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Avifaunal diversity of Dalma Wildlife Sanctuary, Jharkhand, India

MD ABU IMRAN MALLICK[1,♥], SHILADITYA ACHARJEE[2], SIMA PAIK[3], SHABA ALAM ANSARI[1], SMITHA PANKAJ[4]

[1]Department of Zoology, West Bengal State University. Kolkata, Berunanpukhuria, West Bengal 700126, India. Tel./fax.: +91-7278048651, ♥email: imranmallick708@gmail.com

[2]Dalma Wildlife Sanctuary. Jamshedpur, Jharkhand 832401, India

[3]Department of Zoology, University of Calcutta. Kolkata, West Bengal 700019, India

[4]Forest Singhbhum. Gua, Jharkhand 833213, India

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Abstract. *Mallick MAI, Acharjee SH, Paik S, Ansari SA, Pankaj S. 2025. Avifaunal diversity of Dalma Wildlife Sanctuary, Jharkhand, India. Biodiversitas 26: 5780-5802.* Birds are pivotal indicators of environmental health, underscoring their importance in conservation planning and ecological assessments. This study presents a systematic evaluation of avifaunal diversity and abundance in Dalma Wildlife Sanctuary, Jharkhand, India, based on surveys conducted from January 2025 to July 2025 using variable-radius point counts and transect methods. We recorded 205 bird species from 61 families, with Muscicapidae dominating (16 species, 7.80% relative abundance). Insectivorous birds (93 species) highlighted the sanctuary's rich trophic structure. According to International Union for Conservation of Nature (IUCN) classifications, 199 species were Least Concern, 4 Vulnerable, and 2 Near Threatened. Site 3 exhibited the highest species richness (122 taxa) and diversity (Simpson and Shannon indices). Rarefaction analysis corroborated these patterns. Statistical analyses revealed a significant difference in sample medians (Kruskal-Wallis test, χ^2: 9.454, p: 0.02572), contrasting with ANOVA's non-significant mean differences (F-statistic: 1.079, p: 0.3654). Biodiversity indices were highest for Site 3: Margalef (21.81), Menhinick (7.61), and Fisher's alpha (90.9). Unweighted Pair Group Method with Arithmetic Mean (UPGMA) hierarchical clustering identified patterns among samples. Notably, this study underscores Dalma Wildlife Sanctuary's significant avifaunal diversity, offering critical insights for conservation prioritization and environmental management in this ecologically vital region. Major findings highlight the sanctuary's role in sustaining diverse bird communities, including species of conservation concern, emphasizing the need for targeted habitat preservation. The documented diversity patterns contribute novel ecological data for Jharkhand's eastern India avifauna and inform regional biodiversity conservation strategies.

Keywords: Bird species, conservation, Dalma Wildlife Sanctuary, feeding guild, IUCN status

INTRODUCTION

Birds are sensitive indicators of ecosystem health (Carrasco et al. 2025). Monitoring changes in their populations, behaviors, and reproductive patterns provides a crucial window into the long-term impacts of environmental degradation and habitat disruption (Harisha and Hosetti 2009; Dutta 2017). Forests are crucial ecosystems for avifauna, supplying the necessary conditions for survival and reproduction (Marzluff et al. 2000; Mariyappan et al. 2023). The presence of trees is fundamental to the life cycles of many bird species, underscoring the importance of forest conservation for avian biodiversity (Basile et al. 2016). Birds exhibit varying levels of affinity for different forests, often influenced by the forest's structural complexity and resource availability; they tend to favor structurally complex, resource-rich forests over simpler, disturbed ones (Drapeau et al. 2000; Graser et al. 2025). The specific mix of bird species in a forest is closely tied to its vegetation structure, highlighting the intricate relationship between avian communities and forest characteristics (Pearman 2002; Coddington et al. 2023). As pollinators and seed dispersers, birds provide essential ecosystem services that maintain plant diversity and promote ecosystem resilience (Whelan et al. 2008; Diyaolu and Folarin 2024). Their contributions are crucial for the health and functioning of many ecosystems. Understanding bird community dynamics is vital for developing targeted conservation initiatives (Shochat et al. 2010). Recognizing key landscapes for birds helps conservationists target protection efforts (Donald et al. 2019).

Feeding guilds in birds' form when species exploit similar environmental resources, reflecting their shared ecological niches (Simberloff and Dayan 1991; Chatterjee et al. 2020). Guilds exhibit distinct resource requirements and tolerances, influenced by factors like vegetation, food, predation, and temporal fluctuations, reflecting their specific ecological niches (Panda et al. 2021). Because birds are highly diverse, ecologically varied, and readily censused across productivity gradients, they offer an advantageous model for testing productivity-richness hypotheses (Lawrence and Fraser 2020). Their capacity for long-distance movement enables them to capitalize on temporary resources, responding dynamically to fluctuations in environmental production across both space and time (Cooper and Marra 2020). Studying avian feeding guilds reveals ecosystem intricacies and deepens habitat knowledge, informing ecological understanding (Willson 1974; Kavana et al. 2024).

Habitat fragmentation is a complex process that affects ecosystems in various ways (Liu et al. 2018). It involves the reduction of patch size, increased isolation of patches, and changes in habitat quality (Maseko et al. 2020). The impact of habitat fragmentation varies significantly among species (Hanski 2015). Some species, such as forest interior birds, are sensitive to fragmentation and require large, contiguous areas of habitat (Arcilla and Strazds 2023). In contrast, edge species thrive in fragmented habitats and are often favored by the creation of edges and patchy environments (Porensky and Young 2013). While forest fragmentation is generally considered detrimental to many forest birds, some studies suggest that fragmentation of forest areas in farmland might benefit certain farmland bird species (Reino et al. 2009).

The loss of species diversity is a mounting global crisis, demanding immediate attention and action to protect the planet's ecological integrity (Pörtner et al. 2023). Protected areas like wildlife sanctuaries, national parks, and biodiversity reserves are vital for maintaining biodiversity and supporting crucial ecosystem functions (Naughton-Treves et al. 2005). These areas help regulate the climate, store carbon, replenish groundwater, and mitigate natural disasters, underscoring their importance for planetary health (DeFries et al. 2007). India, a mega-biodiverse nation, is home to around 1,358 bird species - a significant portion of the world's approximately 11,000 species (Hussain and Ali 2025). Located in eastern India, Jharkhand is home to 11 wildlife sanctuaries and one national park. The state has been the focus of various ornithological studies, which have shed light on its avian diversity and conservation status.

Research on avian species composition in Jharkhand, India, has been limited, with notable contributions from Ball (1874), Lopez and Mundkar (1997), and Saeed et al. (2023). Verma (2011) documented 71 bird species from Dalma Wildlife Sanctuary, highlighting a paucity of detailed avifaunal information for the region. Given the sanctuary's varied habitats and its importance for regional biodiversity conservation, a systematic assessment of bird diversity and abundance is needed to guide conservation prioritization and management strategies. Therefore, the present study aims to investigate the diversity and abundance of bird species in Dalma Wildlife Sanctuary, Jharkhand, India, during January-July 2025.

MATERIALS AND METHODS

Study area

Dalma Wildlife Sanctuary, located in Jharkhand, India (22°46'30"N to 22°57'N, 86°3'15"E to 86°26'30"E), spans ~193 km² across East Singhbhum and Saraikela-Kharsawan Districts (Figure 1). Situated in the Chota Nagpur Plateau, the sanctuary features undulating hills (up to 280 meters above sea level) and diverse habitats supporting significant biodiversity, notably *Elephas maximus* (elephant). The vegetation comprises Peninsular Sal and Northern Dry Mixed Deciduous Forest, with dominant species like *Shorea robusta*. The sanctuary includes a 10 km eco-sensitive buffer zone and is hydrologically linked to the Subarnarekha River and Dimna Lake. Covering 193.22 km² (45.56 km² reserved forest, 147.44 km² protected forest), it encompasses a 59.27 km² core area. The climate features distinct summer, rainy, and winter seasons, influencing ecological dynamics. Located in a region with sandy-loam to clayey-loam soils, Dalma's habitat diversity underscores its conservation importance.

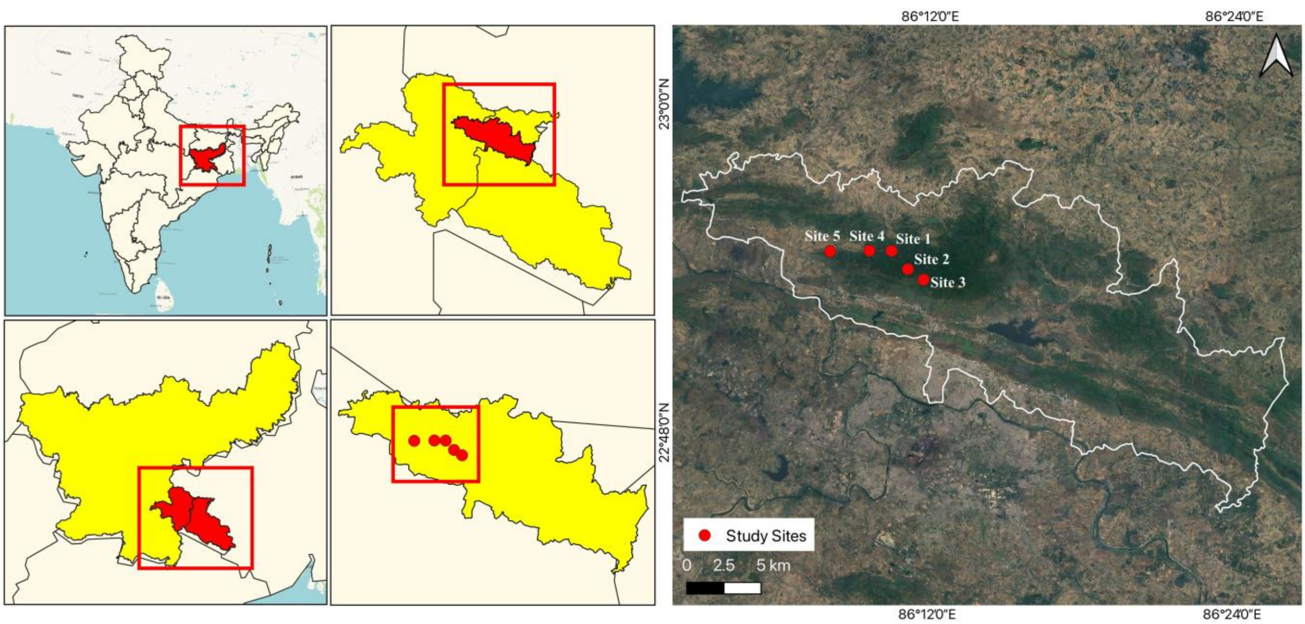

Figure 1. The map showing Dalma Wildlife Sanctuary, Jharkhand, India

Data collection methods

The avian community survey at Dalma Wildlife Sanctuary, Jharkhand, employed a methodology combining variable radius point counts and transect methods (Emlen 1971) to comprehensively survey bird species. The study was conducted from January 2025 to July 2025, with observations made during morning (6 am to 11 am) and evening (3 pm to 6 pm) sessions. Each site was visited once a week, resulting in a total of approximately 28-30 sampling days per site over the 7-month period, assuming one visit per week. A limitation of this study is that it only covers a partial annual cycle (January to July 2025). Future research should aim to cover a full year to capture seasonal variations in the avian community. The method approach was selected to account for the diverse bird species and habitats within the sanctuary. Variable radius points count enable the detection of birds within a certain radius, providing insights into bird abundance and distribution. Transect methods, on the other hand, allow for the detection of birds along a fixed route, providing data on bird density and habitat use. By combining these methods, the study aimed to obtain a representative sample of the bird population.

Sixteen line transects, each approximately 1,000 meters long and 20-30 meters wide, were established across four landscape element types: Sal Forest, mixed deciduous forest, riparian forest, and grassland/open scrubland. These transects were walked at a constant pace for about half an hour to ensure consistent data collection. The transects were designed to cover various habitats and microhabitats within the sanctuary, allowing for a representative sample of the bird population.

Five distinct sites with permanent sampling points along transects were set up, maintaining a 200-meter buffer distance between points to ensure spatial independence. Each site was visited once per week. Point counts were conducted during morning (06:00-10:00) and evening (16:00-18:00) sessions, totaling 7-8 hours per day, to capture the peak activity periods of birds. At each sampling point, birds were recorded via visual and auditory detection within a 50 m radius during a 10-minute count period. The maximum number of individuals of each species detected simultaneously was recorded to avoid double-counting. The combination of visual and auditory records, along with the standardized counting protocol, aimed to provide robust estimates of bird abundance and distribution.

Birds were observed with the naked eye or using binoculars (Nikon Aculon T02 10X21), and photographs were taken with a digital camera (Nikon D5300) for documentation. Systematic positions and names were assigned following Simkins et al. (2020). The conservation status of each species was assessed and incorporated into the checklist based on the International Union for Conservation of Nature (IUCN) Red List. This allowed for the identification of species that are threatened or vulnerable, informing conservation efforts in the sanctuary.

