

Altitudinal Variation of Avian Fauna from Kalimpong Town to Nokdara of West Bengal, India

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ABSTRACT

The spatial distribution of bird species across altitudinal gradients is governed by a complex interplay of ecological and biogeographic factors, making this relationship a central focus in avian research. The Kalimpong Town – Nokdara stretch study region examines important study sites within the 80 Km range. It was subdivided into three zones with altitudinal ranges: which are, Pudung Khasmal, Relli, and the lower part of Lolay (less than 1000 m asl); upper Lolay to Budhabare (1000 -1500 m asl); Giddabbling, Nokdara, and Lava (greater than 1500 m asl). This preliminary study documented 48 avian species representing 25 distinct families within the study area. Avian species composition varied significantly across elevational gradients, with the highest species diversity and richness observed in low-elevation zones (<1000 m asl). This pattern may be attributed to greater vegetation diversity at lower elevations, which provides enhanced shelter and more abundant food resources, supporting a wider array of bird species. Concerns regarding ecological imbalances and possible long-term behavioural changes are raised, for example, by the concentration of species near waste disposal sites.

Keywords- Altitudinal diversity, avian fauna, Species Diversity, Species Richness, RDi.

I. INTRODUCTION

With the possible exception of large mammals, the distribution and systematics of birds are better known than those of any other comparable animal groups due to their longstanding popularity among amateur and professional naturalists (Vyas & Raval, 2022). Because they exhibit relationships with forest vegetation, serve a wide variety of feeding niches, and are essential pollinators or scavengers in their natural habitats, bird communities are frequently thought of as reliable indicators of ecological health (Routh & Sharma, 2025). Avifaunal diversity plays a crucial role in sustaining the species diversity of plants and animals. As an integral component of biodiversity, birds hold

immense aesthetic, economic, and ecological significance (Pschorn-Walcher, 1977). There are thousands of bird species in the world, and they are essential to preserving ecological harmony. From consumers to top predators, they occupy different trophic levels in the food chain and make use of resources in their habitats (Ricklefs, 2010). Unfortunately, human activity and the growing consequences of climate change are the main causes of the gradual reduction in worldwide avian diversity (Sharma & Routh, 2025). Due to extreme globalization throughout the world and the growth of the developmental phase is of the most severe and irreversible types of human impact, having far-reaching repercussions for land use and land cover, hydrology and

hydrobiology, linked biochemical activities and climate change (Harris., 2000). Anthropogenic pressures, particularly habitat destruction, are accelerating species endangerment. Projections indicate that 90% of Himalayan forests may be lost by 2100, triggering widespread biodiversity collapse (Bhutia et al., 2020). Of late, protecting biodiversity, 'big picture' ecosystem preservation, and cross-border conservation initiatives have been recognized around the world as issues that need urgent attention. Such activities enable the implementation of appropriate management plans to protect ecosystem balance, increase ecological as well as functional diversity, and safeguard ecosystem services. Approaches that focus on wider geographical areas enable conservation specialists to cope more effectively with the issues of habitat fragmentation, species loss, and ecosystem collapse—so that sustainable biodiversity management can be achieved (Green et. al., 2003; Mahanta et. al., 2021). There are 11,158 known living bird species worldwide, inhabiting nearly every ecosystem (Bird Life International, 2020). There are 1341 species in India, representing 26 orders, 113 families, and 489 genera (Praveen et. al., 2021). The ecological values and biological richness of the Indian Himalayan range are widely acknowledged (Bhattacharya et al., 2007).

