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Seasonal Variation of Avifauna in Chintamani Kar Bird Sanctuary, West Bengal, India

Anish Ganguly

Department of Environmental Science, University of Calcutta, Kolkata, India

E-mail address: anishganguly70@gmail.com

ABSTRACT

Chintamani Kar Bird Sanctuary (CKBS), situated in the peri-urban zone of southern Kolkata, West Bengal, constitutes a critical refuge for avian biodiversity within an increasingly urbanised landscape. Encompassing approximately 17 acres, the sanctuary comprises a heterogeneous mosaic of vegetation types including semi-deciduous tree cover, bamboo stands, fruiting trees, and ephemeral aquatic features. These habitat structures provide essential ecological resources – such as food, nesting substrates, and microclimatic regulation – upporting both resident and migratory avifaunal communities. This study aims to examine the seasonal variation in avian diversity at CKBS, with a focus on how climatic fluctuations and associated habitat dynamics influence species richness, abundance, and community composition. Data were compiled through longitudinal field observations and literature synthesis across three major seasonal phases: pre-monsoon/summer (March – June), monsoon (July – September), and post-monsoon/winter (October – February). Avifaunal richness was observed to peak during the post-monsoon and winter periods, coinciding with the arrival of Palearctic migrants along the Central Asian Flyway. The cooler ambient temperatures, reduced evapotranspiration, and increased trophic resource availability during this period facilitated optimal foraging and roosting conditions. Notably, species adapted to high-humidity environments, including select Ardeidae and Columbidae, remained active. The pre-monsoon period exhibited moderate avian diversity, dominated by resident frugivores and granivores, with breeding activity peaking in synchrony with fruiting phenology of native flora. The findings of this study underscore the role of seasonal climatic variability and habitat heterogeneity in shaping temporal avifaunal dynamics within urban forest fragments. CKBS, despite its limited spatial extent, maintains high ornithological value and warrants continuous monitoring and conservation intervention to mitigate the impacts of anthropogenic encroachment and environmental change.

Keywords: Avifaunal Diversity, Seasonal Variability, Order, Family, Species

1. INTRODUCTION

West Bengal, situated in the eastern region of India, is famous for its avifaunal diversity. This richness stems from the state's vast ecological and topographical variation – ranging from the Himalayan foothills in the north to the Sundarbans' mangrove swamps in the south. The environmental diversity found across altitudinal and climatic gradients supports a wide range of bird species, including both resident and migratory taxa (Ali and Ripley, 1987). The state encompasses a variety of key avian habitats, including deciduous forests, wetlands, mangroves, grasslands, and coastal zones, rendering it an important region for ornithological research and avian conservation (Islam and Rahmani, 2004). According to recent avifaunal records, West Bengal is home to over 700 bird species, some of which are globally threatened or endemic to the Indian subcontinent (BirdLife International, 2022). Prominent birding hotspots such as the Neora Valley National Park, Buxa Tiger Reserve, and East Kolkata Wetlands highlight the importance of this region for both migratory corridors and resident bird populations. These protected and semi-protected areas, interspersed across various ecological zones, serve as critical habitats for numerous taxa, especially during breeding and migratory periods.

The southern region of West Bengal, including peri-urban and rural landscapes surrounding Kolkata, represents a mosaic of biodiversity. This area falls within the Lower Gangetic Plains, characterised by alluvial soils, seasonal wetlands, and high agricultural productivity. Such landscape heterogeneity provides a unique assemblage of habitats that supports both wetland-dependent and terrestrial bird species (Mukhopadhyay et al., 2021). Urbanisation has gradually transformed much of the landscape, yet numerous ecological pockets remain rich in avifauna. These include areas such as the Chintamani Kar Bird Sanctuary (CKBS) and the East Kolkata Wetlands (EKW) – both of which are crucial for bird conservation due to their habitat variety and positioning along the Central Asian Flyway (Sundar and Subramanya, 2010). This flyway is one of the most important migratory routes for birds travelling between Central Asia and the Indian subcontinent, and sites in southern West Bengal act as essential stopovers for refuelling, roosting, and breeding. Located in the southern periphery of Kolkata, CKBS is a small yet biologically rich forest patch that serves as an important refuge for both common and uncommon bird species. Although relatively modest in size (approximately 17 acres), the sanctuary supports diverse avifauna, including representatives from nine orders and 23 families (Sen, Biswas and Banerji, 2023).

Recent surveys have highlighted that the sanctuary maintains a healthy Shannon Diversity Index (2.84) and equitability (0.78), indicating not only species richness but also an even distribution among recorded taxa. CKBS is particularly significant as an example of urban biodiversity conservation, providing ecological services such as carbon sequestration, microclimate regulation, and educational opportunities for urban dwellers. It includes diverse microhabitats such as moist deciduous patches, bamboo groves, fruit-bearing trees, and small water bodies - all of which support varied foraging and nesting behaviours among bird species.

Seasonal variation profoundly influences avifaunal diversity in subtropical regions, where climatic fluctuations between dry and wet seasons drive significant ecological changes (Li et al. 2021). Birds, as bioindicators, are highly responsive to such shifts due to their sensitivity to habitat structure, food availability, and breeding conditions (Li et al. 2021). During the wet season, increased precipitation enhances primary productivity, leading to a surge in insect populations, flowering plants, and fruiting trees. This abundance supports a higher diversity and density of insectivorous and frugivorous bird species (Li et al., 2021).

Many resident species initiate breeding during this period, exploiting favorable conditions for nesting and chick-rearing (Liang et al., 2021). Migratory species also arrive from temperate and boreal zones, to utilize the feeding grounds and mild climate, thereby temporarily boosting regional avian diversity (Liang et al. 2021). In contrast, the dry season imposes resource constraints, such as reduced water availability and lower primary productivity. This causes shifts in species composition, as some birds migrate to wetter habitats or change their foraging strategies. Seed-eating species may become more dominant due to the persistence of dry-season food sources. Additionally, habitat conditions such as leaf cover and water body levels alter, affecting roosting and nesting opportunities. Subtropical regions often serve as both wintering grounds and migratory corridors, making them ecologically critical for global avifaunal diversity (Liang et al., 2021). Climate-driven phenological mismatches - such as altered timing of insect emergence or flowering - can disrupt these patterns, especially under the influence of climate change. Such disruptions can reduce reproductive success and alter interspecies interactions (Zhange et. al., 2020). Seasonality plays a significant role in determining the abundance and distribution of birds. It is influenced by the availability of food and cover, which in turn affects breeding behaviour and ultimately the survival of bird species (Mengesha and Bekele, 2008). Seasonal fluctuations in rainfall, temperature, and microhabitat conditions significantly influence the availability of food resources for birds, thereby affecting their abundance and distribution.