Data analysis methods

The data analysis phase involved calculating various species diversity indices using the Paleontological Statistics (PAST) software, version 3.2. The study employed various species diversity indices to assess community diversity, including Shannon's diversity index, Simpson's index, Fisher's alpha, and evenness. Shannon's diversity index was calculated using the formula:

$$H = -\sum (pi \ln pi)$$

Where, pi represents the proportion of individuals of a particular species to the total number of individuals. This index provides insight into the overall diversity of the community, taking into account both species richness and evenness. The Shannon index is a widely used metric for assessing diversity, as it reflects the uncertainty or randomness of species distribution within a community.

Simpson's index was utilized as a dominance measure, calculated as:

$$D = 1/(\sum(pi^2))$$

This index provides insight into the distribution of individuals among species, with higher values indicating greater diversity. Simpson's index is useful for understanding the dominance structure of a community, as it highlights the relative abundance of different species (Simpson 1949).

Fisher's alpha was used to describe the relationship between species and individuals, expressed as:

$$S = \alpha \times \ln (1 + n/\alpha)$$

Where, S denotes the number of taxa, n represents the number of individuals, and α is Fisher's alpha. This index is valuable for understanding the species richness and abundance relationship within a community. Fisher's alpha is particularly useful for datasets with varying sample sizes, as it provides a more nuanced understanding of species diversity (Fisher et al. 1943).

Evenness was calculated to compare actual diversity to maximum potential diversity, using the formula:

$$E = H'/H\_max$$

This metric ranges between 0 and 1, with higher values indicating greater evenness. Evenness is an important aspect of community diversity, as it reflects the relative abundance of different species (Pielou 1966).

The relative abundance (RA) of each bird species was determined as:

$$RA = ni/N \times 100$$

Where, ni is the number of individuals of the species and N is the total number of individuals. This metric ranges from 0 to 100, indicating the percentage of each species in the community.

UPGMA clustering with the Jaccard similarity index was used to assess the similarity between different species communities. The index is calculated as:

$$J (A, B) = |A \cap B| / |A \cup B|$$

Where, $|A \cap B|$ is the number of species common to both communities A and B; $|A \cup B|$ is the total number of unique species in both communities.

The Jaccard similarity index is a valuable metric for assessing the similarity between species communities. It ranges from 0 to 1, providing a clear indication of community similarity. A value of 1 indicates that the two communities have identical species composition, while a value of 0 indicates that they share no species in common.

To assess group differences, a one-way ANOVA framework was used. The Intraclass Correlation Coefficient (ICC) was first computed to evaluate within-group similarity:

$$\mathrm{ICC} = \frac{\sigma^2_{between}}{\sigma^2_{between} + \sigma^2_{within}}$$

Where, $\sigma^2_{between}$: variance between groups, σ^2_{within}: variance within groups. A low ICC: little consistency among observations in the same group.

Differences in group means were tested using Welch's ANOVA, which corrects for unequal variances:

$$F = \frac{\omega_{i(\overline{X_i - X})/(k-1)}}{1 + \frac{2(K-2)}{K^2-1}\frac{(1-\omega_{i}/\omega.)2}{n_{i-1}}}$$

Where, K: number of groups, X_i overall weighted mean, X: Overall weighted mean, n_i sample size of the i-th group, ω_i: Weight for each group (usually ω_i:in$_i$/s_i^2), ω.: Sum of all weights (ω_i).

One-way ANOVA, a parametric test, was used to compare the means of three or more groups, calculating the F-statistic by dividing between-group variability by within-group variability. If the p-value is below 0.05, it indicates a significant difference between group means. However, ANOVA assumes normality, homogeneity of variance, and independence of observations.

The Kruskal-Wallis test, a non-parametric method, was employed to compare the medians of three or more independent groups. This test assesses whether the distribution of a variable is the same across different groups, without assuming normality. The test calculates a chi-squared statistic (H) and p-value, determining if significant differences exist between group medians.

Species diversity indices evaluated community diversity, while relative abundance and UPGMA clustering with Jaccard similarity indices revealed patterns in species distribution and community similarity. One-way ANOVA and Kruskal-Wallis tests were employed to compare group means and medians, respectively, selected based on the data's parametric assumptions.

RESULTS AND DISCUSSION

A total of 205 bird species, belonging to 20 orders and 61 families, were recorded during the study period (Table S1 and Figure S1). The five sites exhibited varying levels of species richness and individual abundance. Site 3 ranked highest in terms of species richness, with 122 taxa recorded, followed closely by Site 4 with 108 taxa and Site 2 with 100 taxa. Site 1 and Site 5 had relatively lower species richness, with 85 and 90 taxa, respectively. In terms of individual abundance, Site 3 again topped the list with 257 individuals, followed by Site 4 with 234 individuals and Site 2 with 210 individuals. Site 1 and Site 5 had 197 and 199 individuals, respectively (Figure 2).

The avifauna comprised 20 orders with varying species richness. The most species-rich order was Passeriformes, with 89 species, followed by Accipitriformes with 14 species and Pelecaniformes with 13 species. Other notable orders included Piciformes with 10 species, Charadriiformes with 8 species, Coraciiformes with 7 species, and Columbiformes and Cuculiformes, each with 6 species. Additionally, there were 9 species of Anseriformes and 9 species of Strigiformes. The least represented orders were Apodiformes, Psittaciformes, and Ciconiiformes, each with 3 species, while Caprimulgiformes, Falconiformes, and Podicipidiformes had only 2 species each. Bucerotiformes, Suliformes, and Gruiformes had 4, 4, and 5 species, respectively (Figure 3).

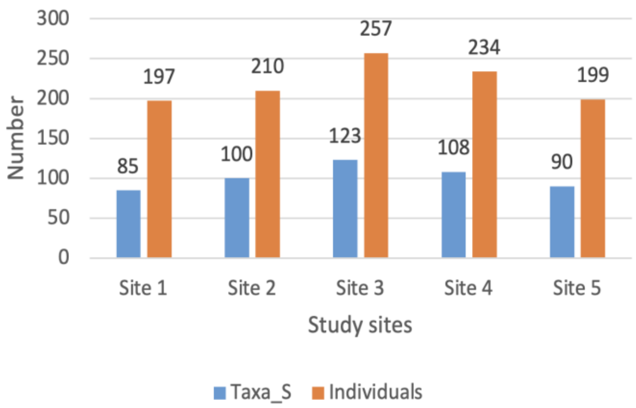

Figure 2. Abundance of bird species at five sites in Dalma Wildlife Sanctuary, Jharkhand, India

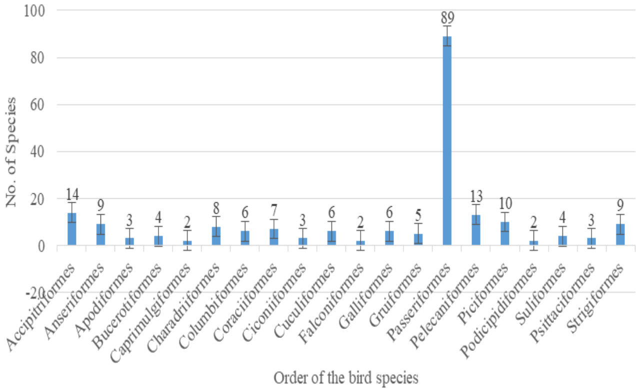

Figure 3. The bird community comprised various orders in Dalma Wildlife Sanctuary, Jharkhand, India

The avifauna comprised various families with varying species richness and relative abundance. The most species-rich family was Muscicapidae, with 16 species and a relative abundance of 7.80%, followed by Accipitridae with 13 species and 6.34% relative abundance. Other notable families included Ardeidae with 10 species and 4.87% relative abundance, Strigidae with 9 species and 4.39% relative abundance, and Anatidae with 9 species and 4.39% relative abundance. Several families had moderate species richness and relative abundance, including Columbidae, Cuculidae, Phasianidae, and Picidae, each with 6 species and 2.92% relative abundance. Families like Motacillidae, with 7 species and 3.41% relative abundance, and Dicaeidae, Hirundinidae, Rallidae, and Sturnidae, each with 5 species and 2.43% relative abundance, were also well-represented (Table 1).

The avifauna exhibited a diverse range of feeding guilds. The most prominent guild was Insectivorous, comprising 93 species, indicating a rich diversity of birds that rely on insects as a primary food source. This was followed by Carnivorous birds, with 41 species, which likely include predators that feed on small animals, other birds, or carrion. Omnivorous birds, which feed on a wide variety of food sources, accounted for 31 species. Frugivorous birds, which primarily consume fruits, comprised 16 species. Fishivorous birds, which feed on fish and other aquatic organisms, consisted of 11 species. Additionally, there were 6 species each of Grainivorous and Nectarivorous birds, which feed on grains and nectar, respectively. Herbivorous birds, which feed on plants and plant material, were the least represented, with only 1 species (Figure 4).

The conservation status (IUCN) of the bird species revealed that the majority, 199 species, were classified as 'Least Concern'. A small number of species were categorized as 'Vulnerable', totaling 4 species. Only 2 species were classified as 'Near Threatened'. The rarefaction analysis revealed varying levels of species richness across the five sites. Site 3 consistently exhibited the highest species richness, followed closely by Site 4 and Site 2. Sites 1 and 5 had relatively lower species richness. As the sampling effort increased, the species richness estimates for each site followed a predictable pattern, with Site 3 maintaining the highest richness and Site 1 the lowest (Figure 5).

The biodiversity indices revealed varying levels of species richness, evenness, and dominance across the five sites. Site 3 exhibited the highest species richness (Taxa_S: 123) and individual abundance (Individuals: 257), followed closely by Site 4 and Site 2. The Simpson diversity index (Simpson_1-D) and Shannon diversity index (Shannon_H) were highest for Site 3, indicating a more diverse community. The dominance index (Dominance_D) was lowest for Site 3, suggesting a more even distribution of species. The Menhinick and Margalef indices, which measure species richness, were also highest for Site 3. The Fisher alpha index, which measures diversity, was highest for Site 3, followed by Site 4 and Site 2. The Berger-Parker index, which measures dominance, was lowest for Site 5. The Chao-1 estimator, which estimates true species richness, was highest for Site 4 (Table 2).

Table 1. Relative abundance of dominant families in avifaunal composition in Dalma Wildlife Sanctuary, Jharkhand, India

Family	No. of species	Relative abundance
Accipitridae	13	6.34
Pandionidae	1	0.48
Anatidae	9	4.39
Apodidae	2	0.97
Hemiprocnidae	1	0.48
Bucerotidae	3	1.46
Upupidae	1	0.48
Caprimulgidae	2	0.97
Burhinidae	1	0.48
Charadriidae	1	0.48
Jacanidae	2	0.97
Laridae	2	0.97
Scolopacidae	2	0.97
Columbidae	6	2.92
Alcedinidae	4	1.95
Coraciidae	2	0.97
Meropidae	1	0.48
Ciconiidae	3	1.46
Cuculidae	6	2.92
Falconidae	2	0.97
Phasianidae	6	2.92
Rallidae	5	2.43
Aegithinidae	1	0.48
Alaudidae	4	1.95
Campephagidae	3	1.46
Chloropseidae	2	0.97
Cisticolidae	3	1.46
Corvidae	2	0.97
Dicaeidae	5	2.43
Emberizidae	1	0.49
Estrildidae	3	1.46
Hirundinidae	5	2.43
Laniidae	3	1.46
Leiothrichidae	2	0.97
Monarchidae	3	1.46
Motacillidae	7	3.41
Muscicapidae	16	7.80
Nectariniidae	3	1.46
Oriolidae	2	0.97
Paradoxornithidae	1	0.48
Passeridae	2	0.97
Pellorneidae	1	0.48
Phylloscopidae	4	1.95
Pittidae	1	0.48
Ploceidae	1	0.48
Pycnonotidae	3	1.46
Stenostiridae	1	0.48
Sturnidae	5	2.43
Turdidae	3	1.46
Vangidae	1	0.48
Zosteropidae	1	0.48
Ardeidae	10	4.87
Pelecanidae	1	0.48
Threskiornithidae	2	0.97
Megalaimidae	4	1.95
Picidae	6	2.92
Podicipedidae	2	0.97
Anhingidae	1	0.48
Phalacrocoracidae	3	1.46
Psittaculidae	3	1.46
Strigidae	9	4.39

The rarefaction analysis ranked sites by species richness: Site 3 (123 species) was the richest, followed by Site 4 (108 species), Site 2 (100 species), Site 5 (90 species), and Site 1 (85 species) being the least rich. This ranking indicates Site 3 has the most diverse bird community and Site 1 the least (Figure 6.A). The Shannon exponential index (exp (H)) transforms the Shannon diversity index into a more intuitive measure, representing the effective number of species in a community. Higher values indicate greater diversity. In this context, the ranking suggests that Site 3 has the most diverse ecosystem, while Site 1 has the least diverse (Figure 6.B). The Simpson diversity index values increase with sample size, indicating higher diversity, and show consistent patterns across sites with minor variations (Figure 6.C). The Shannon diversity index values exhibit a similar trend, increasing with sample size and indicating higher diversity (Figure 6.D). This study utilized Unweighted Pair Group Method with Arithmetic Mean (UPGMA) hierarchical clustering based on the Jaccard similarity index to identify patterns and relationships among samples (Figure 7).