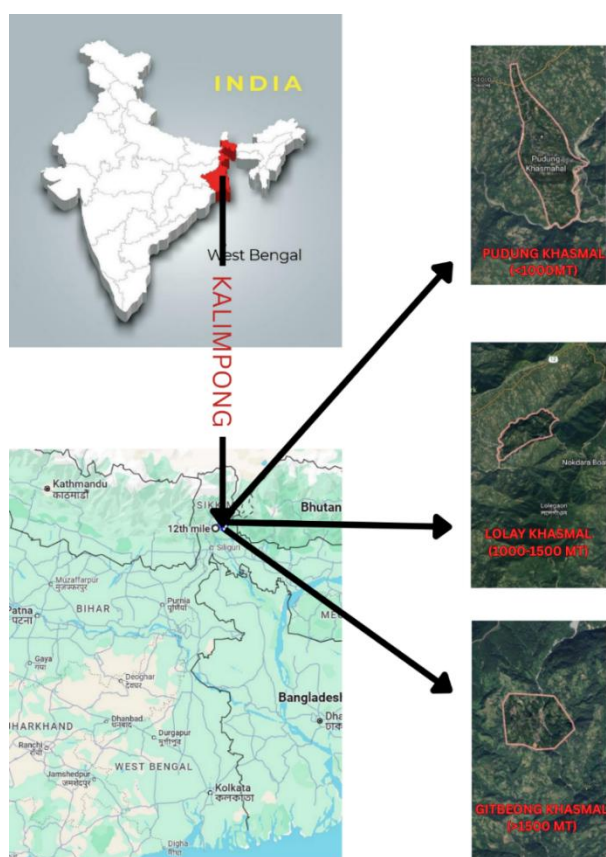


Figure 1: Location of Study Area

The north-eastern region of India, with its distinctive geographical setting, fosters exceptional environmental conditions and diverse habitat types—ranging from lush tropical rainforests to alpine meadows and expansive wetlands. This ecological richness has made it a thriving haven for avian biodiversity, supporting over 950 bird species. Remarkably, this accounts for approximately 77% of India's total recorded avifauna, underscoring the region's critical importance as a global biodiversity hotspot for birdlife (Saikia et. Al., 1990; Saikia et. al., 2000; Upadhyaya & Raj., 2013). Mountains exhibit distinct altitudinal gradients that shape unique patterns of avian diversity. As elevation changes, variations in temperature, vegetation, and habitat structure create stratified ecological zones, each supporting different bird communities (McCain., 2009). The northern part of West Bengal boasts a rich tapestry of biodiversity, supported by an extensive network of protected areas—including wildlife sanctuaries, national parks, reserve forests, and vital wetlands (Rahmani & Islam., 2004).

The Eastern Himalayan region (EHR), which includes West Bengal's Darjeeling and Kalimpong hills, is one of India's biodiversity hotspots and is known for its rare bird populations (Birdlife International., 2001). Kalimpong (27° 4' 0.0048" N, 88° 28' 0.0012" E), nestled in the eastern Himalayas, is a region of remarkable ecological diversity. Spanning an elevation range of 91 to 3,000 meters above sea level, it experiences a subtropical to temperate climate, receiving an average annual rainfall of 220 centimetres. Despite its relatively small land area of just 1,053.60 km², a substantial portion remains under dense forest cover, creating a thriving habitat for biodiversity. Notably, Kalimpong is a haven for avian life, hosting approximately 550 bird species, making it a critical hotspot for ornithologists and nature enthusiasts alike (Kalimpong.gov.in). Despite its vast scope, avian biodiversity across the Himalayan region remains relatively under-researched (Sultana et. Al., 2007). The Neora Valley National Park (NVNP) and adjacent areas of Kalimpong Forest Division serve as a critical ecological corridor within the Eastern Himalayas. These interconnected habitats facilitate wildlife movement between protected areas of northern Bengal, underscoring their vital role in regional biodiversity conservation (Chettri et al., 2007; Wangchuk, 2007).

II. MATERIAL AND METHODS

Study sites:

Nestled between 91 and 3000 meters above sea level, Kalimpong district in West Bengal boasts terraced hills dotted with lush forest patches nourished by springs. The temperature in Kalimpong district ranges between 8°C and 25°C, with summer temperatures reaching a maximum of 25°C and dropping to a minimum of 15°C (dmm.gov.in). Rainfall in the study

area is primarily influenced by the monsoon, with Kalimpong experiencing peak rainfall from July to September. With an annual precipitation of 2000–4000 mm, Kalimpong gets 80% of its rainfall during the monsoon period (Das et. al., 2022). Along an 80-kilometer transect that spanned from Kalimpong Town to Nokdara and included important locations like Pudung Khasmal, Relli, Lolay, Giddabbling and Lava, the survey recorded bird populations (Figure.1).