Roberto, et al., (2018) observed that seasonal variations in rainfall and temperature, along with spatial and temporal microhabitat conditions, impact the availability of various food items for birds. This seasonal variation can lead to changes in bird abundance and distribution patterns, as species adapt to the availability of resources (Girma et al., 2017). In tropical and subtropical regions, such as the southern Amazon Basin, seasonal differences in rainfall and food availability have been shown to affect the foraging behaviour of birds. For instance, during periods of increased rainfall, the abundance of arthropod prey items increases, leading to higher foraging rates and changes in feeding strategies among birds (Girma et al., 2017). Similarly, in semi-arid regions, the availability of water and food resources during the dry season can influence bird foraging behaviour. Studies have demonstrated that the provision of water sources can alter the value of food patches, affecting the foraging decisions of birds (Girma et al., 2017).

Furthermore, microhabitat conditions, such as vegetation structure and cover, play a crucial role in determining food availability and, consequently, bird abundance. Changes in vegetation due to seasonal variations can impact the abundance and distribution of food resources, thereby influencing bird populations (Girma et al., 2017). In a study in Orissa, it is found that avian diversity was notably high during the post-monsoon and winter seasons.

This can be attributed to the presence of migratory species, as well as favourable habitat conditions for resident birds. In contrast, both species richness and diversity were lower during the monsoon season, likely due to heavy rainfall, which reduces bird activity and affects nesting behaviour. Sites with extensive wetlands exhibited greater avian diversity. Wetlands not only provide essential habitat for waterbirds but also support terrestrial bird species through the presence of diverse peripheral vegetation.

In the study, Chilika showed the highest species richness and diversity, owing to its extensive wetland area compared to other surveyed sites. Similarly, the wetland in Koraput supported considerable avian diversity, likely due to the availability of a stable waterbody and

dense canopy cover. Moreover, wetlands located adjacent to agricultural landscapes also hosted a wide variety of bird species, as revealed by this study.

This indicates the role of both aquatic and terrestrial habitat heterogeneity in supporting avifaunal diversity (Panda et al., 2021). The spatial distribution of food and shelter resources plays a crucial role in determining the abundance and distribution of bird species. These resources are largely governed by vegetation structure and composition, which directly influence habitat use and species occupancy (Waterhouse, Mather and Seip, 2002). Vegetation not only provides foraging substrates and nesting sites but also influences predator avoidance and thermoregulation, all of which are critical for avian survival and reproduction. Environmental variables such as elevation, slope, and aspect are key drivers of vegetation heterogeneity. These topographical factors shape microclimatic conditions, which in turn affect vegetation composition, productivity, and phenological cycles (Hofer, Bersier and Felix, 1999; Waterhouse et al., 2002).

Elevation gradients, for instance, can lead to zonation in plant communities, thereby creating distinct habitat types that influence the spatial turnover of bird assemblages. Slope and aspect also modulate sunlight exposure and soil moisture, further contributing to vegetation variability. This, in turn, alters the availability of prey species (e.g., insects and seeds) and nesting materials, which are critical for sustaining breeding bird populations. As a result, bird species exhibit preferences for specific microhabitats based on their ecological requirements, leading to structured patterns of community composition across landscapes. Moreover, vegetation structure influences not only the static distribution of birds but also their dynamic behaviours such as seasonal migration. Birds may shift habitats seasonally in response to changes in food availability, which are closely tied to vegetative productivity (Lincoln, Peterson and Zimmerman, 1998).

The present study examines the annual and seasonal variations in bird diversity recorded over a three-year period at Chintamani Kar Bird Sanctuary (CKBS), located in the southern part of Kolkata, West Bengal. As a subtropical semi-urban forest patch, CKBS supports a wide variety of avian fauna, acting as a critical habitat for both resident and migratory species. Seasonal changes in temperature, rainfall, and vegetation phenology were found to significantly influence bird abundance and diversity throughout the study period.

2. STUDY AREA

Chintamani Kar Bird Sanctuary lies in unspoilt natural splendour on the outskirts of Kolkata, positioned at Latitude 22°25'44.4"N and Longitude 88°24'06.7"E (see Fig. 1). The area was originally designated as Narendrapur Wildlife Sanctuary. Subsequently, it was renamed Chintamani Kar Bird Sanctuary through on dated 21st October 2005, in honour of the renowned artist Chintamani Kar.

Chintamani Kar Bird Sanctuary (CKBS), situated in the southern suburbs of Kolkata, encompasses approximately 17 acres of diverse vegetation, primarily characterised by a dense canopy of mature trees. Dominant species include *Mangifera indica* (mango), *Artocarpus heterophyllus* (jackfruit), *Cocos nucifera* (coconut), *Tamarindus indica* (tamarind), *Psidium guajava* (guava), and *Ficus benghalensis* (banyan). This rich flora provides essential resources for a variety of avian species. The sanctuary's undergrowth is equally diverse, featuring shrubs, climbers, ferns, and grasses.