The study on avifaunal diversity and abundance in Dalma Wildlife Sanctuary, Jharkhand, India, employed statistical analysis to compare the means of bird species across different sites (Table 3). The Analysis of Variance (ANOVA) results showed no significant difference in means between groups, with an F-statistic of 1.079 and a p-value of 0.3654. The permutation p-value, calculated from 99,999 permutations, further supported this finding with a p-value of 0.3654. The components of variance analysis revealed a low variance component for the group effect (0.001184) and a higher variance component for the error (3.04415). The Intraclass Correlation Coefficient (ICC) was 0.000389, indicating a very low correlation between observations within the same group. Levene's test for homogeneity of variance, conducted from both means and medians, showed no significant difference in variance between groups, with p-values of 0.8715 and 0.9292, respectively. The Welch F test, which accounts for unequal variances, also yielded a similar result, with F: 1.089, df: 506, and p: 0.3611.

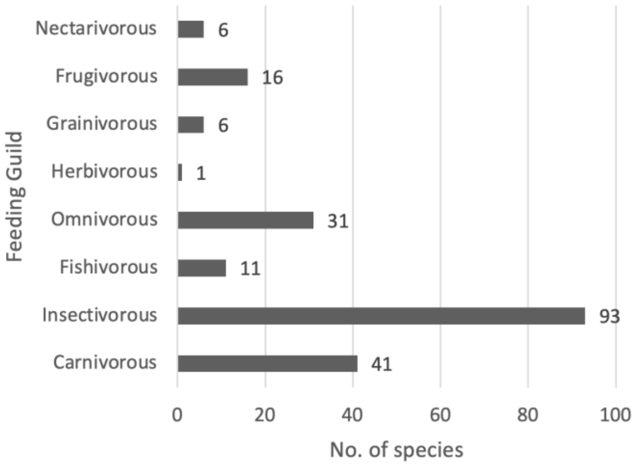

Figure 4. The bird community exhibited diverse feeding guilds in Dalma Wildlife Sanctuary, Jharkhand, India

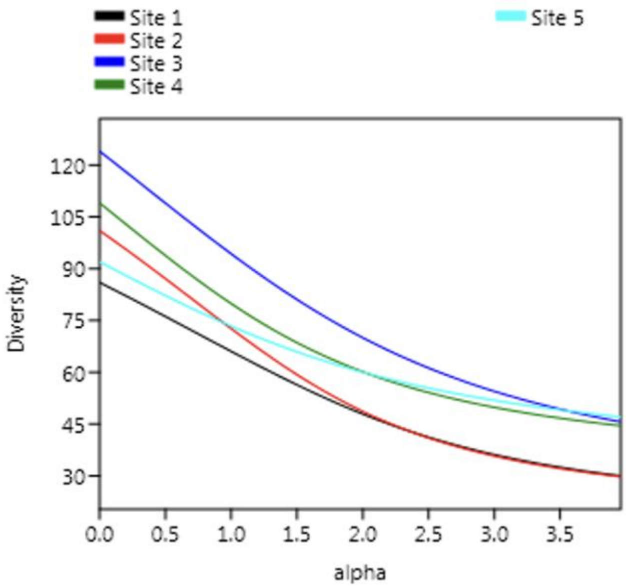

Figure 5. Alpha diversity patterns varied significantly among the 5 study sites in Dalma Wildlife Sanctuary, Jharkhand, India

Table 2. Diversity indices for bird species from the study area

	Site 1	Site 2	Site 3	Site 4	Site 5
Taxa_S	85	100	123	108	90
Individuals	197	210	257	234	199
Dominance_D	0.022	0.021	0.015	0.017	0.011
Simpson_1-D	0.98	0.98	0.98	0.98	0.98
Shannon_H	4.18	4.275	4.529	4.371	4.275
Evenness_e^H/S	0.769	0.719	0.7595	0.7326	0.7989
Brillouin	3.646	3.713	3.96	3.821	3.723
Menhinick	6.056	6.901	7.61	7.06	6.38
Margalef	15.9	18.51	21.81	19.61	16.81
Equitability_J	0.94	0.92	0.94	0.93	0.95
Fisher_alpha	56.76	74.79	90.9	77.79	63.32
Berger-Parker	0.06	0.06	0.04	0.03	0.03
Chao-1	100.5	144.5	218.1	230.4	129.3

Table 3. The study on avifaunal diversity and abundance in Dalma Wildlife Sanctuary, Jharkhand, India, employed statistical analysis (One-way ANOVA) to compare the means of bird species across different sites

Test for equal means	Sum of sqrs	df	Mean square	F	p (same)
Between groups:	13.141	4	3.28528	1.079	0.3654
Within groups:	3083.73	1013	3.04415	Permutation p (n:99999)	
Total:	3096.87	1017	0.3654		
Components of variance (only for random effects):					
Var(group):	0.001184	Var(error):	3.04415	ICC:	0.000389
omega2:	0.000311				
Levene's test for homogeneity of variance, from means	p (same):	0.8715			
Levene's test, from medians	p (same):	0.9292			
Welch F test in the case of unequal variances: F: 1.089, df: 506, p: 0.3611					

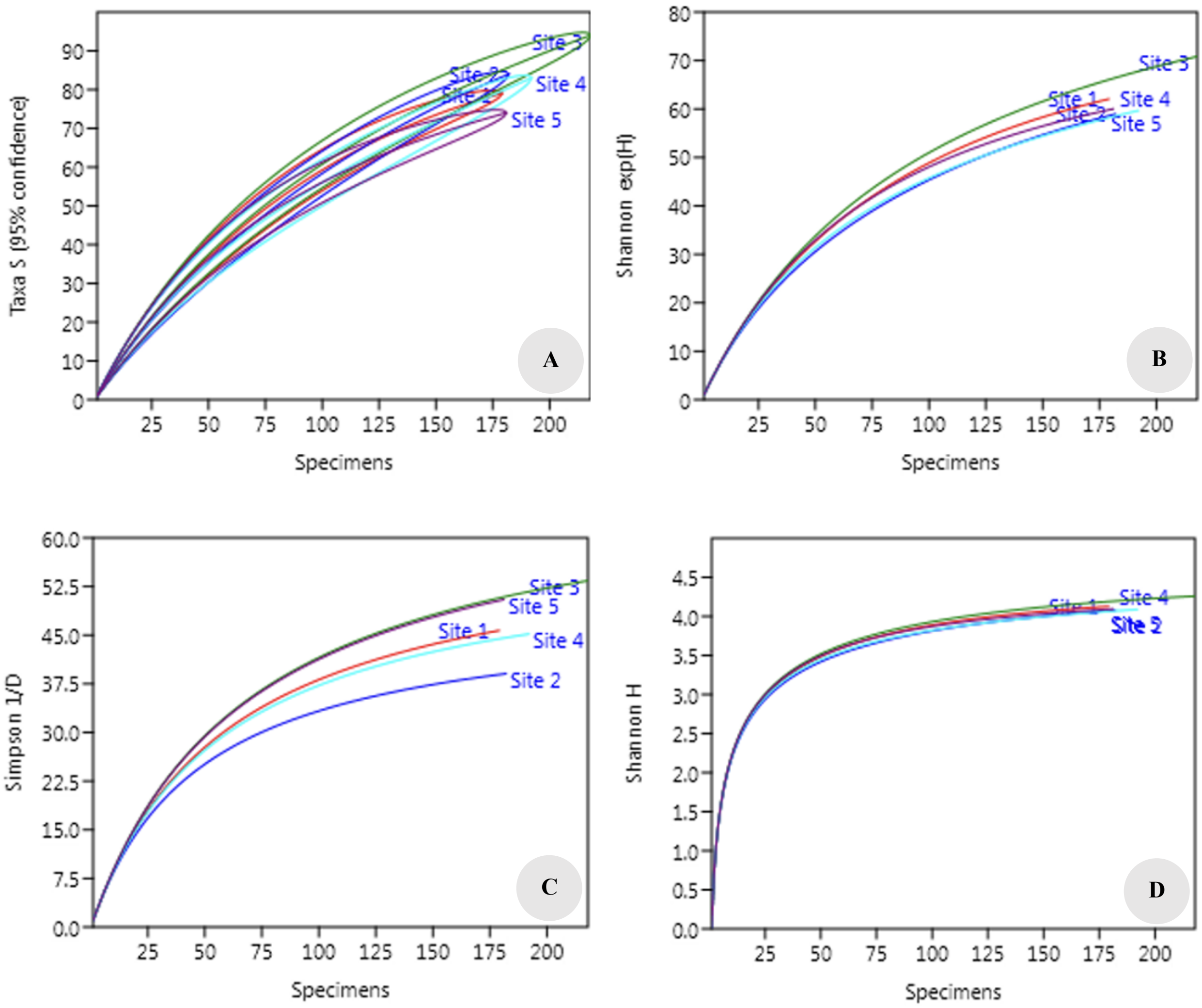

Figure 6. Species rarefaction curves in study area. A. Taxa (S) vs Specimens (Individuals), B. Shannon exp (H) vs Specimens (Individual), C. Simpson (1/D) vs Specimens (Individuals), D. Shannon (H) vs Specimens (Individuals)

The Kruskal-Wallis test was conducted to determine if there is a significant difference in median species richness or abundance across the five study sites. The results indicate a significant difference between sample medians, with a chi-squared value (H) of 9.454 and a p-value of 0.02572. Even after correcting for ties, the test statistic (Hc) increased to 11.08, further supporting the significance of the results. Since the p-value is less than 0.05, we reject the null hypothesis of equal medians, suggesting that the median species richness or abundance varies significantly across the sites.

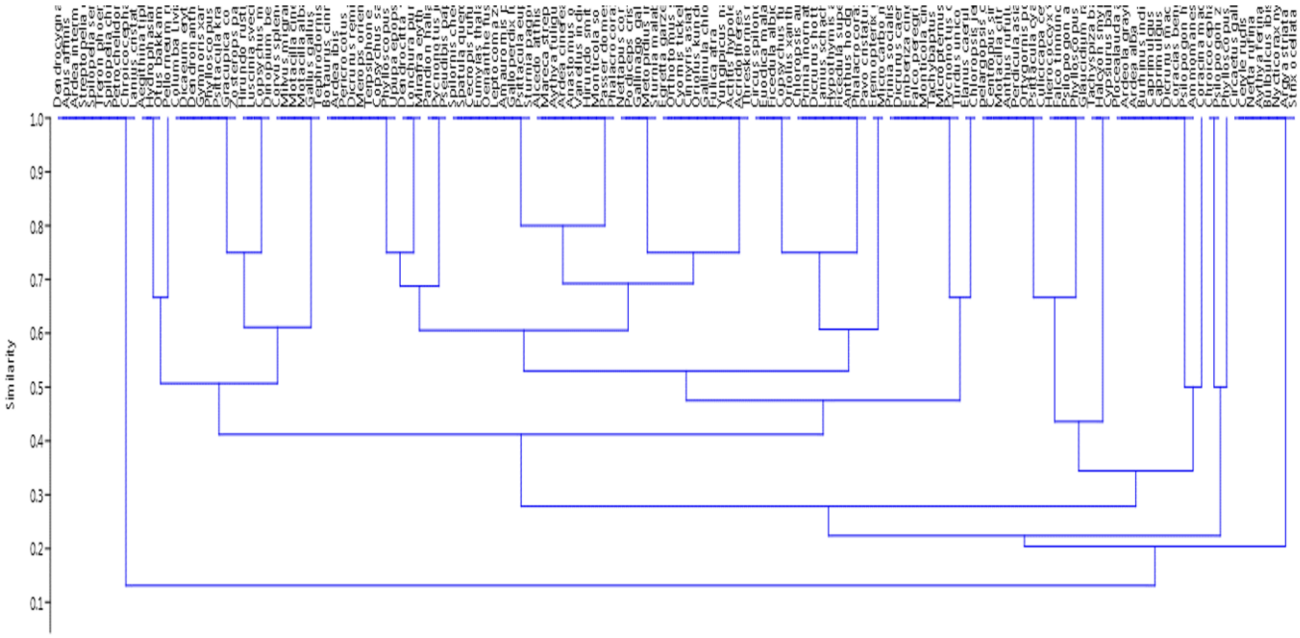

Figure 7. This study used UPGMA clustering with the Jaccard similarity index to identify patterns among samples

Discussion

Dalma Wildlife Sanctuary emerges as a significant haven for avifauna, harboring 205 species across 20 orders and 61 families. The interplay of diverse microhabitats, alongside proximity to the Subarnarekha River and Dimna Lake, fosters a conducive environment sustaining breeding resident birds. Notably, Site 3 showcases exceptional species richness, with Muscicapidae predominating. Contextualizing these findings against prior studies in Jharkhand and India unveils parallels and divergences. Dalma's conservation value is pronounced, underlined by endemic species, yet the sanctuary presently contends with threats including escalating tourism, cattle grazing, and local fuelwood extraction-pressures potentially disrupting ecological equilibrium and impinging on avian populations.