The study area was categorized into three altitudinal zones: Pudung Khasmal, Relli, and the lower section of Lolay (<1000m asl); the upper Lolay to Budhabare (1000-1500m asl); and Giddabbling, Nokdara, and Lava (>1500m asl). Avian diversity was assessed across these elevation gradients, revealing distinct species distributions influenced by varying climatic and habitat conditions associated with each altitudinal range. A wide variety of bird species can be found in this area's mosaic of habitats, which include terraced agricultural landscapes, montane woodlands, and subtropical forests. The varied habitats provide an ideal environment for both resident and migratory bird species. The region has become a popular spot for birding because of its natural diversity and abundance of both resident and migratory species.

III. METHODS

Survey technique: From March 2024 to April 2025, comprehensive avian surveys were conducted in the study area using standard methodologies, including the point count method. Point Count Method: Observers recorded all bird species seen or heard within a 50-meter radius over a five-minute period at randomly selected locations. Each sampling point was spaced at least 200 meters apart to ensure data independence. Opportunistic

observations were also documented during transit within the study area (Nautiyal et. al., 2015). Bird point counts were conducted between 06:00–10:00 A.M. and 4:00–6:30 P.M., coinciding with peak avian activity. Surveys were avoided during rain, mist, strong winds, or other unfavourable weather conditions to minimize bias. During each field observation day, five 40-minute Timed Species Counts (TSCs) were performed (Bett.et.al.,2016).

Instrument used: We sighted birds using a Cason 10×50 binocular (50mm objective lens, 10x magnification) and captured images with a Nikon D500 camera equipped with two lenses: Nikon AF-S 200-500mm f/5.6 E ED VR and Nikon 50mm prime lens. We occasionally used bird calls to aid identification and carried a GPS device during field surveys to record locations, gather evidence, and verify species. To ensure accurate species-level identification of observed birds, we employed a comprehensive approach combining field observations with authoritative reference materials. Our primary identification tools included three renowned field guides: Birds of the Indian Subcontinent (Grimmett, Inskipp & Inskipp, 2013) - for detailed species accounts and regional distributions, The Book of Indian Birds (Ali, 2002) - for classic descriptions and behavioural notes and A Pictorial Field Guide to Birds of India (Grewal, Singh & Devasar, 2016) - for comparative visual references. Consultation of additional ornithological literature, Comparative analysis of field marks, vocalizations, and behavioural characteristics. This multi-source verification process helped eliminate identification ambiguities, particularly for similar-looking species or challenging field conditions. Special attention was given to diagnostic features like plumage patterns, morphological characteristics, and habitat preferences as described in these authoritative sources.

Table:1 Checklist and diversity of birds based on altitudinal variation from Kalimpong Town to Nokdara and included Pudung Khasmal, Relli, Lolay, Giddabbling and Lava

Sn	Name	Diversity			Scientific Name	Family	Diet	IUCN Status	Occurrence	Availability
		<1000 m	1000m-1500 m	>1500 m						
1	Long-tailed minivet	✓	✗	✓	<i>Pericrocotus ethologus</i>	Campephagidae	IN	LC	WR	R
2	Small Minivet	✓	✗	✗	<i>Pericrocotus cinnamomeus</i>	Campephagidae	IN	LC	WR	R
3	Sikkim tree creeper	✗	✗	✓	<i>Certhia discolor</i>	Certhiidae	IN	LC	F	R
4	Tailorbird	✗	✓	✗	<i>Orthotomus atrogularis</i>	Cisticolidae	IN	LC	RA	C
5	Oriental turtle dove	✓	✗	✗	<i>Streptopelia orientalis</i>	Columbidae	GR	LC	WR	C
6	Spotted dove	✓	✓	✗	<i>Spilopelia chinensis</i>	Columbidae	GR	LC	WR	C
7	Common Green	✓	✗	✗	<i>Cissa chinensis</i>	Corvidae	OM	LC	F	C