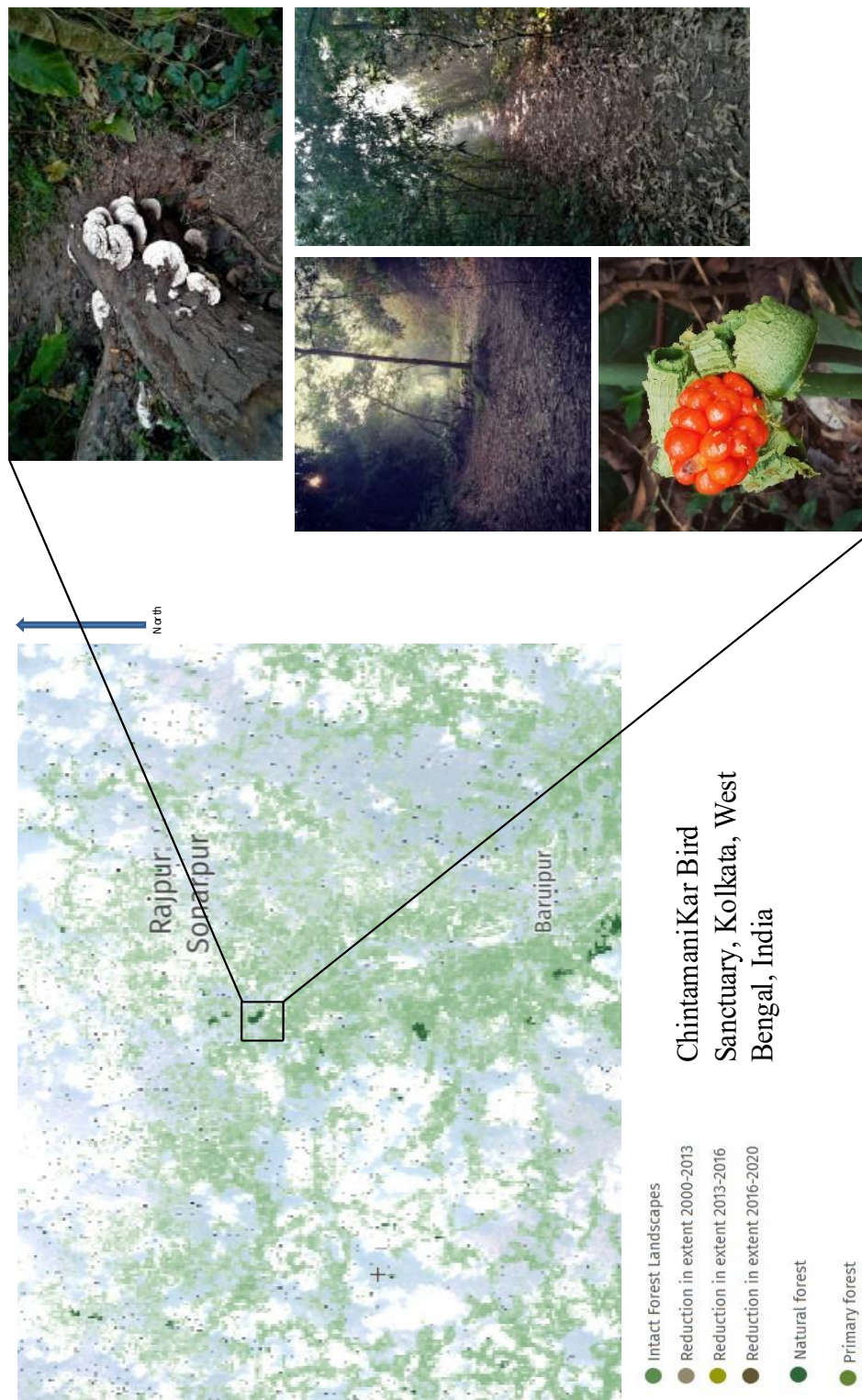


Figure 1. The location of Chintamani Kar Bird Sanctuary (CKBS) in southern West Bengal and the vegetation landscape.

Notably, species like *Mikania scandens*, *Lantana camara*, and *Dendrocalamus strictus* (bamboo) contribute to the structural complexity of the habitat, supporting both resident and migratory bird populations. Additionally, the presence of epiphytic plants, including orchids and ferns, adds to the sanctuary's ecological richness.

Seasonally, CKBS experiences distinct climatic variations that influence its ecological dynamics. The summer months are characterised by high temperatures, with daytime averages around 37 °C and nighttime temperatures dropping to approximately 32 °C. Humidity levels during this period can reach up to 91%, creating a humid environment conducive to the growth of various plant species. These conditions support a thriving insect population, which in turn sustains insectivorous bird species.

The monsoon season brings rainfall, leading to an increase in water availability and the growth of aquatic plants. This period is crucial for species like *Tringa glareola* (Wood Sandpiper) and *Anas acuta* (Northern Pintail), which rely on wetland habitats for feeding and breeding. The dense canopy cover also provides shelter for various bird species, reducing predation risk and facilitating nesting. In contrast, the winter months experience cooler temperatures, averaging around 27 °C during the day and 13 °C at night. Lower humidity levels during this season can lead to a decrease in insect populations, prompting insectivorous birds to adjust their foraging strategies.

3. METHODOLOGY

This study was conducted to assess the seasonal variation in avifaunal diversity at Chintamani Kar Bird Sanctuary (CKBS), situated in the southern peri-urban zone of Kolkata, West Bengal. To ensure consistent and replicable data collection across seasons and years, the line transect method - a standard and widely utilised approach in ornithological fieldwork – was adopted (Bibby et al., 2000). This method allows for the systematic recording of bird species and individuals encountered along a fixed path, thereby facilitating estimates of species richness and relative abundance while minimising observer bias. Three representative months were selected to characterise the seasonal spectrum of the region: March (representing the pre-monsoon or summer season), July (representing the monsoon season), and October (representing the post-monsoon or early winter season).

These months were strategically chosen to correspond with key ecological transitions in the sanctuary's climatic and phenological conditions. March typically marks the onset of increasing temperatures and fruiting activity in native vegetation; July coincides with peak monsoonal precipitation and heightened canopy growth; and October represents a post-monsoonal period where temperatures begin to decline and migratory birds begin arriving from northern regions via the Central Asian Flyway. Field surveys were conducted during these selected months across three consecutive years: 2017, 2018, and 2019, thus providing a longitudinal perspective on seasonal and interannual variability in avifaunal presence. Each survey involved early morning transect walks along a predetermined route covering all major habitat types within the sanctuary – such as dense tree cover, bamboo groves, open clearings, water bodies, and understory vegetation. Observations were carried out between 06:00 and 09:00 hours, a period during which avian activity is typically at its peak (Sutherland, 2006).

During each transect session, all bird species seen or heard within a fixed radius were recorded, alongside information on flock size, habitat association, and behavioural activity

(e.g., foraging, calling, nesting). Binoculars (8×42) and field guides (Ali and Ripley, 1987; Grimmett et al., 2011) were used for species identification, and auditory cues were cross-referenced with established call databases for verification.

The data obtained were used to analyse seasonal species richness, relative abundance, and changes in community structure. This methodological framework facilitated not only seasonal comparisons but also enabled detection of subtle interannual shifts in avifaunal composition, potentially linked to broader climatic or anthropogenic changes.

4. RESULTS

This table (Table 1) provides data about bird taxonomy, displaying their family and order classifications along with yearly counts across three years: March 2017, March 2018, and March 2019 for Summer months. Across all years, a total of 185 bird observations were recorded. While 2017 had the highest count (79), 2018 and 2019 recorded 53 observations each, suggesting a more consistent trend in later years.