The present study highlights the significance of Dalma Wildlife Sanctuary (DWS) as an essential bird habitat, supporting a diverse range of avifauna. Verma (2011) documented 71 species at Dalma, contrasting with 205 species presently recorded, highlighting expanded understanding and possibly reflecting sanctuary health. Research in other Indian ecosystems underscores habitat complexity as pivotal for avian diversity (e.g., Western Ghats, Himalayan foothills), paralleling Dalma's profile (Kumar et al. 2010; Mali et al. 2017; Vinayak and Mali 2018). Feeding guild composition at Dalma reflects resource availability, aligning with patterns seen elsewhere where insectivores like Muscicapidae thrive in forested habitats (Khan and Pant 2017; Saeed et al. 2023).

The present study reveals significant correlations between bird guilds and habitats in DWS. Insectivores showed a strong positive correlation with aquatic habitats, consistent with previous studies that highlight the importance of aquatic insects in wetland ecosystems (Maher 1984; Batzer and Resh 1992; Mukhopadhyay and Mazumdar 2019). The dominance of aquatic insects in these habitats supports a diverse range of insectivorous bird species. In contrast, omnivores and granivores were significantly correlated with scrubland habitats, likely due to the mosaic structure of these habitats in DWS. This finding contrasts with previous studies that suggest omnivores dominate residential and plantation forest areas (Panda et al. 2021). However, the positive relationship between granivores and scrubland habitats is supported by studies that highlight the importance of scrublands for granivorous bird species (Poulin et al. 1993). Carnivorous bird species were primarily observed in cultivated forest areas, likely due to the abundance of small vertebrates, such as frogs, fish, and mollusk. This finding is consistent with previous studies that suggest carnivorous birds thrive in areas with high food availability, such as rice fields (King et al. 2010; Stafford et al. 2010). The study also revealed a significant positive correlation between resident bird species and forest fragments, consistent with previous research (Daily et al. 2001).

In contrast, migratory bird species did not show a significant correlation with any particular habitat, likely due to their spatial and temporal distribution relative to available fruit resources (Wolfe et al. 2014). The dependence of local settlers on the DWS for resources poses a significant threat to the scrub habitat and its avifauna. The increasing number of settlers has led to habitat degradation through fuelwood collection, livestock grazing, quarrying, and clearance for agriculture and plantations. These anthropogenic activities not only alter the habitat structure but also increase disturbance to birds, potentially affecting their behavior, breeding, and survival. Furthermore, accidental and opportunistic trapping may also be a concern in DWS. The loss of habitat and increased human disturbance can have long-term consequences for bird populations, emphasizing the need for sustainable conservation and management practices in the sanctuary.

The Sal Forest in Dalma Wildlife Sanctuary (DWS) is a hotspot for bird diversity, making it a key area for avifaunal conservation. As a dominant vegetation type, Sal forests create a unique ecosystem that supports a wide range of bird species. The forest's structural complexity, including various tree species, understory vegetation, and microhabitats, contributes to its high avian diversity. DWS faces varying levels of disturbance, impacting bird density and diversity.

Highly disturbed areas with low habitat heterogeneity have fewer bird species, while less disturbed areas with higher habitat complexity support a richer avifauna. Preserving habitat integrity and reducing human impact is crucial for maintaining biodiversity. Implementing bird-friendly forestry practices can balance ecological health and economic interests. Methods like selective logging, habitat corridor maintenance, and reduced pesticide use enhance biodiversity, leading to healthier forests. This approach supports long-term timber production and creates alternative revenue streams through eco-tourism and birdwatching. Engaging local communities in conservation efforts fosters coexistence and promotes bird population thriving. Sustainable forest management benefits both wildlife and landowners by improving forest health and productivity. The occurrence of human-associated bird species signals anthropogenic disturbances from surrounding urbanization. Local participation through eco-tourism committees and awareness initiatives can drive conservation of avian diversity. DWS holds significant conservation value, requiring balanced approaches that harmonize biodiversity protection with developmental needs.

Although this study provides a comprehensive assessment of avifaunal diversity in Dalma Wildlife Sanctuary, several limitations should be acknowledged. The survey period, spanning a single seasonal cycle from January to July 2025, may not capture full annual variations in bird assemblages, especially migratory species that occur during the late monsoon or winter months. Sampling was limited to accessible areas, potentially overlooking cryptic or nocturnal species in dense forest zones. The study should be interpreted in the context of ongoing human activities (wood collection, tourism) in buffer zones, which likely shape bird detectability and habitat conditions.

Future research should incorporate multi-seasonal monitoring, acoustic surveys, and remote sensing tools to better understand temporal and spatial patterns in avian diversity. Integrating local community participation and habitat restoration programs will further enhance long-term conservation outcomes for the sanctuary’s avifauna.

In conclusion, this study underscores the importance of Dalma Wildlife Sanctuary as a vital habitat for avifaunal conservation, with a remarkable 205 bird species recorded, including 4 Vulnerable and 2 Near Threatened species. Among the surveyed areas, Site 3 stands out as a key area, supporting the highest species richness of 122 taxa and individual abundance of 257 individuals. To safeguard the sanctuary's avifaunal diversity, targeted conservation efforts are necessary, focusing on controlled cattle grazing, habitat management, and alternative fuel sources to reduce human impact. Moreover, implementing eco-tourism management strategies will help mitigate the effects of increasing tourist activity. Site-specific conservation plans are crucial, with Site 3 requiring protection of its unique habitat characteristics and Sites 1 and 5 benefiting from restoration efforts to enhance biodiversity. Long-term avifaunal monitoring protocols involving seasonal surveys and guild tracking are vital for assessing the impacts of anthropogenic pressures and climate change. Aligning local efforts with India's commitments under the Central Asian Flyway and involving local communities through eco-development and awareness programs will be crucial for ensuring the sanctuary's ecological integrity and sustainable coexistence between people and wildlife.

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REFERENCES

Arcilla N, Strazds M. 2023. Ten principles for bird-friendly forestry: Conservation approaches in natural forests used for timber production. Birds 4 (2): 245-261. DOI: 10.3390/birds4020021.

Ball V. 1874. Avifauna of Chotanagpur. Stray Feathers 2: 1-355. DOI: page/29846368.

Basile M, Balestrieri R, de Groot M, Flajšman K, Posillico M. 2016. Conservation of birds as a function of forestry. Ital J Agron 11: 42-48. DOI: 10.1016/S1125-4718(24)00438-9.

Batzer DP, Resh VH. 1992. Macroinvertebrates of a California seasonal wetland and responses to experimental habitat manipulation. Wetlands 12 (1): 1-7. DOI: 10.1007/BF03160538.

Carrasco L, Jiménez-Mora E, Utrilla MJ, Pizarro IT, Reglero MM, Rico-San Román L, Martin-Maldonado B. 2025. Birds as bioindicators: Revealing the widespread impact of microplastics. Birds 6 (1): 10. DOI: 10.3390/birds6010010.

Chatterjee A, Adhikari S, Pal S, Mukhopadhyay SK. 2020. Foraging guild structure and niche characteristics of waterbirds wintering in selected sub-Himalayan wetlands of India. Ecol Indic 108: 105693. DOI: 10.1016/j.ecolind.2019.105693.

Coddington CP, Cooper WJ, Mokross K, Luther DA. 2023. Forest structure predicts species richness and functional diversity in Amazonian mixed-species bird flocks. Biotropica 55 (2): 467-479. DOI: 10.1111/btp.13201.

Cooper NW, Marra PP. 2020. Hidden long-distance movements by a migratory bird. Curr Biol 30 (20): 4056-4062. DOI: 10.1016/j.cub.2020.07.056.

Daily GC, Ehrlich PR, Sanchez-Azofeifa GA. 2001. Countryside biogeography: Use of human-dominated habitats by the avifauna of southern Costa Rica. Ecol Appl 11 (1): 1-13. DOI: 10.2307/3061051.

DeFries R, Hansen A, Turner BL, Reid R, Liu J. 2007. Land use change around protected areas: Management to balance human needs and ecological function. Ecol Appl 17 (4): 1031-1038. DOI: 10.1890/05-1111.

Diyaolu CO, Folarin IO. 2024. The role of biodiversity in agricultural resilience: Protecting ecosystem services for sustainable food production. Intl J Res Publ Rev 5 (10): 1560-1573. DOI: 10.55248/gengpi.5.1024.2741.

Donal PF, Fishpool LD, Ajagbe A, Bennun LA, Bunting G, Burfield LJ, Wege DC. 2019. Important Bird and Biodiversity Areas (IBAs): The development and characteristics of a global inventory of key sites for biodiversity. Bird Conserv Intl 29 (2): 177-198. DOI: 10.1017/S0959270918000102.

Drapeau P, Leduc A, Giroux JF, Savard JPL, Bergeron Y, Vickery L. 2000. Landscape-scale disturbances and changes in bird communities of boreal mixed-wood forests. Ecol Monogr 70 (3): 423-444. DOI: 10.2307/2657210.

Dutta H. 2017. Insights into the impacts of four current environmental problems on flying birds. Energy Ecol Environ 2 (5): 329-349. DOI: 10.1007/s40974-017-0075-6.

Emlen JT. 1971. Population densities of birds derived from transect counts. The Auk 88 (2): 323-342. DOI: 10.2307/4083883.

Fisher RA, Corbet AS, Williams CB. 1943. The relation between the number of species and the number of individuals in a random sample of an animal population. J Anim Ecol 12 (1): 42-58. DOI: 10.2307/1411.

Graser A, Georg M, Kallmayer J, Marten A, Pertl C, Rumpf H, Kamp J. 2025. Large-scale forest disturbance and associated management shape bird communities in Central European spruce forests. J Appl Ecol 62 (2): 329-343. DOI: 10.1111/1365-2664.14849.

Hanski I. 2015. Habitat fragmentation and species richness. J Biogeogr 42 (5): 989-993. DOI: 10.1111/jbi.12478.

Harisha MN, Hosetti BB. 2009. Diversity and distribution of avifauna of Lakkavalli Range Forest, Bhadra Wildlife Sanctuary, Western Ghat, India. Ecoprint 16: 21-27. DOI: 10.3126/eco. v16i0.3469.

Hussain Z, Ali M. 2025. An avifaunal checklist of the Zanskar Region, Ladakh Himalaya, India. J Threat Taxa 17 (3): 26669-26679. DOI: 10.11609/jott.9288.17.3.26669-26679.

Kavana DJ, Mbije N, Sirilo TM, Bupamba HC. 2024. The spatio-temporal influences of habitat heterogeneity on the community structure of avian feeding guilds in human-dominated landscapes of the East African miombo woodlands. Afr J Ecol 62 (1): e13237. DOI: 10.1111/aje.13237.

Khan MS, Pant A. 2017. Conservation status, species composition, and distribution of Avian Community in Bhimbandh Wildlife Sanctuary, India. J Asia-Pacific Biodivers 10 (1): 20-26. DOI: 10.1016/j.japb.2016.07.004.

King S, Elphick CS, Guadagnin D, Taft O, Amano T. 2010. Effects of landscape features on waterbird use of rice fields. Waterbirds 33: 151-159. DOI: 10.1675/063. 033.s111.

Kumar TS, Chandra R, Azeez PA. 2010. The birds of Araku, Visakhapatnam, Andhra Pradesh, India. J Threat Taxa 2 (1): 662-665. DOI: 10.11609/JoTT.o2108.662-5.

Lawrence ER, Fraser DJ. 2020. Latitudinal biodiversity gradients at three levels: Linking species richness, population richness and genetic diversity. Glob Ecol Biogeogr 29 (5): 770-788. DOI: 10.1111/geb.13075.

Liu J, Wilson M, Hu G, Liu J, Wu J, Yu M. 2018. How does habitat fragmentation affect the biodiversity and ecosystem functioning relationship? Landsc Ecol 33 (3): 341-352. DOI: 10.1007/s10980-018-0620-5.

Lopez A, Mundkar T. 1997. The Asian Waterfall Census 1994-1996. Wetlands International, Kuala Lumpur, Malaysia.

Maher M. 1984. Benthic studies of waterfowl breeding habitat in south-western New South Wales. I. The fauna. Mar Freshw Res 35 (1): 85-96. DOI: 10.1071/MF9840085.

Mali S, Srinivasulu C, Rahmani AR. 2017. Avifaunal diversity in the scrub forest of Sri Lankamalleswara Wildlife Sanctuary, Andhra Pradesh, India. J Threat Taxa 9 (9): 10679-10691. DOI: 10.11609/jott.2720.9.9.10679-10691.

Mariyappan M, Rajendran M, Velu S, Johnson AD, Dinesh GK, Solaimuthu K, Sankar M. 2023. Ecological role and ecosystem services of birds: A review. Intl J Environ Clim Change 13 (6): 76-87. DOI: 10.9734/ijecc/2023/v13i61800.

Marzluff JM, Raphael MG, Sallabanks R. 2000. Understanding the effects of forest management on avian species. Wildl Soc Bull 28 (4): 1132-1143. DOI: 10.2307/3783874.

Maseko MS, Zungu MM, Ehlers-Smith DA, Ehlers-Smith YC, Downs CT. 2020. Effects of habitat-patch size and patch isolation on the diversity of forest birds in the urban-forest mosaic of Durban, South Africa. Urban Ecosyst 23 (3): 533-542. DOI: 10.1007/s11252-020-00945-z.