	Magpie									
8	Grey headed tree pie	✓	✓	✗	<i>Dendrocitta formosae</i>	Corvidae	OM	LC	WR	C
9	Large billed Crow	✓	✗	✗	<i>Corvus macrorhynchos</i>	Corvidae	OM	LC	F	C
10	Green-billed malkoha	✓	✗	✗	<i>Phaenicophaeus tristis</i>	Cuculidae	CA	LC	F	C
11	Sprangled Drongo	✓	✓	✗	<i>Dicrurus bracteatus</i>	Dicruridae	CA	LC	M	C
12	Bronzed drongo	✗	✗	✓	<i>Dicrurus aeneus</i>	Dicruridae	CA	LC	M	UC
13	scarlet finch	✗	✗	✓	<i>Carpodacus sipahi</i>	Fringillidae	GR	LC	RA	R
14	barn swallow	✓	✗	✗	<i>Hirundo rustica</i>	Hirundinidae	IN	LC	RA	VC
15	long tail shrike	✓	✓	✗	<i>Lanius schach</i>	Laniidae	CA	LC	M	C
16	Greater necklaced laughingthrush	✓	✗	✗	<i>Pterorhinus pectoralis</i>	Leiotherichidae	OM	LC	F	C
17	Lesser necklaced laughingthrush	✓	✗	✗	<i>Lesser necklaced laughingthrush</i>	Leiotherichidae	OM	LC	M	UC
18	White Crested laughing thrush	✓	✗	✗	<i>Garrulax leucolophus</i>	Leiotherichidae	OM	LC	F	OV
19	Hoary-throated Barwing	✗	✓	✗	<i>Actinodura nipalensis</i>	Leiotherichidae	OM	LC	RA	R
20	Red-tailed minla	✗	✗	✓	<i>Minla ignotincta</i>	Leiotherichidae	IN	LC	F	UC
21	Rufous sibia	✗	✗	✓	<i>Heterophasia capistrata</i>	Leiotherichidae	OM	LC	F	C
22	Great Barbet	✓	✓	✗	<i>Psilopogon virens</i>	Megalaimidae	OM	LC	WR	VC
23	Blue wishling thrush	✓	✓	✓	<i>Myophonus caeruleus</i>	Muscicapidae	OM	LC	RA	VC
24	Verditer flycatcher	✓	✓	✗	<i>Eumyias thalassinus</i>	Muscicapidae	OM	LC	M	C
25	Little pied flycatcher	✗	✗	✓	<i>Ficedula westermanni</i>	Muscicapidae	IN	LC	F	R
26	Oriental magpie-robin	✗	✗	✓	<i>Copsychus saularis</i>	Muscicapidae	CA	LC	WR	C
27	Rock thrush	✗	✗	✓	<i>Monticola saxatilis</i>	Muscicapidae	OM	LC	RA	C
28	Rufous-bellied niltava	✗	✗	✓	<i>Niltava sundara</i>	Muscicapidae	IN	LC	F	UC
29	White-capped redstart	✗	✗	✓	<i>Chaimarrornis leucocephalus</i>	Muscicapidae	IN	LC	F	C
30	Maroon Oriole	✓	✗	✗	<i>Oriolus trailii</i>	Oriolidae	OM	LC	F	OV
31	Green-backed tit	✗	✓	✗	<i>Parus monticolus</i>	Paridae	IN	LC	RA	C
32	Eurasian Tree Sparrow	✓	✗	✗	<i>Passer montanus</i>	Passeridae	OM	LC	RA	VC
33	White-rumped munia	✗	✗	✓	<i>Lonchura striata</i>	Estrildidae	OM	LC	WR	C
34	grey-hooded warbler	✓	✗	✗	<i>Phylloscopus xanthoschistos</i>	Phylloscopidae	OM	LC	WR	UC
35	yellow browed warbler	✗	✓	✗	<i>Phylloscopus inornatus</i>	Phylloscopidae	IN	LC	M	OV
36	Siberian chiffchaff	✗	✗	✓	<i>Phylloscopus collybita tristis</i>	Phylloscopidae	IN	LC	M	OV
37	European green woodpecker	✓	✗	✗	<i>Picus viridis</i>	Picidae	IN	LC	M	UC
38	greater yellow nape	✓	✗	✗	<i>Chrysophlegma flavinucha</i>	Picidae	IN	LC	F	C
39	Himalayan Bulbul	✓	✗	✓	<i>Pycnonotus leucogenys</i>	Pycnonotidae	OM	LC	RA	C
40	Red vented bulbul	✓	✗	✗	<i>Pycnonotus cafer</i>	Pycnonotidae	OM	LC	RA	VC
41	Black bulbul	✗	✓	✗	<i>Hypsipetes</i>	Pycnonotidae	OM	LC	F	UC