Passeriformes, the largest and most diverse avian order, was the most prevalent group observed during the study, accounting for 64.3% of total observations with 119 individuals recorded over the three years. Within this order, the Passeridae family exhibited the highest frequency, with 25 observations, followed by Corvidae and Oriolidae, each with 13 observations. Notably, the abundance of Passeridae species showed a significant increase, peaking at 15 individuals in March 2018, suggesting a potential correlation with seasonal breeding activities and resource availability during the summer months.

Cuculiformes, primarily represented by the Cuculidae family, ranked second in terms of abundance with 11 observations.

The peak count of six individuals occurred in March 2018, indicating a possible influx during the summer season, although the distribution across the study years was irregular, necessitating further investigation into migratory patterns and habitat preferences. Piciformes, though less abundant with 14 observations, demonstrated a steady presence throughout the study period. Contributions from the Picidae family, particularly a notable count of nine individuals in March 2019, and the Megalaimidae family, underscore the ecological significance of CKBS in supporting woodpecker populations. Apodiformes, represented exclusively by the Apodidae family, accounted for eight observations, maintaining a consistent yearly presence. This group's steady occurrence may be attributed to CKBS's provision of suitable nesting sites and aerial foraging opportunities. Orders such as Coraciiformes, Suliformes, and Gruiformes contributed minimally to the overall avian diversity, with only one or two observations per year.

This limited representation reflects their rarity or less frequent documentation within the sanctuary, possibly due to specific habitat requirements or low population densities. Ciconiiformes, represented solely by the Ciconiidae family, exhibited a notable decline in observations, from five individuals in March 2017 to one in March 2018, with no sightings in 2019. This decrease may reflect changes in habitat suitability or alterations in migratory routes, warranting further ecological monitoring. Strigiformes (owls) and Pelecaniformes showed sporadic observations but remained present across all study years.

Their intermittent presence suggests that CKBS provides essential nocturnal and aquatic habitats, albeit in limited extent. Orders such as Accipitriformes and Gruiformes registered only

marginal counts (2 or 3 total), indicating limited sightings or local population size. These low numbers may be attributed to specific ecological niches or the sanctuary's capacity to support such species.

Table 1. Distribution of Avifaunal Species across three years in the month of March from 2017-2019 across different Orders and Families.

Taxonomy Ranks	Yearly Count			Grand Total
Order and Family	Mar 2017	Mar 2018	Mar 2019	
Accipitriformes	2		1	3
Accipitridae	2		1	3
Apodiformes	2	3	3	8
Apodidae	2	3	3	8
Ciconiiformes	5	1		6
Ciconiidae	5	1		6
Columbiformes	5		2	7
Columbidae	5		2	7
Coraciiformes	1			1
Alcedinidae	1			1
Cuculiformes	3	6	2	11
Cuculidae	3	6	2	11
Gruiformes	2			2
Rallidae	2			2
Passeriformes	50	35	34	119
Acrocephalidae	1		3	4
Campephagidae			9	9
Cisticolidae			4	4
Corvidae	7	6		13
Dicruridae	5	3	4	12
Estrildidae			3	3
Laniidae	1			1
Monarchidae	4			4

Motacillidae	6	4		10
Muscicapidae	5		5	10
Oriolidae	6	7		13
Passeridae	10	15		25
Phylloscopidae	4			4
Sturnidae			5	5
Turdidae			1	1
Vangidae	1			1
Pelecaniformes	3	1		4
Ardeidae	3	1		4
Piciformes		5	9	14
Megalaimidae		5		5
Picidae			9	9
Strigiformes	5	1	2	8
Strigidae	5	1	2	8
Suliformes	1	1		2
Anhingidae	1			1
Phalacrocoracidae		1		1
Grand Total	79	53	53	185

Table 2. Distribution of Avifaunal Species across three years in the month of July from 2017-2019 across different Orders and Families.

Taxonomy Ranks	Yearly Count			Grand Total
	July 2017	July 2018	July 2019	
Order and Family				
Accipitriformes	1	8	2	11
Accipitridae	1	8	2	11
Apodiformes	4	4		8
Apodidae	4	4		8

Caprimulgiformes		7		7
Caprimulgidae		7		7
Ciconiiformes		5		5
Ciconiidae		5		5
Cisticolidae			4	4
Cisticola			4	4
Columbiformes	7	5	6	18
Columbidae	7	5	6	18
Coraciiformes	1			1
Alcedinidae	1			1
Cuculiformes		32		32
Cuculidae		32		32
Falconiformes			3	3
Falconidae			3	3
Gruiformes	4			4
Rallidae	4			4
Passeriformes	36	44	8	88
Aegithinidae		1		1
Artamidae			2	2
Cisticolidae		7	1	8
Corvidae	5	11		16
Dicruridae	2			2
Motacillidae			2	2
Nectariniidae	1			1
Oriolidae	3	4		7
Paridae	2			2
Passeridae	17	7		24
Sturnidae	5	8	3	16
Turdidae		3		3
Zosteropidae	1	3		4
Pelecaniformes		6	3	9

Ardeidae		6	3	9
Piciformes	4	6		10
Megalaimidae		3		3
Picidae	4	3		7
Psittaciformes		4		4
Psittaculidae		4		4
Strigiformes	1			1
Strigidae	1			1
Suliformes		5		5
Phalacrocoracidae		5		5
Grand Total	58	126	26	210

This table (Table 2) offers valuable insights into bird species observations categorized by taxonomy ranks over three consecutive years: July 2017, July 2018, and July 2019. It records a total of 210 bird observations, reflecting dynamic patterns in diversity and abundance. The years are marked by notable fluctuations, with July 2018 standing out as a peak year for observations (126 counts), in stark contrast to the lower counts in July 2017 (58) and the significantly reduced numbers in July 2019 (26).

This variability may be influenced by factors like environmental changes, migration patterns, or shifts in observer focus during the respective years. Passeriformes dominate the table with 88 observations, making up approximately 42% of the total dataset. This group's overwhelming representation highlights its importance in the studied region and emphasizes the abundance of songbird families within this order. Among these, *Passeridae* leads with 24 sightings, maintaining a steady presence across 2017 and 2018 before disappearing from the data in 2019. Similarly, *Corvidae* (16 observations) and *Sturnidae* (16) contribute significantly, with their counts concentrated in the first two years. These trends suggest that habitats suitable for Passeriformes were well-represented in the surveyed locations, but their stark decline in 2019 points to potential disruptions or changes in local bird populations.