Mukhopadhyay S, Mazumdar S. 2019. Habitat-wise composition and foraging guilds of avian community in a suburban landscape of lower Gangetic plains, West Bengal, India. Biologia 74 (8): 1001-1010. DOI: 10.2478/s11756-019-00226-x.

Naughton-Treves L, Holland MB, Brandon K. 2005. The role of protected areas in conserving biodiversity and sustaining local livelihoods. Annu Rev Environ Resour 30 (1): 219-252. DOI: 10.1146/annurev.energy.30.050504.164507.

Panda BP, Prusty BAK, Panda B, Pradhan A, Parida SP. 2021. Habitat heterogeneity influences avian feeding guild composition in urban landscapes: Evidence from Bhubaneswar, India. Ecol Proc 10 (1): 31. DOI: 10.1186/s13717-021-00304-6.

Pearman PB. 2002. The scale of community structure: Habitat variation and avian guilds in tropical forest understory. Ecol Monogr 72 (1): 19-39. DOI: 10.1890/0012-9615(2002)072[0019: TSOCSH]2.0.CO;2.

Pielou EC. 1966. The measurement of diversity in different types of biological collections. J Theor Biol 13: 131-144. DOI: 10.1016/0022-5193(66)90013-0.

Porensky LM, Young TP. 2013. Edge-effect interactions in fragmented and patchy landscapes. Conserv Biol 27 (3): 509-519. DOI: 10.1111/cobi.12042.

Pörtner HO, Scholes RJ, Arneth A, Barnes DKA, Burrows MT, Diamond SE, Val AIL. 2023. Overcoming the coupled climate and biodiversity crises and their societal impacts. Science 380 (6642): eabl4881. DOI: 10.1126/science. abl4881.

Poulin B, Lefebvre G, Mcneil R. 1993. Variations in bird abundance in tropical arid and semi-arid habitats. Ibis 135 (4): 432-441. DOI: 10.1111/j.1474-919X.1993.tb02116. x.

Reino L, Beja P, Osborne PE, Morgado R, Fabião A, Rotenberry JT. 2009. Distance to edges, edge contrast and landscape fragmentation: Interactions affecting farmland birds around forest plantations. Biol Conserv 142 (4): 824-838. DOI: 10.1016/j.biocon.2008.12.011.

Saeed U, Ahamad M, Ranjan V, Hussain SA, Badola R. 2023. Assessing and understanding diversity and foraging guilds of bird community structure in Gautam Buddha Wildlife Sanctuary, Bihar and Jharkhand, India. J Threat Taxa 15 (12): 24331-24344. DOI: 10.11609/jott.8357.15.12.24331-24344.

Shochat E, Lerman S, Fernández-Juricic E. 2010. Birds in urban ecosystems: Population dynamics, community structure, biodiversity, and conservation. Urban Ecosyst Ecol 55: 75-86. DOI: 10.2134/agronmonogr55.c4.

Simberloff D, Dayan T. 1991. The guild concept and the structure of ecological communities. Ann Rev Ecol Syst 22: 115-143. DOI: 10.1146/annurev.es.22.110191.000555.

Simkins AT, Buchanan GM, Davies RG, Donald PF. 2020. The implications for conservation of a major taxonomic revision of the world's birds. Anim Conserv 23 (4): 345-352. DOI: 10.1111/acv.12545

Simpson EH. 1949. Measurement of diversity. Nature 163 (4148): 688. DOI: 10.1038/163688a0.

Stafford JD, Kaminski RM, Reinecke KJ. 2010. Avian foods, foraging and habitat conservation in world rice fields. Waterbirds 33: 133-150. DOI: 10.5281/zenodo.8187007.

Verma SK. 2011. A preliminary survey on the avian community of Dalma Wildlife Sanctuary, Jharkhand, India. J Threat Taxa 3 (5): 1764-1770. DOI: 10.11609/JoTT.o2181.1764-70.

Vinayak DC, Mali SV. 2018. A checklist of bird communities in Tamhini Wildlife Sanctuary, the northern Western Ghats, Maharashtra, India. J Threat Taxa 10 (3): 11399-11409. DOI: 10.11609/jott.3377.10.3.11399-11409.

Whelan CJ, Wenny DG, Marquis RJ. 2008. Ecosystem services provided by birds. Ann N Y Acad Sci 1134 (1): 25-60. DOI: 10.1196/annals.1439.003.

Willson MF. 1974. Avian community organization and habitat structure. Ecology 55 (5): 1017-1029. DOI: 10.2307/1940352.

Wolfe JD, Johnson MD, Ralph CJ. 2014. Do birds select habitat or food resources? Nearctic-Neotropic migrants in northeastern Costa Rica. Plos One 9 (1): e86221. DOI: 10.1371/journal.pone.0086221.

Table S1. List of bird species with detailed information recorded during this study (Appendix 1)

Sl. No.	Common name	Scientific name	Feeding guild	IUCN red list status	Site 1	Site 2	Site 3	Site 4	Site 5	No. of individual	Relative abundance
Order: Accipitriformes											
Family: Accipitridae											
1	Eurasian Sparrowhawk	*Accipiter nisus*	Carnivorous	LC	0	0	0	1	0	1	0.091
2	Bonelli's Eagle	*Aquila fasciata*	Carnivorous	LC	0	0	0	0	1	1	0.091
3	Tawny Eagle	*Aquila rapax*	Carnivorous	VU	0	0	0	1	1	2	0.182
4	Jerdon's Baza	*Aviceda jerdoni*	Carnivorous	LC	0	0	0	1	1	2	0.182
5	Short-toed Snake Eagle	*Circaetus gallicus*	Carnivorous	LC	0	0	1	0	0	1	0.091
6	Western Marsh Harrier	*Circus spilonotus*	Carnivorous	LC	0	1	1	1	1	4	0.365
7	Black-winged Kite	*Elanus caeruleus*	Carnivorous	LC	0	0	1	0	1	2	0.182
8	Brahminy Kite	*Haliastur indus*	Carnivorous	LC	0	0	0	1	1	2	0.182
9	Crested Goshawk	*Lophospiza trivirgatus*	Carnivorous	LC	0	0	0	1	0	1	0.091
10	Black Kite	*Milvus migrans*	Carnivorous	LC	0	0	1	1	0	2	0.182
11	Changeable Hawk-eagle	*Nisaetus cirrhatus*	Carnivorous	LC	0	0	0	0	1	1	0.091
12	Crested Serpent-Eagle	*Spilornis cheela*	Carnivorous	LC	1	2	2	1	0	6	0.547
13	Shikra	*Accipiter badius*	Carnivorous	LC	0	1	0	0	0	1	0.091
Family: Pandionidae											
14	Osprey	*Pandion haliaetus*	Fishivorous	LC	1	1	0	1	0	3	0.274
Order: Anseriformes											
Family: Anatidae											
15	Common Pochard	*Aythya ferina*	Omnivorous	LC	0	0	3	0	0	3	0.274
16	Tufted Duck	*Aythya fuligula*	Omnivorous	LC	2	1	3	2	5	13	1.186
17	Lesser Whistling Duck	*Dendrocygna javanica*	Omnivorous	LC	0	0	0	0	4	4	0.365
18	Gadwall	*Mareca strepera*	Omnivorous	LC	12	13	4	7	2	38	3.467
19	Cotton Pygmy-goose	*Nettapus coromandelianus*	Herbivorous	LC	2	1	1	0	0	4	0.365
20	Red Crested Pochard	*Netta rufina*	Omnivorous	LC	0	0	1	0	0	1	0.091
21	Northern Shoveler	*Spatula clypeata*	Omnivorous	LC	0	0	0	3	0	3	0.274
22	Garganey	*Spatula querquedula*	Omnivorous	LC	2	1	4	3	0	10	0.912
23	Ruddy Shelduck	*Tadorna ferruginea*	Omnivorous	LC	2	2	1	2	0	7	0.639
Order: Apodiformes											
Family: Apodidae											
24	Little Swift	*Apus affinis*	Insectivorous	LC	0	0	0	0	2	2	0.182
25	Asian Palm Swift	*Cypsiurus balasiensis*	Insectivorous	LC	0	2	0	0	0	2	0.182
Family: Hemiprocnidae											
26	Crested Treeswift	*Hemiprocne coronata*	Insectivorous	LC	0	1	0	0	0	1	0.091
Order: Bucerotiformes											
Family: Bucerotidae											
27	Oriental Pied Hornbill	*Anthracoceros albirostris*	Frugivorous	LC	0	2	0	2	0	4	0.365
28	Great Hornbill	*Buceros bicornis*	Frugivorous	VU	0	0	0	1	2	3	0.274
29	Indian Grey Hornbill	*Ocyceros birostris*	Frugivorous	LC	0	0	0	2	1	3	0.274
Family: Upupidae											
30	Eurasian Hoopoe	*Upupa epops*	Insectivorous	LC	2	1	0	1	1	5	0.456

Order: Caprimulgiformes											
Family: Caprimulgidae											
31	Savanna Nightjar	*Caprimulgus affinis*	Insectivorous	LC	0	0	0	4	0	4	0.365
32	Indian Nightjar	*Caprimulgus asiaticus*	Insectivorous	LC	0	0	0	1	0	1	0.091
Order: Charadriiformes											
Family: Burhinidae											
33	Indian Thick-knee	*Burhinus indicus*	Insectivorous	LC	0	0	0	1	0	1	0.091
Family: Charadriidae											
34	Red-wattled Lapwing	*Vanellus indicus*	Insectivorous	LC	4	2	1	1	2	10	0.912
Family: Jacanidae											
35	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	Insectivorous	LC	1	0	0	1	0	2	0.182
36	Bronze-winged Jacana	*Metopidius indicus*	Insectivorous	LC	2	1	3	0	0	6	0.547
Family: Laridae											
37	Brown-headed Gull	*Chroicocephalus brunnicephalus*	Omnivorous	LC	4	0	0	0	0	4	0.365
38	Black-headed Gull	*Chroicocephalus ridibundus*	Omnivorous	LC	0	0	0	0	4	4	0.365
Family: Scolopacidae											
39	Common Sandpiper	*Actitis hypoleucos*	Insectivorous	LC	3	7	6	0	3	19	1.734
40	Common Snipe	*Gallinago gallinago*	Insectivorous	LC	1	2	1	0	0	4	0.365
Order: Columbiformes											
Family: Columbidae											
41	Rock Pigeon (feral)	*Columba livia*	Grainivorous	LC	3	0	6	7	0	16	1.460
42	Eurasian Collared-Dove	*Streptopelia decaocto*	Grainivorous	LC	0	0	0	0	4	4	0.365
43	Spotted Dove	*Spilopelia chinensis*	Grainivorous	LC	0	0	0	0	1	1	0.091
44	Laughing Dove	*Spilopelia senegalensis*	Grainivorous	LC	0	0	0	0	5	5	0.456
45	Orange-breasted Green Pigeon	*Treron bicinctus*	Frugivorous	LC	0	0	1	0	0	1	0.091
46	Yellow-footed Green Pigeon	*Treron phoenicopterus*	Frugivorous	LC	0	0	0	0	2	2	0.182
Order: Coraciiformes											
Family: Alcedinidae											
47	Common Kingfisher	*Alcedo atthis*	Fishivorous	LC	1	1	2	1	2	7	0.639
48	Pied Kingfisher	*Ceryle rudis*	Fishivorous	LC	0	0	1	0	0	1	0.091
49	White-throated Kingfisher	*Halcyon smyrnensis*	Fishivorous	LC	0	1	0	0	0	1	0.091
50	Stork-billed Kingfisher	*pelargopsis capensis*	Fishivorous	LC	0	1	0	3	0	4	0.365
Family: Coraciidae											
51	Indian Roller	*Coracias benghalensis*	Carnivorous	LC	0	0	0	2	0	2	0.182
52	Indochinese Roller	*Coracias affinis*	Insectivorous	LC	0	0	2	0	0	2	0.182
Family: Meropidae											
53	Asian Green Bee-eater	*Merops orientalis*	Insectivorous	LC	3	2	0	5	4	14	1.277
Order: Ciconiiformes											
Family: Ciconiidae											
54	Asian Openbill Stork	*Anastomus oscitans*	Carnivorous	LC	3	11	7	4	2	27	2.464
55	Black-necked Stork	*Ephippiorhynchus asiaticus*	Frugivorous	NT	0	0	0	2	0	2	0.182
56	Painted Stork	*Mycteria leucocephala*	Fishivorous	LC	0	0	0	4	2	6	0.547
Order: Cuculiformes											
Family: Cuculidae											
57	Grey-billed Cuckoo	*Cacomantis passerines*	Insectivorous	LC	1	4	0	2	1	8	0.730
58	Banded Bay Cuckoo	*Cacomantis sonneratii*	Insectivorous	LC	0	0	1	1	1	3	0.274