					<i>leucocephalus</i>					
42	Striated bulbul	✗	✗	✓	<i>Alcurus striatus</i>	Pycnonotidae	OM	LC	F	OV, R
43	chestnut-bellied nuthatch	✗	✓	✗	<i>Sitta cinnamoventris</i>	Sittidae	OM	LC	RA	C
44	grey-headed canary-flycatcher	✗	✗	✓	<i>Culicicapa ceylonensis</i>	Stenostiridae	IN	LC	F	OV
45	Asian barred owl	✓	✗	✗	<i>Glaucidium cuculoides</i>	Strigidae	IN	LC	F	R
46	Rusty-cheeked scimitar babbler	✗	✓	✗	<i>Erythrogeus erythrogeus</i>	Timaliidae	OM	LC	RA	R
47	Oriental white eye	✓	✓	✓	<i>Zosterops palpebrosus</i>	Zosteropidae	OM	LC	RA	OV
48	whiskered Yuhina	✗	✓	✓	<i>Yuhina flavicollis</i>	Zosteropidae	OM	LC	WR	UC

Data Analysis: Based on our field observations, we classified bird species into four distinct habitat categories: Resident (R): Species permanently inhabiting the area, Migratory (M): Seasonal visitors, Forest Dweller (F): Exclusive Forest inhabitants, and Wide Range (WR): Species utilizing both forested and residential areas. We quantified species abundance using the following sighting frequency scale: Very Common (VC): ≥8 observations, Common (C): 6-7 observations, Uncommon (UC): 4-5 observations, Rare (R): 2-3 observations and Occasional Visitor (OV): 1 observation. We categorized observed bird species into four distinct trophic guilds based on their primary feeding habits: Insectivorous (IN): Species predominantly consuming insects and other arthropods, Carnivorous (CA): Predatory birds feeding mainly on vertebrates, Omnivorous (OM): Species with varied diets including both plant and animal matter and Granivorous (GR): Birds specializing in seed consumption. This classification system enabled systematic documentation of species distribution patterns and habitat preferences across the study area (Table 1).

We quantified taxonomic representation (Table 2) using the following formula to determine relative family diversity (Wells, 2010).

$$\text{Relative Diversity (\%)} = (\text{Number of species in a family} / \text{Total species observed}) \times 100$$

This metric, alternatively termed "percentage of occurrence," provides a standardized measure of each avian family's proportional representation within our study area (Figure. 2).

Table:2 The RDi (Relative diversity) of different families of bird in the Research area.

SN	FAMILY NAME	NO OF SPECIES	RDi	SN	FAMILY NAME	NO OF SPECIES	RDi
1	Campephagidae	2	4.2	14	Oriolidae	1	2.1
2	Certhiidae	1	2.1	15	Paridae	1	2.1
3	Cisticolidae	1	2.1	16	Passeridae	1	2.1
4	Columbidae	2	4.2	17	Estrildidae	1	2.1
5	Corvidae	3	6.3	18	Phylloscopidae	3	6.3
6	Cuculidae	1	2.1	19	Picidae	2	4.2
7	Dicruridae	2	4.2	20	Pycnonotidae	4	8.3
8	Fringillidae	1	2.1	21	Sittidae	1	2.1
9	Hirundinidae	1	2.1	22	Stenostiridae	1	2.1
10	Laniidae	1	2.1	23	Strigidae	1	2.1
11	Leiothrichidae	6	12.5	24	Timaliidae	1	2.1
12	Megalaimidae	1	2.1	25	Zosteropidae	2	4.2
13	Muscicapidae	7	14.6				

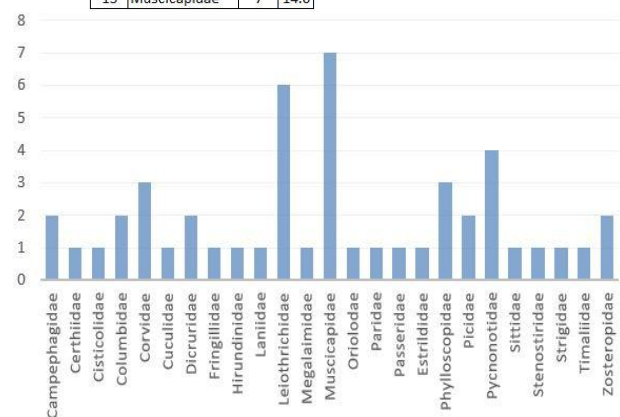


Figure.2-Family wise distribution of Avian fauna.