The table also highlights *Cuculiformes* as a notable group, which peaks dramatically with 32 records in 2018, all attributed to the *Cuculidae* family. This significant spike suggests either an exceptional focus on this group during that year or a temporary ecological factor that encouraged an unusual abundance of cuckoos. This sharp increase contrasts sharply with zero sightings in 2017 and 2019, underlining the irregular and possibly opportunistic presence of this order in the region.

Other orders like *Apodiformes* and *Columbiformes* demonstrate steadier trends across the years. *Apodiformes* (comprising solely the *Apodidae* family) shows consistency with 8 total sightings spread evenly over 2017 and 2018. Similarly, *Columbiformes* (18 observations attributed to *Columbidae*) exhibits a relatively stable presence with moderate counts each year, suggesting that these groups may have resident populations or stable migratory patterns.

However, there are examples of families and orders with sporadic or declining appearances. For instance, *Caprimulgiformes* only appears in 2018 with 7 observations, all from *Caprimulgidae*. *Ciconiiformes* and *Suliformes* follow a similar pattern, showing 5 records each, but exclusively in 2018. Such isolated spikes could indicate targeted observations or specific environmental events during that period, such as favorable weather conditions or habitat changes attracting these species temporarily. Meanwhile, *Falconiformes* and its family, *Falconidae*, are entirely absent in the first two years but show up in 2019 with 3 sightings, reflecting their sporadic presence.

The order *Pelecaniformes*, represented by the *Ardeidae* family, maintains a moderate yet consistent presence with 9 records spread over 2018 and 2019. Likewise, *Piciformes* remains relatively stable with 10 total observations, showcasing contributions from *Picidae* (woodpeckers) and *Megalaimidae* (barbets). Their steady counts suggest the continued availability of suitable habitats such as wooded areas. Other orders like *Psittaciformes* (parrots) and *Gruiformes* (rails) are comparatively rare, with 4 total sightings each, confined to specific years.

The table also highlights the decline or absence of several groups in 2019. For example, *Passeridae* and *Cuculidae*, both major contributors in earlier years, are entirely missing from that year's data. Similarly, the overall reduction of observations in 2019, down to just 26 compared to 126 in 2018, raises questions about potential factors. These could range from environmental shifts – such as habitat loss, changes in food availability, or climatic events — to logistical reasons like reduced observer effort or scope. In summary, the table underscores dynamic patterns in bird populations over three years, with notable peaks for some groups and declines for others.

Orders like *Passeriformes* dominate throughout, while occasional surges in groups like *Cuculiformes* and *Caprimulgiformes* add interest to the dataset. The overall drop in observations by 2019 warrants further exploration to understand its underlying causes. These fluctuations, likely influenced by ecological and observational factors, reflect the complex and ever-changing nature of avian populations in the region.

Table 3. Distribution of Avifaunal Species across three years in the month of October from 2017-2019 across different Orders and Families.

Taxonomy Ranks	Yearly Count			Oct Total	Grand Total
	Oct				
Order and Family	2017	2018	2019		
Accipitriformes	1	2		3	3
Accipitridae	1	2		3	3
Anseriformes		6		6	6
Anatidae		6		6	6
Columbiformes		5		5	5
Columbidae		5		5	5

Coraciiformes	2		1	3	3
Meropidae	2		1	3	3
Cuculiformes	6	2	9	17	17
Cuculidae	6	2	9	17	17
Falconiformes		2		2	2
Falconidae		2		2	2
Muscicapidae	1			1	1
Muscicapa	1			1	1
Passeriformes	29	68	52	149	149
Corvidae		14	3	17	17
Dicruridae	12	1		13	13
Estrildidae		5		5	5
Leiothrichidae			28	28	28
Monarchidae	2			2	2
Motacillidae	3			3	3
Muscicapidae		7		7	7
Nectariniidae			4	4	4
Oriolidae	5	6		11	11
Paridae			7	7	7
Passeridae		10		10	10
Phylloscopidae	5			5	5
Pittidae	2	6		8	8
Ploceidae		2		2	2
Pycnonotidae			6	6	6
Rhipiduridae			4	4	4
Sturnidae		16		16	16
Zosteropidae		1		1	1
Pelecaniformes			1	1	1
Ardeidae			1	1	1
Phalacrocoracidae			1	1	1
Phalacrocorax			1	1	1

Piciformes		6	2	8	8
Megalaaimidae		3		3	3
Picidae		3	2	5	5
Psittaciformes	4			4	4
Psittaculidae	4			4	4
Strigiformes	1			1	1
Strigidae	1			1	1
Grand Total	44	91	66	201	201

This table (Table 3) provides a detailed analysis of bird observations categorized by taxonomic ranks across three Octobers: 2017, 2018, and 2019. A total of 201 observations were recorded over the three years, with 2018 showing the highest count (91), followed by 2019 (66) and 2017 (44). The stark difference in yearly counts, particularly the significant increase from 2017 to 2018 and the subsequent decline in 2019, may reflect ecological shifts, migration patterns, or variations in observation efforts. This dataset highlights the complex distribution patterns of avian populations across different families and orders.

Passeriformes dominate the observations, contributing a staggering 149 records, or approximately 74% of the grand total. This reflects the ecological prominence and diversity of this order, which is well-known for including many small to medium-sized perching birds. Within Passeriformes, Corvidae and Leiothrichidae stand out. Corvidae, with 17 observations, is relatively stable across years but shows a peak in 2018 with 14 records, emphasizing its importance in that year. Meanwhile, Leiothrichidae, exclusively represented in 2019 with 28 records, is remarkable for its sudden appearance, which could suggest either a localized influx of species in this family or changes in the survey focus during that year. Other notable families within Passeriformes include Sturnidae (16 records concentrated in 2018), Passeridae (10 records also from 2018), and Dicruridae (13 records predominantly from 2017). Cuculiformes is another significant order, contributing 17 records, all from the Cuculidae family.

Its distribution is interesting, with a steady presence in 2017 (6 records), a dip in 2018 (2 records), and a surge in 2019 (9 records). This variation may reflect changes in cuckoo migratory behaviors or local environmental factors, such as habitat changes or food availability. The sharp increase in 2019 could also indicate favorable breeding or stopover conditions for cuckoos in that particular year. Anseriformes and Columbiformes are relatively less abundant but show consistent representation, with 6 and 5 observations respectively, all concentrated in 2018. These orders are represented by Anatidae (waterfowl) and Columbidae (pigeons and doves), which are generally linked to aquatic and semi-urban habitats.