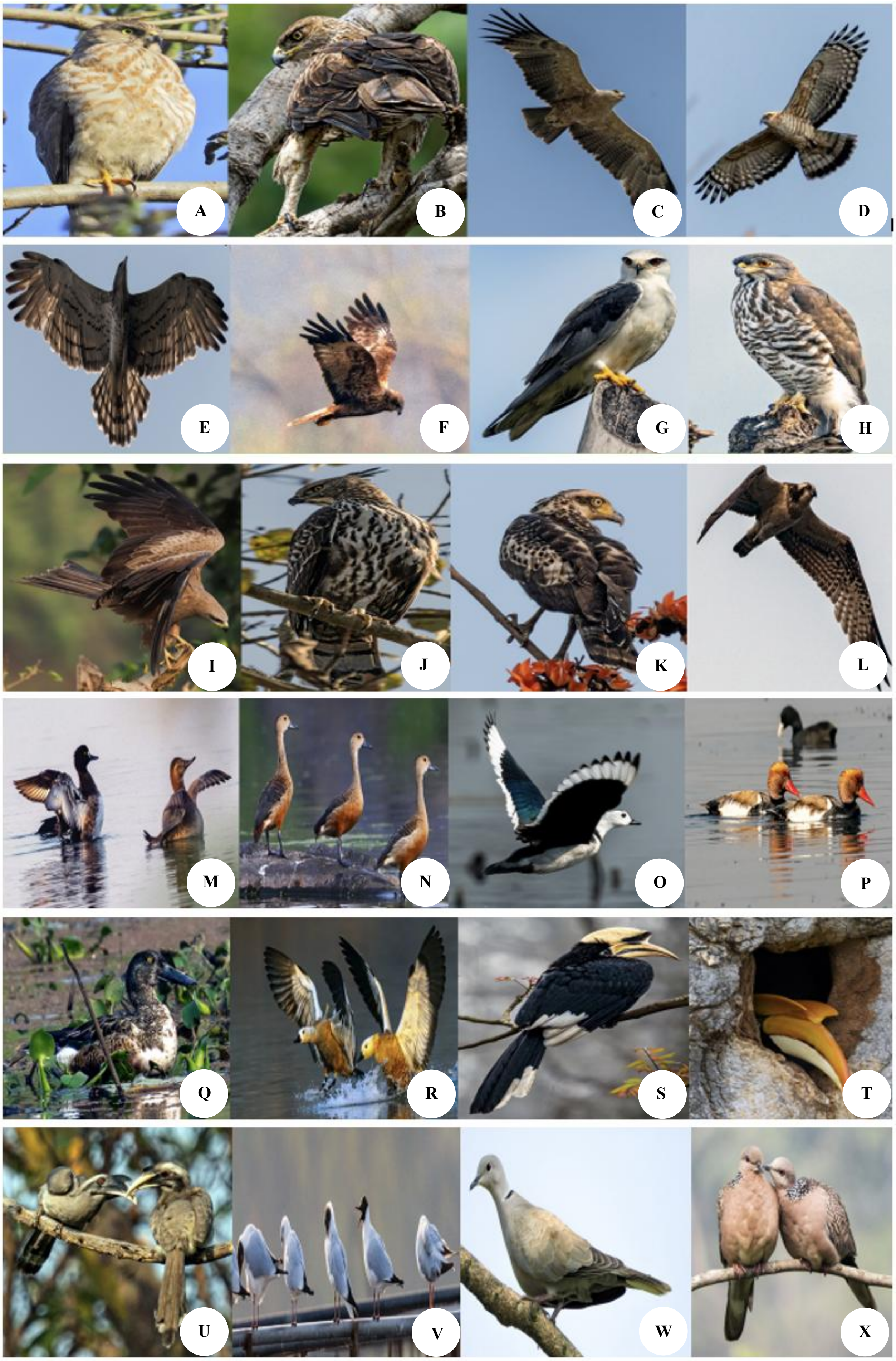
59	Greater Coucal	*Centropus sinensis*	Carnivorous	LC	0	1	0	1	0	2	0.182
60	Pied Cuckoo	*Clamator jacobinus*	Insectivorous	LC	0	0	2	0	1	3	0.274
61	Common Hawk-cuckoo	*Hierococcyx varius*	Insectivorous	LC	0	3	2	1	0	6	0.547
62	Sirkeer Malkoha	*Taccocua leschenaultii*	Insectivorous	LC	0	0	1	0	1	2	0.182
Order: Falconiformes											
Family: Falconidae											
63	Peregrine Falcon	*Falco peregrinus*	Carnivorous	LC	2	0	2	0	3	7	0.639
64	Eurasian Kestrel	*Falco tinnunculus*	Carnivorous	LC	0	2	1	1	0	4	0.365
Order: Galliformes											
Family: Phasianidae											
65	Black Francolin	*Francolinus francolinus*	Omnivorous	LC	0	0	1	1	1	3	0.274
66	Painted-spurfowl	*Galloperdix lunulata*	Omnivorous	LC	1	1	1	2	0	5	0.456
67	Red Jungle Fowl	*Gallus gallus*	Omnivorous	LC	0	0	1	1	0	2	0.182
68	Grey Francolin	*Ortygornis pondicerianus*	Omnivorous	LC	0	4	0	1	0	5	0.456
69	Indian Peafowl	*Pavo cristatus*	Omnivorous	LC	0	5	3	0	2	10	0.912
70	Jungle Bush Quail	*Perdicula asiatica*	Insectivorous	LC	0	2	0	1	0	3	0.274
Order: Gruiformes											
Family: Rallidae											
71	White-breasted Waterhen	*Amaurornis phoenicurus*	Carnivorous	LC	3	1	2	1	0	7	0.639
72	Eurasian Coot	*Fulica atra*	Omnivorous	LC	3	2	4	0	1	10	0.912
73	Common Moorhen	*Gallinula chlorpus*	Omnivorous	LC	2	1	4	0	2	9	0.821
74	Grey-headed Swamphen	*Porphyrio poliocephalus*	Nectivorous	LC	0	0	1	0	0	1	0.091
75	Western Swamphen	*Porphyrio porphyrio*	Nectivorous	LC	0	2	0	0	0	2	0.182
Order: Passeriformes											
Family: Aegithinidae											
76	Common Iora	*Aegithina tiphia*	Insectivorous	LC	1	0	0	2	0	3	0.274
Family: Alaudidae											
77	Rufous Tailed Lark	*Ammomanes phoenicura*	Insectivorous	LC	0	0	0	1	0	1	0.091
78	Ashy Crowned Sparrow Lark	*Eremopterix griseus*	Insectivorous	LC	0	2	2	0	0	4	0.365
79	Indian Bushlark	*Mirafra erythroptera*	Insectivorous	LC	1	2	0	0	5	8	0.730
80	Bengal Bush Lark	*Mirafra assamica*	Insectivorous	LC	0	0	0	1	0	1	0.091
Family: Campephagidae											
81	Indian Cuckooshrike	*Coracina macei*	Insectivorous	LC	0	0	0	6	4	10	0.912
82	Small Minivet	*Pericrocotus cinnamomeus*	Insectivorous	LC	2	5	0	2	3	12	1.095
83	Long-tailed Minivet	*Pericrocotus ethologus*	Insectivorous	LC	0	1	0	0	0	1	0.091
Family: Chloropseidae											
84	Golden Fronted Leafbird	*Chloropsis aurifrons*	Insectivorous	LC	0	2	4	0	6	12	1.095
85	Jerdon's Leafbird	*Chloropsis jerdoni*	Insectivorous	LC	0	0	1	0	1	2	0.182
Family: Cisticolidae											
86	Common Tailorbird	*Orthotomus sutorius*	Insectivorous	LC	1	2	3	0	5	11	1.004
87	Ashy Prinia	*Prinia socialis*	Insectivorous	LC	1	0	2	0	3	6	0.547
88	Plain Prinia	*Prinia inornata*	Insectivorous	LC	0	1	1	0	1	3	0.274
Family: Corvidae											
89	House Crow	*Corvus splendens*	Omnivorous	LC	0	0	3	3	0	6	0.547
90	Rufous Treepie	*Dendrocitta vagabunda*	Omnivorous	LC	3	2	0	0	7	12	1.095

Family: Dicaeidae											
91	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	Nectivorous	LC	1	0	4	1	0	6	0.547
92	White-bellied Drongo	*Dicrurus caerulescens*	Insectivorous	LC	1	0	1	0	2	4	0.365
93	Hair-crested Drongo	*Dicrurus hottentottus*	Insectivorous	LC	0	1	2	0	1	4	0.365
94	Black Drongo	*Dicrurus macrocercus*	Insectivorous	LC	0	0	0	4	0	4	0.365
95	Lesser Racket-tailed Drongo	*Dicrurus remifer*	Insectivorous	LC	1	3	0	1	1	6	0.547
Family: Emberizidae											
96	Cinereous Bunting	*Emberiza cineracea*	Omnivorous	LC	2	0	2	0	5	9	0.821
Family: Estrildidae											
97	Red Avadavat	*Amandava amandava*	Omnivorous	LC	0	0	1	1	0	2	0.182
Family: Estrildidae											
98	Common Silverbill	*Lonchura malabarica*	Grainivorous	LC	0	2	1	1	7	11	1.004
99	Scaly-breasted Munia	*Lonchura punctulata*	Grainivorous	LC	1	2	0	0	4	7	0.639
Family: Hirundinidae											
100	Red Rumped Swallow	*Cecropis daurica*	Insectivorous	LC	1	1	1	1	0	4	0.365
101	White-tailed Swallow	*Hirundo megaensis*	Insectivorous	VU	0	0	1	0	0	1	0.091
102	Barn swallow	*Hirundo rustica*	Insectivorous	LC	1	0	3	1	2	7	0.639
103	Wire tailed Swallow	*Hirundo smithii*	Insectivorous	LC	3	2	1	1	3	10	0.912
104	Streak-throated Swallow	*Petrochelidon fluvicola*	Insectivorous	LC	0	0	0	0	1	1	0.091
Family: Laniidae											
105	Brown Shrike	*Lanius cristatus*	Carnivorous	LC	0	0	0	0	1	1	0.091
106	Long-tailed Shrike	*Lanius schach*	Carnivorous	LC	0	3	2	0	5	10	0.912
107	Bay-backed Shrike	*Lanius vittatus*	Insectivorous	LC	0	0	3	5	0	8	0.730
Family: Leiothrichidae											
108	Common Babbler	*Argya caudate*	Omnivorous	LC	1	0	0	0	0	1	0.091
109	Jungle Babbler	*Argya striata*	Omnivorous	LC	0	0	1	0	0	1	0.091
Family: Monarchidae											
110	Ultramarine Flycatcher	*Ficedula superciliaris*	Insectivorous	LC	0	1	4	0	2	7	0.639
111	Black-naped Monarch	*Hypothymis azurea*	Insectivorous	LC	0	1	3	0	2	6	0.547
112	Indian Paradise-flycatcher	*Terpsiphone paradise*	Insectivorous	LC	2	1	0	1	1	5	0.456
Family: Motacillidae											
113	Olive Backed Pipit	*Anthus hodgsoni*	Insectivorous	LC	0	1	1	0	1	3	0.274
114	Paddyfield Pipit	*Anthus rufulus*	Insectivorous	LC	0	1	0	1	0	2	0.182
115	Forest Wagtail	*Dendronanthus indicus*	Insectivorous	LC	1	0	3	9	0	13	1.186
116	White Wagtail	*Motacilla alba*	Insectivorous	LC	0	0	3	7	0	10	0.912
117	Grey Wagtail	*Motacilla cinerea*	Insectivorous	LC	0	0	9	4	0	13	1.186
118	Citrine Wagtail	*Motacilla citreola*	Insectivorous	LC	0	2	0	8	0	10	0.912
119	White-browed Wagtail	*Motacilla maderaspatensis*	Insectivorous	LC	0	3	2	0	1	6	0.547
Family: Muscicapidae											
120	Himalayan Rubythroat	*Calliope pectoralis*	Insectivorous	LC	0	0	2	0	0	2	0.182
121	Indian Robin	*Copsychus fulicatus*	Insectivorous	LC	0	1	2	1	2	6	0.547
122	Bluethroat	*Luscinia svecica*	Insectivorous	LC	1	0	2	1	4	8	0.730
123	Blue Rock Thrush	*Monticola solitaries*	Insectivorous	LC	2	1	1	1	1	6	0.547
124	Blue-capped Rock Thrush	*Monticola cinclorhyncha*	Insectivorous	LC	1	0	1	0	1	3	0.274
125	White-rumped Shama	*Copsychus malabaricus*	Insectivorous	LC	2	0	2	2	3	9	0.821
126	Oriental Magpie-robin	*Copsychus saularis*	Insectivorous	LC	2	1	0	1	5	9	0.821