Statistical Analysis:

Nine distinct diversity indices were applied to assess avian diversity, with computations performed using PAST statistical software (Version 4.03) (Hammer et al., 2001).

Species Diversity index: Diversity indices are key parameters for measuring biodiversity within an ecosystem. Among the most widely used statistical tools in ecology are Shannon's (or Shannon-Wiener) and Simpson's diversity indices. The Shannon-Wiener index, in particular, has been extensively applied in environmental studies to assess species richness and

ecosystem abundance. It is especially effective for comparative analyses, enabling researchers to evaluate biodiversity across multiple environments simultaneously (Omayio et. al., 2019). To assess avian diversity (biodiversity) across altitudinal gradients, three ecological indices were employed: the Shannon-Wiener index (H') for species diversity, Simpson's diversity index (D) for dominance, and the Evenness index (E) for species distribution uniformity (Table 3). The calculation formulas for these indices are as follows:

$$H' = - \sum_{i=1}^S (p_i \cdot \ln p_i)$$

Shannon-Weiner index (H'):

Where H' = Shannon-Weiner index, $P_i = n_i/N$
 n_i = Number of individuals of a species, N = Total individuals of all species, $\ln$ is the natural log, Σ is the sum of the calculations, and S is the number of species.
 $H' \leq 1$ = Low diversity; $1 < H' \leq 3$ = Moderate diversity and $H' \geq 3$ = high diversity (Ulfah., 2019)

$$D = 1 / \sum_{i=1}^S p_i^2$$

Simpson's diversity index (D):

Where n = number of individuals of a particular species, N = total number of individuals of all species. (D) is usually between 0 and 1. The closer D is to 1, the higher is diversity.

$$J' = \frac{H'}{H'_{max}} = \frac{H'}{\ln(S)}$$

Pielou's Evenness Index (J')

Where: J = Pielou's Evenness Index (ranges from 0 to 1).

1 = Perfect evenness (all species equally abundant) whereas 0 = Complete unevenness (one species dominates) (Krebs., 1989).

H' = Shannon-Wiener Diversity Index, S = Total number of species in the community, $\ln$ is the natural log.

Species Richness Indices: There are simpler versions of species richness indices. Species richness (S) (Peet., 1974), Menhinick index (Dmn) (Menhinick., 1964), Margalef index (Dmg) (Margalef.,1969) and Fisher's Alpha (α) (Schulte et. al., 2005) are the fundamental component of species richness indices. These indexes do not use data on species incidence or abundance to assess species richness. The oldest, most straightforward, and still most widely used metric among them is species richness (S). Regardless of the number of people, it refers to the number of species found in a region or assemblage. In contrast to S , the other richness indices (α , Dmn , and Dmg) presume that S and the total number of individuals (N) are related (Özkan et. al., 2024). The calculation formulas for these indices are as follows:

species richness (S)

S = number of species

Menhinick index (Dmn)

$$Dmn = S / \sqrt{N}$$

Where: Dmn = Menhinick index, S = number of species and N = total number of individuals of all species in the sample, $\sqrt{}$ = square root.

High Dmn = high density of species; Low Dmn = fewer species related to abundance.

Margalef index (Dmg)

$$Dmg = (S - 1) / \ln N$$

Where: Dmg = Margalef index, S = number of species, N = total number of individuals of all species in the sample and $\ln$ = natural log.

High Dmg = high species richness; Low Dmg = low species richness.

A detailed statistical result of all recorded species is presented in Table 3.