The absence of their observations in other years suggests that their visibility or abundance might be tied to specific ecological events or survey timing in 2018. Orders such as Coraciiformes and Piciformes exhibit lower overall counts but demonstrate steady contributions across multiple years. Coraciiformes, represented by the Meropidae family, has a total of 3 observations spread across 2017 and 2019, emphasizing its sporadic yet recurring presence.

Similarly, Piciformes contributes 8 records, showing consistent representation in 2018 and 2019 from Picidae (5 records) and Megalaimidae (3 records). These groups are typically associated with wooded habitats, and their persistence hints at the stability of such environments. Rarely recorded orders such as Psittaciformes and Strigiformes (4 and 1 observations respectively, all from 2017) highlight the occasional sightings of parrots and owls in the study area. These observations may be influenced by their secretive nature or specific habitat preferences, making them less frequently encountered during surveys. Another order worth noting is Pelecaniformes, which contributes 1 record in 2019. This order, represented by the Ardeidae and Phalacrocoracidae families, includes wading birds and cormorants, whose presence is likely tied to aquatic habitats. The limited observation suggests either a minimal population in the surveyed areas or a lack of comprehensive focus on these species.

Interestingly, Falconiformes and Muscicapidae also exhibit minimal presence, with 2 and 1 observations respectively. The latter is represented exclusively by the Muscicapa genus in 2017, emphasizing the rare recording of flycatchers during the survey. The dataset also reveals a few clear patterns. Families like Passeridae, Estrildidae, and Oriolidae show notable peaks in 2018, suggesting that specific ecological conditions, such as food abundance or breeding opportunities, may have facilitated their increased visibility during this year. In contrast, the sudden prominence of Leiothrichidae in 2019 and its complete absence in other years raises questions about migratory influxes or habitat suitability changes. The decline in total observations from 2018 (91) to 2019 (66), despite the appearance of certain families, hints at a possible reduction in overall bird activity or survey coverage. This drop may be attributed to various factors, including habitat degradation, climatic influences, or even reduced observer effort. Similarly, the low counts in 2017 may reflect an underrepresentation of certain groups, as some prominent families are entirely absent from that year's data.

In conclusion, this table offers a comprehensive look at the bird populations surveyed across three years, with Passeriformes dominating the data and showing significant diversity. The fluctuations in species presence and abundance underscore the dynamic nature of avian populations, influenced by ecological, climatic, and observational factors. The data also highlights the importance of consistent monitoring to detect long-term trends and ensure effective conservation strategies for these bird species.

The tables detailing bird observations from March, July, and October over multiple years provide a valuable dataset for analyzing avian diversity, abundance, and distribution patterns across different seasons. Examining these data through the lens of taxonomic orders and families highlights dynamic trends in bird populations, reflecting ecological, environmental, and possibly methodological factors. A combined total of 596 records across the three months reveals notable seasonal and taxonomic variations, with specific orders such as Passeriformes dominating observations.

In March, bird observations totaled 185, with Passeriformes representing the most prominent order, accounting for 119 (64.3%) of the total. Within this order, *Passeridae* contributed significantly with 25 records, followed by *Corvidae* and *Oriolidae*, each adding 13 observations. The dominance of Passeriformes reflects its ecological ubiquity and the prevalence of habitats favoring perching birds during this period. Other orders like Cuculiformes (11 observations) and Apodiformes (8 observations) also showed substantial representation, suggesting favorable conditions for these groups. However, lower counts in orders such as *Coraciiformes* (1 observation) and *Gruiformes* (2 observations) indicate their sporadic presence, potentially linked to habitat specificity or reduced migratory activity in early

spring. The consistent contributions of *Piciformes* (14 total) and *Strigiformes* (8 total) suggest the availability of stable forested habitats during this time.

The July dataset, with 210 total records, highlights a seasonal shift in avian abundance, showcasing the peak of breeding or post-breeding dispersal for many species. Passeriformes again dominate, contributing 88 observations, with *Passeridae* (24 records), *Corvidae* (16 records), and *Sturnidae* (16 records) leading within this order. This prominence may be linked to increased detectability during breeding activities or territorial behaviors. Notably, Cuculiformes experienced a substantial spike, contributing 32 records exclusively from *Cuculidae*, marking it as the second-most abundant order. This surge may reflect heightened cuckoo activity during their breeding period. Other orders like *Caprimulgiformes* (7 records) and *Ciconiiformes* (5 records) appeared solely in July, suggesting their seasonal migratory presence or specific ecological requirements met during summer. However, sporadic contributions from *Coraciiformes* (3 total) and *Suliformes* (5 total) emphasize the variability of certain groups in this dataset.

By October, the dataset recorded 201 observations, reflecting the transition from breeding to migratory phases for many species. Passeriformes maintained their dominance, accounting for 149 observations (74.1%), with notable contributions from *Leiothrichidae* (28 records, exclusively in 2019) and *Corvidae* (17 records). The sudden prominence of *Leiothrichidae*, absent in previous months, suggests either an influx during migration or changes in observer focus. Other families like *Sturnidae* (16 records) and *Passeridae* (10 records) further reinforce Passeriformes' ecological prevalence. Cuculiformes (17 records) ranked second, showing a steady presence across all three Octobers, with a significant peak in 2019 (9 observations). Orders like *Piciformes* (8 total) and *Psittaciformes* (4 total) displayed consistent but modest representation, indicating their limited yet stable presence in suitable habitats.

Across the three months, several patterns emerge. Passeriformes consistently dominated observations, highlighting their adaptability and the availability of habitats favoring small to medium-sized perching birds. Families such as *Passeridae*, *Corvidae*, and *Sturnidae* were frequently recorded, underscoring their ecological ubiquity. Cuculiformes exhibited notable variability, with significant spikes in July and October, suggesting seasonal influences on cuckoo abundance or visibility. Orders like *Caprimulgiformes*, *Ciconiiformes*, and *Falconiformes* were confined to specific months, reflecting their migratory behaviors or reliance on ephemeral ecological conditions.

Conversely, the steady presence of *Piciformes* and *Columbiformes* across multiple months suggests habitat stability for these groups. Seasonal shifts in bird abundance and diversity are evident from the data. March observations are characterized by lower overall counts and a focus on resident or early migratory species, while July reflects the peak of breeding activities, with many orders reaching their highest abundance. October, in contrast, is marked by migratory transitions, with certain families (e.g., *Leiothrichidae*) appearing prominently.

These patterns underscore the importance of seasonality in shaping bird population dynamics. The dataset also highlights potential methodological or environmental influences. The significant increase in observations in July 2018 (126) compared to other years suggests either heightened survey efforts or favorable environmental conditions that year. Similarly, the sharp decline in total counts in March 2019 (53) and July 2019 (26) may reflect reduced observer coverage or adverse ecological factors such as habitat degradation or climatic anomalies.