127	Tickell's Blue Flycatcher	*Cyornis tickelliae*	Insectivorous	LC	2	3	2	0	1	8	0.730
128	Verditer Flycatcher	*Eumyias thalassinus*	Insectivorous	LC	1	1	1	1	0	4	0.365
129	Taiga Flycatcher	*Ficedula albicilla*	Insectivorous	LC	0	1	1	1	1	4	0.365
130	Brown-breasted Flycatcher	*Muscicapa muttui*	Insectivorous	LC	0	1	0	0	0	1	0.091
131	Dark-sided Flycatcher	*Muscicapa sibirica*	Insectivorous	LC	0	0	1	0	0	1	0.826
132	Brown rock Chat	*Oenanthe fusca*	Insectivorous	LC	2	1	3	5	0	11	1.004
133	Black Redstart	*Phoenicurus ochruros*	Insectivorous	LC	3	0	1	1	0	5	0.456
134	White-throated Bush Chat	*Saxicola insignis*	Insectivorous	VU	0	1	0	1	0	2	0.182
135	Red-flanked Bluetail	*Tarsiger cyanurus*	Insectivorous	LC	0	0	1	0	0	1	0.091
Family: Nectariniidae											
136	Crimson Sunbird	*Aethopyga siparaja*	Nectivorous	LC	0	0	2	0	0	2	0.182
137	Purple Sunbird	*Cinnyris asiaticus*	Nectivorous	LC	2	2	1	0	1	6	0.547
138	Purple-rumped Sunbird	*Leptocoma zeylonica*	Nectivorous	LC	2	1	1	1	0	5	0.456
Family: Oriolidae											
139	Indian Golden Oriole	*Oriolus kundoo*	Insectivorous	LC	1	2	3	0	2	8	0.730
140	Black-hooded Oriole	*Oriolus xanthornus*	Insectivorous	LC	0	1	1	2	1	5	0.456
Family: Paradoxornithidae											
141	Yellow-eyed Babbler	*Chrysomma sinense*	Insectivorous	LC	0	0	0	1	0	1	0.091
Family: Passeridae											
142	Yellow-throated Sparrow	*Gymnoris xanthocollis*	Omnivorous	LC	1	0	2	1	0	4	0.365
143	House Sparrow	*Ceratophyllus fringillae*	Omnivorous	LC	2	5	1	7	2	17	1.551
Family: Pellorneidae											
144	Puff-throated Babbler	*Pellorneum ruficeps*	Insectivorous	LC	2	0	0	1	1	4	0.365
Family: Phylloscopidae											
145	Hume's Warbler	*Phylloscopus humei*	Insectivorous	LC	0	2	3	4	0	9	0.821
146	Yellow-browed warbler	*Phylloscopus inornatus*	Insectivorous	LC	3	0	6	7	0	16	1.460
147	Green Warbler	*Geospiza olivacea*	Insectivorous	LC	2	1	0	1	1	5	0.456
148	Greenish Warbler	*Phylloscopus trochiloides*	Insectivorous	LC	5	2	0	0	0	7	0.639
Family: Pittidae											
149	Indian Pitta	*Pitta brachyuran*	Insectivorous	LC	0	2	0	4	0	6	0.547
Family: Ploceidae											
150	Baya Weaver	*Ploceus philippinus*	Omnivorous	LC	10	0	4	0	0	14	1.277
Family: Pycnonotidae											
151	Red-vented Bulbul	*Pycnonotus cafer*	Frugivorous	LC	7	0	12	0	4	23	2.099
152	Red-whiskered Bulbul	*Pycnonotus jocosus*	Frugivorous	LC	3	12	0	7	0	22	2.007
153	Himalayan Bulbul	*Pycnonotus leucogenys*	Insectivorous	LC	0	0	0	1	1	2	0.182
Family: Stenostiridae											
154	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	Insectivorous	LC	0	1	0	1	0	2	0.182
Family: Sturnidae											
155	Common Myna	*Acridotheres tristis*	Omnivorous	LC	12	9	10	0	2	33	3.011
156	Indian Pied Starling	*Sturnidoecus capensis*	Omnivorous	LC	1	0	1	2	0	4	0.365
157	Common Hill Myna	*Gracula religiosa*	Omnivorous	LC	0	4	0	0		4	0.365
158	Chestnut Tailed Starling	*Sturnia malabarica*	Omnivorous	LC	1	1	1	0	0	3	0.274
159	Brahminy Starling	*Sturnia pagodarum*	Omnivorous	LC	2	1	1	1	0	5	0.456
Family: Turdidae											

160	Orange-headed Thrush	*Geokichla citrina*	Insectivorous	LC	0	0	1	0	0	1	0.091
161	Tickell's Thrush	*Turdus unicolor*	Insectivorous	LC	2	0	1	0	1	4	0.365
162	Scaly Thrush	*Zoothera dauma*	Insectivorous	LC	0	0	1	0	0	1	0.091
Family: Vangidae											
163	Common Woodshrike	*Tephrodornis pondicerianus*	Insectivorous	LC	0	0	1	1	0	2	0.182
Family: Zosteropidae											
164	Indian White Eye	*Zosterops palpebrosus*	Frugivorous	LC	2	0	1	1	0	4	0.365
Order: Pelecaniformes											
Family: Ardeidae											
165	Great Egret	*Ardea alba*	Carnivorous	LC	0	0	0	3	0	3	0.274
166	Chestnut Bittern	*Ixobrychus cinnamomeus*	Insectivorous	LC	1	1	0	1	2	5	0.456
167	Eastern Cattle-egret	*Bulbulcus ibis*	Carnivorous	LC	0	0	1	0	0	1	0.091
168	Grey Heron	*Ardea cinerea*	Carnivorous	LC	2	1	1	3	1	8	0.730
169	Indian Pond Heron	*Ardeola grayii*	Carnivorous	LC	0	0	0	3	0	3	0.274
170	Cattle Egret	*Bubulcus ibis*	Carnivorous	LC	3	2	0	1	2	8	0.730
171	Medium Egret	*Ardea intermedia*	Carnivorous	LC	0	0	0	0	7	7	0.639
172	Purple Heron	*Ardea purpurea*	Fishivorous	LC	0	0	0	1	0	1	0.091
173	Little Egret	*Egretta garzetta*	Carnivorous	LC	2	1	1	0	2	6	0.547
174	Black Crowned Night Heron	*Nycticorax nycticorax*	Carnivorous	LC	0	0	5	0	0	5	0.456
Family: Pelecanidae											
175	Spot-billed Pelican	*Pelecanus philippensis*	Carnivorous	NT	0	0	0	1	0	1	0.091
Family: Threskiornithidae											
176	Red-naped Ibis	*Pseudibis papillosa*	Carnivorous	LC	2	1	0	1	0	4	0.365
177	Black-headed Ibis	*Threskiornis melanocephalus*	Carnivorous	LC	5	3	2	0	2	12	1.095
Order: Piciformes											
Family: Megalaimidae											
178	Blue-throated Barbet	*Psilopogon asiaticus*	Frugivorous	LC	0	2	5	8	0	15	1.369
179	Coppersmith Barbet	*Psilopogon haemacephalus*	Frugivorous	LC	0	0	0	2	0	2	0.182
180	Lineated Barbet	*Psilopogon lineatus*	Frugivorous	LC	0	1	1	0	0	2	0.182
181	Brown-headed Barbet	*Psilopogon zeylanicus*	Frugivorous	LC	2	0	0	0	0	2	0.182
Family: Picidae											
182	White-naped Woodpecker	*Chrysocolaptes festivus*	Insectivorous	LC	0	0	2	0	0	2	0.182
183	Greater Flameback	*Chrysocolaptes guttacristatus*	Insectivorous	LC	0	1	1	0	1	3	0.274
184	Black-rumped Flameback	*Dinopium benghalense*	Insectivorous	LC	1	0	1	1	1	4	0.365
185	Eurasian Wryneck	*Jynx torquilla*	Insectivorous	LC	0	0	1	0	0	0	0.091
186	Rufous Woodpecker	*Micropternus brachyurus*	Insectivorous	LC	2	0	1	0	1	4	0.365
187	Brown-capped Pygmy Woodpecker	*Yungipicus nanus*	Insectivorous	LC	1	1	1	0	1	4	0.365
Order: Podicipidiformes											
Family: Podicipedidae											
188	Great Crested Grebe	*Podiceps cristatus*	Carnivorous	LC	2	2	1	0	0	5	0.456
189	Little Grebe	*Tachybaptus ruficollis*	Carnivorous	LC	3	0	1	0	1	5	0.456
Order: Psittaciformes											
Family: Psittaculidae											
190	Plum-headed Parakeet	*Psittacula cyanocephala*	Frugivorous	LC	0	2	0	1	0	3	0.274
191	Alexandrine Parakeet	*Psittacula eupatria*	Frugivorous	LC	2	1	1	1	0	5	0.456
192	Rose-ringed Parakeet	*Psittacula krameri*	Frugivorous	LC	1	0	3	2	0	6	0.547

