., McDonald, M. E. 2004. Application of ecological indicators. *Annual Review of Ecology, Evolution and Systematics*, 35 (1), 89–111.
- [14]. O'Connell, T. J., Jackson, L. E., Brooks, R. P. 2000. Bird guilds as indicators of ecological condition in the central Appalachians. *Ecological Applications*, 10 (6), 1706–1721.
- [15]. Ogden, J.C., Baldwin, J.D., Bass, O.L., Browder, J.A., Cook, M.I., Frederick, P.C., et al. (2014) Waterbirds as indicators of ecosystem health in the coastal marine habitats of southern Florida: 1. Selection and justification for a suite of indicator species. *Ecological Indicators* 44: 148- 163. doi: <https://doi.org/10.1016/j.ecolind.2014.03.007>.
- [16]. Paracuellos M (2006) How can habitat selection affect the use of a wetland complex by waterbirds? *Biodiversity and Conservation*, 15: pp 4569-4582.
- [17]. Mitsch, W.I. and Gosselink, I.G., (1986) *Wetlands*. Van Nostrand Reinhold, New York.
- [18]. MoEF (1990) *Wetlands of India - A Directory*. Ministry of Environment and Forests, Govt. of India, New Delhi.
- [19]. Parekh, H. and I.R. Gadhvi (2013) Water bird diversity at Kumbharvada Marsh Land, Bhavnagar, Gujarat. *Life Sciences Leaflets* 44: 53–59.
- [20]. Buckton, S. (2007) Managing wetlands for sustainable livelihoods at Koshi Tappu. *Danphe* 16(1): 12-13.
- [21]. Austin, G. T. Tomoff, C. S. 1978. Relative abundance in bird populations. *Am.Nat.*, 112: 695-699.
- [22]. Pande S., Deshpande P. and Thatte S. (2016) Checklists: Birds of India (Endemic, Threatened and CITES species); Birds of Maharashtra (Species in schedules of WPA), Ela Foundation Pune and Forest Department, Maharashtra. PP 1-80.
- [23]. Praveen J., Jayapal, R. and Pite, A. (2016) A checklist of the birds of India. *Indian BIRDS* 11(5&6): 113-172.