5. DISCUSSION

March represents the transition from winter to spring in many regions, which may influence migratory influxes or shifts in bird detectability. Additionally, the dataset provides a snapshot of avian community dynamics that can be influenced by factors such as food availability, climatic conditions, and anthropogenic changes.



Figure 2. Dendrogram Chart for the Summer showing the distribution and quantity of different bird Species.

Notable trends, such as the dominance of Passeriformes and variability in Cuculiformes, highlight the need for targeted conservation strategies that account for seasonal behaviors and habitat preferences. Passeriformes represent the largest avian order, consisting of diverse families that occupy a range of habitats. Within this order, families such as *Acrocephalidae*, *Campephagidae*, and *Muscicapidae* demonstrate notable representation, which may indicate their active participation in migratory cycles during March or heightened visibility due to breeding behaviors. Noteworthy species within these families likely adapt well to local conditions, including food availability and suitable nesting sites.

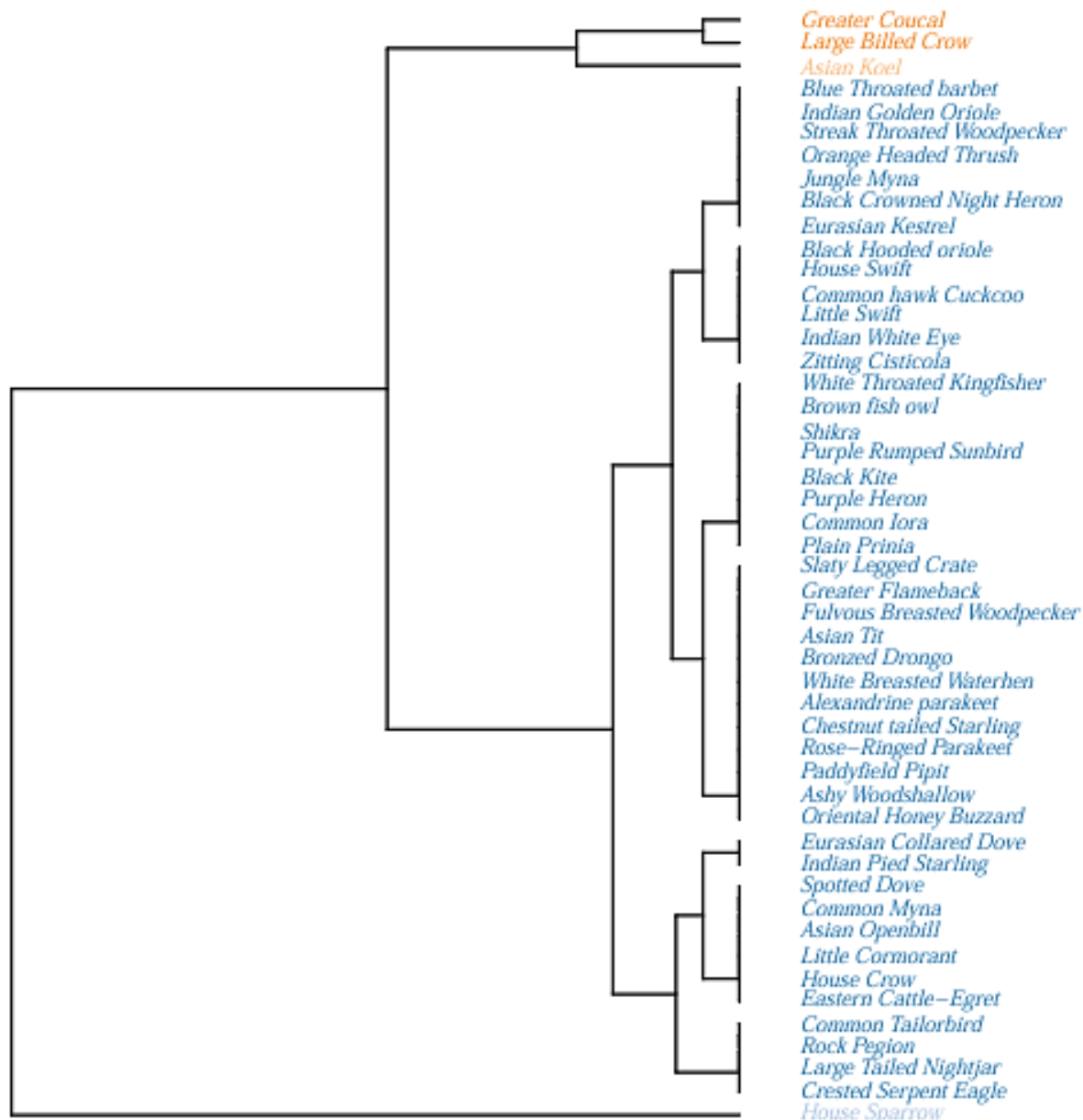


Figure 3. Dendrogram Chart for the Monsoon showing the distribution and quantity of different bird Species.

The consistent presence of families like *Strigidae* (owls) and *Accipitridae* (hawks) suggests the availability of habitats that support their prey base and roosting requirements (Figure 2). Similarly, the limited yet consistent presence of Gruiformes (*Rallidae*) reflects the stability of wetlands or aquatic habitats that favor such species. While families such as *Ciconiidae* (storks) and *Columbidae* (pigeons) show lesser representation, their presence underscores habitat diversity within the study area, ranging from semi-aquatic ecosystems to urban-adjacent green spaces. The representation of piciform families like *Picidae* and *Megalaimidae* signals the importance of wooded habitats for cavity-nesting birds and fruit-eating species (Figure 2).

Over the three years, in July a total of 210 bird individuals were observed. The highest count occurred in July 2018, with 126 individuals noted—a sharp increase compared to July 2017, which recorded 58 individuals, and July 2019, which showed a steep decline to 26 individuals. This variability is significant and warrants exploration of environmental or ecological factors that may have influenced these fluctuations. Many species appear consistently across the years, with notable representation of species like House Swift and Large Billed Crow. However, certain migratory or seasonally active species such as Oriental Darter and Forest Wagtail show sporadic presence, hinting at specific ecological conditions or habitat preferences during their observed years (Figure 3).