Order: Suliformes											
Family: Anhingidae											
193	Oriental Darter	*Anhinga melanogaster*	Fishivorous	LC	0	0	1	0	0	1	0.091
Family: Phalacrocoracidae											
194	Little Cormorant	*Microcarbo niger*	Fishivorous	LC	0	1	1	0	0	2	0.182
195	Indian Cormorant	*Phalacrocorax fuscicollis*	Fishivorous	LC	5	1	3	2	1	12	1.095
196	Great Cormorant	*Phalacrocorax carbo*	Fishivorous	LC	0	2	1	0	1	4	0.365
Order: Strigiformes											
Family: Strigidae											
197	Rock Eagle-owl	*Bubo bengalensis*	Carnivorous	LC	0	0	1	0	0	1	0.091
198	Jungle Owlet	*Glaucidium radiatum*	Carnivorous	LC	0	1	1	1	0	3	0.274
199	Dusky Eagle-owl	*Ketupa coromanda*	Carnivorous	LC	0	1	0	0	0	1	0.091
200	Spot-billed Eagle-owl	*Ketupa nipalensis*	Carnivorous	LC	1	1	0	0	0	2	0.182
201	Brown Fish Owl	*Ketupa zeylonensis*	Carnivorous	LC	0	0	1	0	0	1	0.091
202	Brown Boobook	*Ninox scutulata*	Insectivorous	LC	0	0	1	1	0	2	0.182
203	Indian Scops-owl	*Otus bakkamoena*	Carnivorous	LC	1	0	0	1	0	2	0.182
204	Oriental Scops Owl	*Otus sunia*	Insectivorous	LC	0	1	1	0	0	2	0.182
205	Mottled Wood Owl	*Strix ocellata*	Carnivorous	LC	0	0	1	0	0	1	0.091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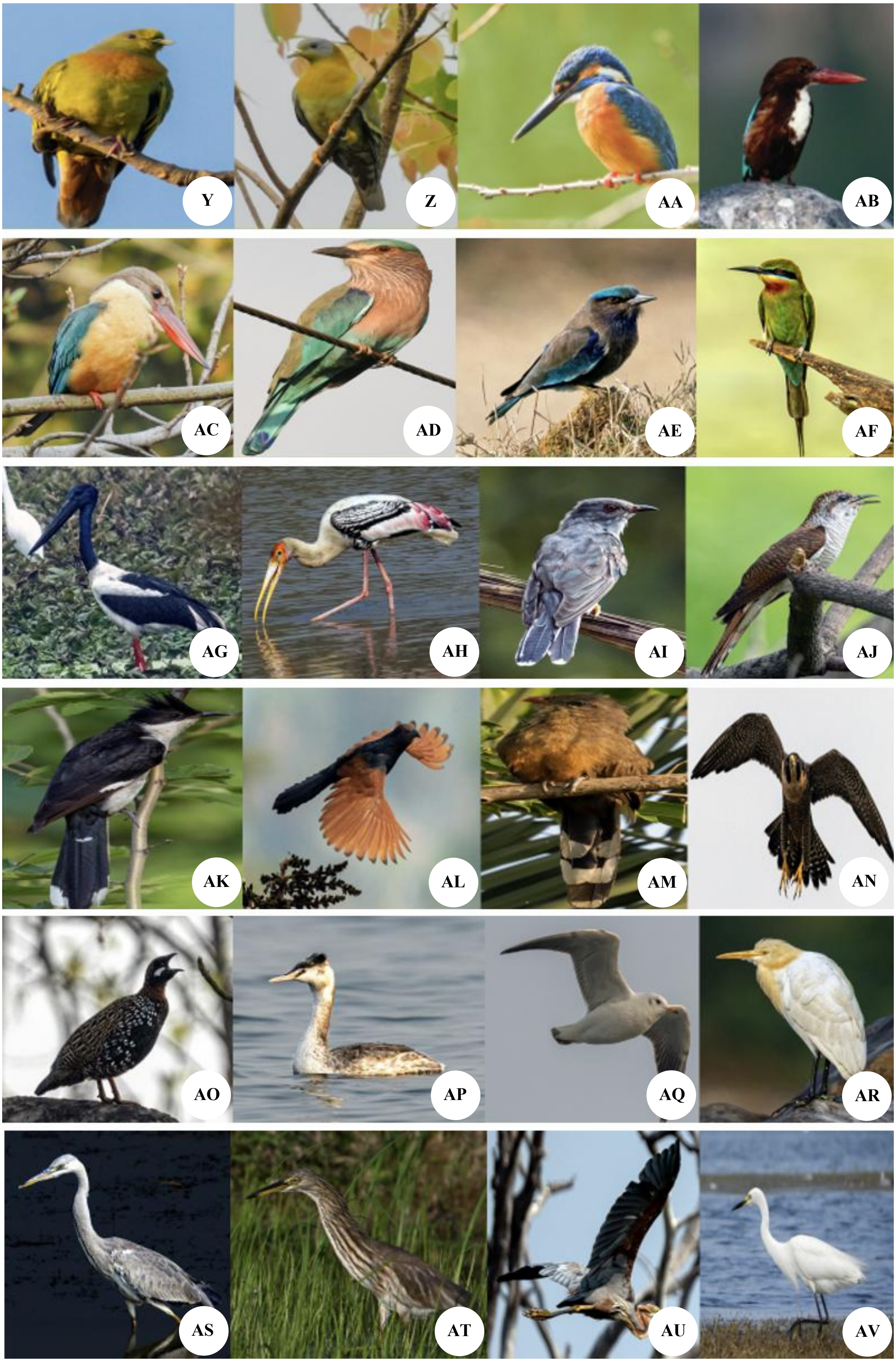
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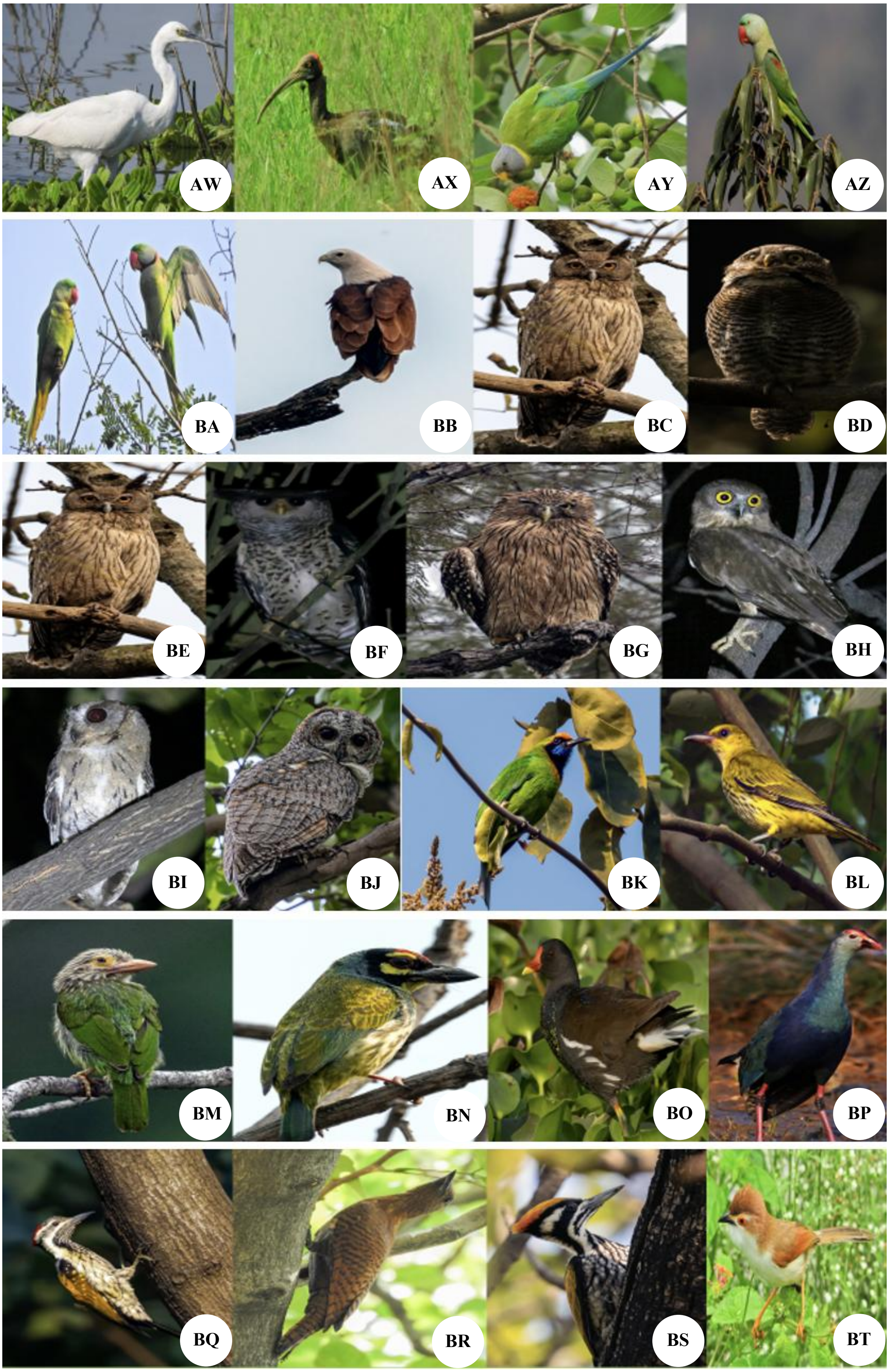
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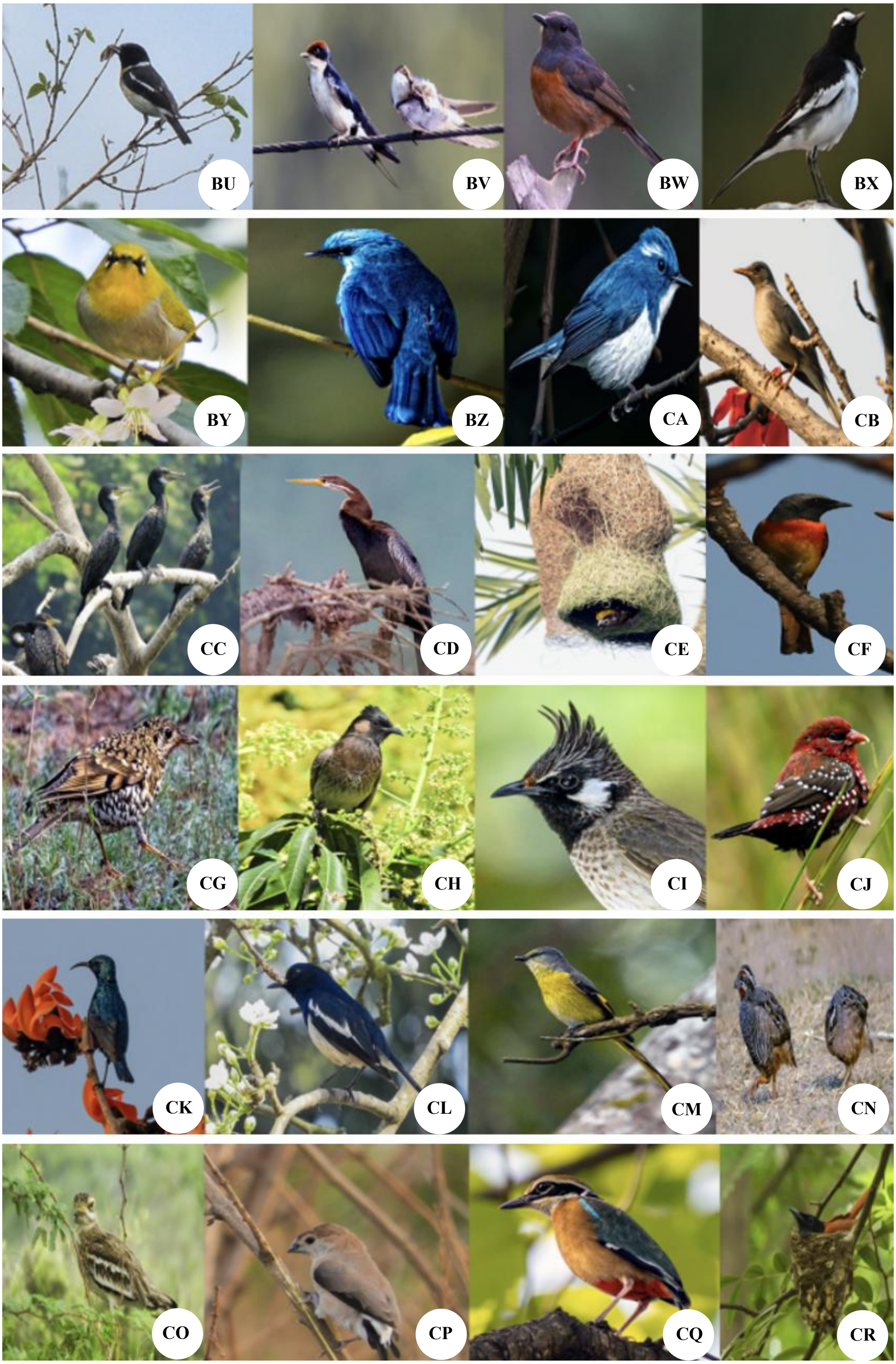
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Figure S1. Photographs of some of the species of bird recorded in Dalma Wildlife Sanctuary. A. *Accipiter nisus*, B. *Aquila fasciata*, C. *Aquila rapax*, D. *Aviceda jerdoni*, E. *Circaetus gallicus*, F. *Circus spilonotus*, G. *Elanus caeruleus*, H. *Lophospiza trivirgatus*, I. *Milvus migrans*, J. *Nisaetus cirrhatus*, K. *Spilornis cheela*, L. *Pandion haliaetus*, M. *Aythya fuligula*, N. *Dendrocygna javanica*, O. *Netta rufina*, P. *Netta coromandeliana*, Q. *Spatula clypeata*, R. *Tadorna ferruginea*, S. *Anthracoceros albirostris*, T. *Buceros bicornis*, U. *Ocyceros birostris*, V. *Larus brunnicephalus*, W. *Streptopelia decaocto*, X. *Spilopelia chinensis*, Y. *Treron bicinctus*, Z. *Treron phoenicopterus*, AA. *Alcedo atthis*, AB. *Halcyon smyrnensis*, AC. *Pelargopsis capensis*, AD. *Coracias benghalensis*, AE. *Coracias affinis*, AF. *Merops orientalis*, AG. *Ephippiorhynchus asiaticus*, AH. *Mycteria leucocephala*, AI. *Cacomantis passerinus*, AJ. *Cacomantis sonneratii*, AK. *Clamator jacobinus*, AL. *Centropus sinensis*, AM. *Taccocua leschenaultii*, AN. *Falco peregrinus*, AO. *Francolinus francolinus*, AP. *Podiceps cristatus*, AQ. *Chroicocephalus ridibundus*, AR. *Ardea ibis*, AS. *Ardea cinerea*, AT. *Ardea grayi*, AU. *Ardea purpurea*, AV. *Ardea intermedia*. AW. *Egretta garzetta*, AX. *Pseudibis papillosa*, AY. *Psittacula cyanocephala*, AZ. *Psittacula eupatria*, BA. *Psittacula krameri*, BB. *Haliastur indus*, BC. *Bubo bengalensis*, BD. *Glaucidium radiatum*, BE. *Ketupa coromanda*, BF. *Ketupa nipalensis*, BG. *Ketupa zeylonensis*, BH. *Ninox scutulata*, BI. *Otus bakkamoena*, BJ. *Strix ocellata*, BK. *Chloropsis aurifrons*, BL. *Oriolus kundoo*, BM. *Psilopogon zeylanicus*, BN. *Psilopogon haemacephalus*, BO. *Gallinula chloropus*, BP. *Porphyrio poliocephalus*, BQ. *Dinopium benghalense*, BR. *Micropternus brachyurus*, BS. *Chrysocolaptes festivus*, BT. *Chrysomma sinense,* BU. *Saxicola insignis*, BV. *Hirundo megaensis*, BW. *Copsychus malabaricus*, BX. *Motacilla madaraspatensis*, BY. *Zosterops palpebrosus*, BZ. *Eumyias thalassinus*, CA. *Ficedula superciliaris*, CB. *Turdus unicolor*, CC. *Phalacrocorax carbo*, CD. *Anhinga melanogaster*, CE. *Ploceus philippinus*, CF. *Pericrocotus cinnamomeus*, CG. *Zoothera dauma*, CH. *Pycnonotus cafer*, CI. *Pycnonotus leucogenys*, CJ. *Amandava amandava*, CK. *Cinnyris asiaticus*, CL. *Copsychus saularis*, CM. *Pericrocotus ethologus*, CN. *Perdicula asiatica*, CO. *Burhinus indicus*, CP. *Lonchura malabarica*, CQ. *Pitta brachyrura*, CR. *Terpsiphone paradisi*. CS. *Coracina macei*, CT. *Calliope pectoralis*, CU. *Dicrurus hottentottus*, CV. *Motacilla cinerea*, CW. *Jynx torquilla*, CX. *Aethopyga siparaja*, CY. *Hemiprocne coronata*, CZ. *Hypthymis azurea*, DA. *Tephrodornis pondicerianus*, DB. *Aegithina tiphia*, DC. *Gracula religiosa*, DD. *Argya caudata*, DE. *Sturnia malabarica*, DF. *Muscicapa muttii*, DG. *Lanius cristatus*, DH. *Sturnia pagodarum*, DI. *Monticola solitarius*, DJ. *Monticola cinclorhyncha*, DK. *Oriolus xanthornus*, DL. *Mirafra erythropera*, DM. *Lanius vittatus*, DN. *Hirundo rustica*, DO. *Prinia socialis*, DP. *Luscinia svecica*, DQ. *Phoenicurus ochruros*. © Dalma Wildlife Sanctuary (Appendix 2)