The dramatic rise in bird numbers during 2018 suggests favorable environmental conditions, possibly linked to food availability or optimal weather during the surveys. For instance, the increase in species like cuckoos aligns with their breeding season, suggesting heightened activity or visibility. Conversely, the sharp decline in 2019 raises concerns about potential disturbances – such as habitat degradation or climatic factors – that might have affected bird populations and their detectability (Figure 3).

In October, a total of 201 individuals were noted across the three years, highlighting dynamic changes in species numbers and diversity. This data sheds light on temporal variations in bird populations and offers insights into their ecological and behavioral characteristics during this time of year (Figure 4).

In 2017, 44 individuals were observed, with notable contributions from species like the Black Naped Oriole (5 individuals) and the Common Myna (16 individuals). These species are commonly associated with semi-urban and woodland habitats, indicating suitable ecological conditions during this period. The presence of species like the Alexandrine Parakeet and Forest Wagtail, which are less abundant, reflects niche-specific observations and possibly migratory influxes. The year 2018 showed the highest overall count with 91 individuals. Species such as the House Crow (12 individuals) and Rufous Treepie, alongside others like the Golden Flameback Woodpecker and White Rumped Munia, dominate the dataset.

The significant rise in counts during this year could be indicative of optimal environmental factors, such as food availability and favorable weather conditions, supporting increased bird activity or survey detectability. By contrast, 2019 recorded 66 individuals, showing a decrease in species numbers compared to the previous year. However, there is a notable influx of *Leiothrichidae* species (28 individuals), reflecting either migratory movements or ecological shifts.

The sudden prominence of this group, absent in previous years, suggests potential localized habitat changes favoring this family. Species like the Indian White Eye, Black Drongo, and Oriental Magpie Robin also feature prominently, underlining continued diversity within Passeriformes (Figure 4).

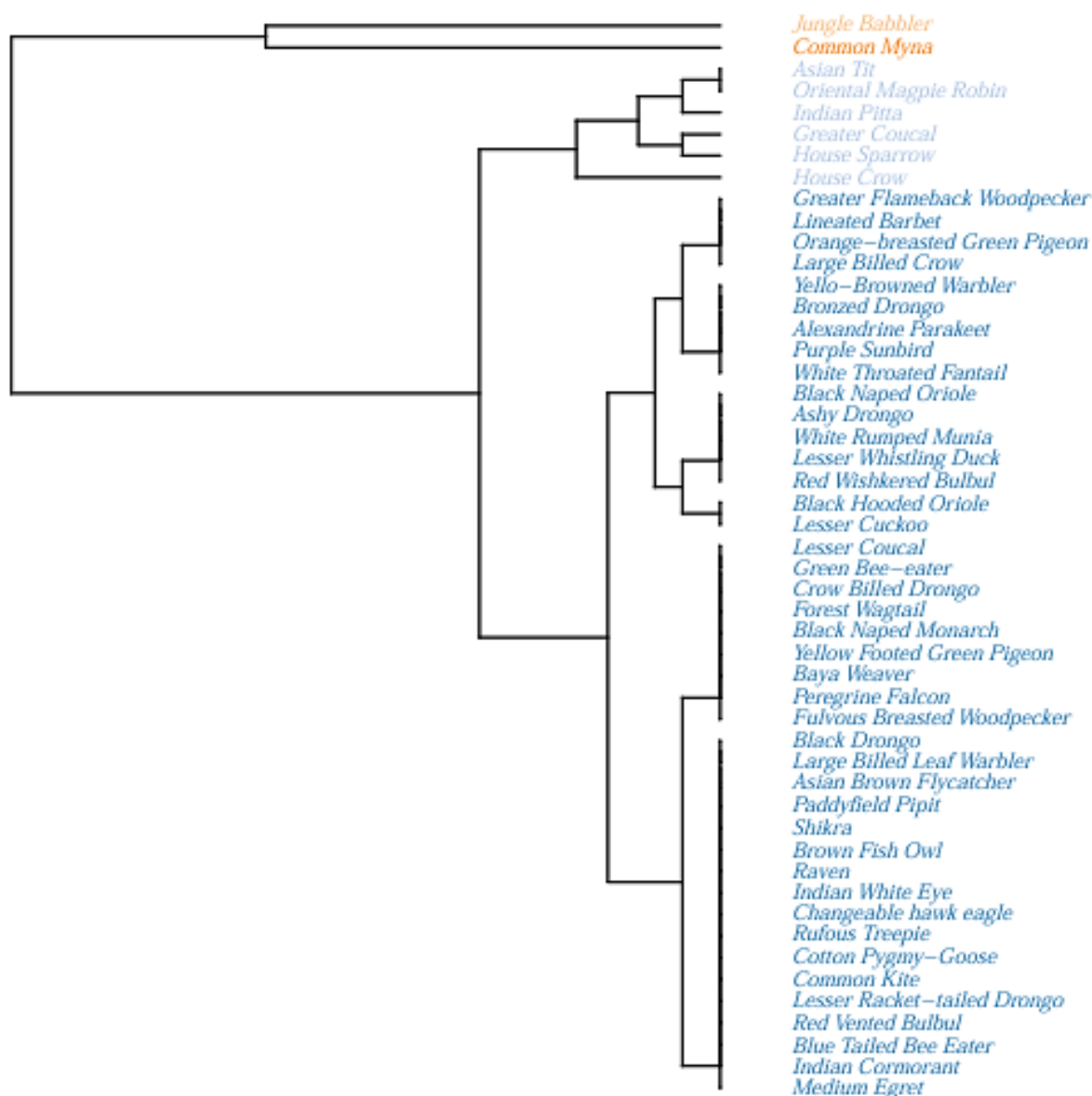


Figure 4. Dendrogram Fan Chart for the Winter showing the distribution and quantity of different bird Species.

6. CONCLUSION

Bird diversity at Chintamani Kar Bird Sanctuary exhibited marked seasonal variation at the species level, reflecting the dynamic influence of climatic conditions and habitat availability throughout the year. Observations conducted during the summer (March), monsoon (July), and winter (October) months over a three-year period revealed that while the overall taxonomic composition at the family level remained relatively stable, the diversity and abundance of individual species fluctuated considerably across seasons. In particular, the winter season supported a significantly higher number of migratory species, especially from the Palearctic

region, contributing to increased richness and temporal turnover within families. Summer observations were dominated by resident frugivorous and insectivorous species, with elevated breeding activity noted among avifaunal families.

Despite these fluctuations at the species level, the consistency of dominant families across seasons suggests that core ecological niches remain intact throughout the year. This highlights the sanctuary's importance as a stable habitat capable of supporting diverse avian assemblages across seasonal gradients.

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