Diversity Indices	<1000m asl	1000m - 1500m asl	>1500m asl
SHANNON WEINER INDEX (H')	2.67	2.40	2.56
SIMPSON'S DIVERSITY INDEX (D)	0.00017	0.000966184	0.00079
1-D	0.99983	0.999033816	0.99921
SPECIES RICHNESS (S)	26	16	19
PIELOU'S EVENNESS INDICES (J')	0.82	0.86	0.87
SHANNON EXPONENTIAL EVENNESS	0.56	0.69	0.68
MENHINICH INDEX (Dmn)	1.66	1.63	1.74
MARGALEF INDEX (Dmg)	4.54	3.29	3.77
FISHER'S ALPHA (α)	11.12	8.37	9.81

IV. RESULT AND DISCUSSION

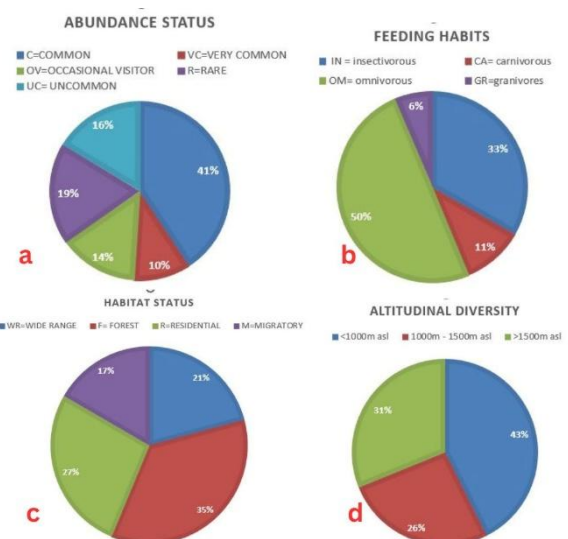


Figure. 3 Avian fauna status based on: a. Abundance Status, b. Feeding Habit, c. Habitat Status, d. Altitudinal Diversity

During this initial investigation, 48 bird species from 25 families were documented. Among the recorded species, abundance classifications (Figure. 3.a.) revealed 5 (10.4%) as very common (VC), 20 (41.7%) as common (C), 7 (14.6%) as occasional visitors, 9 (18.8%) as rare (R), and 8 (16.7%) as uncommon (UN). Such observations affirm the ecological relevance of the area for avian biodiversity, stressing the importance of conservation strategies to mitigate risks to vulnerable bird populations. Dietary classification revealed that 33.3% of the species were insectivores (IN), 10.4% carnivores (CA), approximately half (50%) omnivores (OM), and a small proportion (6.3%) granivores (GR). This distribution highlights the dominance of omnivorous and insectivorous birds in the ecosystem, suggesting a habitat rich in both plant and animal food resources, while granivores were relatively scarce, possibly due to limited seed availability or specialized foraging requirements (Figure. 3.b.). Among the 48 documented species, 27.1% were resident (R), 20.8% wide-ranging (WR), 35.4% forest-dependent (F), and 16.7% migratory. This distribution reflects the area's varied ecological niches, with forest-associated species dominating, likely due to habitat availability. The presence of both resident and migratory birds underscores the region's importance for local and seasonal avifauna (Figure. 3.c.). A detailed inventory of all recorded species is presented in (Table 1).

The RDi analysis of avian diversity revealed Muscicapidae (7 species, 14.6%) as the most dominant family, followed by Leiothrichidae (6 species, 12.5%) and Pycnonotidae (4 species, 8.3%). Families such as Corvidae and Phylloscopidae (3 species each, 6.3%) showed moderate representation, while Campephagidae, Columbidae, Dicruridae, Picidae, and Zosteropidae (2 species each, 4.2%) were less abundant. In contrast, 15 families—including Certhiidae, Cisticolidae, and Strigidae—were rare, each represented by only one species (2.1%). This hierarchical distribution suggests habitat preferences or ecological specialization, with Muscicapidae thriving more prominently in the study area (Table 2 & Figure. 2). Species distribution varies significantly with altitude. The majority of species, approximately 54.2%, are found at elevations below 1000 meters above sea level (asl), indicating a high concentration of biodiversity in lowland regions. In the mid-altitude range, between 1000 and 1500 meters asl, about 33.3% of the species are recorded, suggesting a moderate level of species richness. Interestingly, a substantial proportion—around 39.6%—of the species are also present at elevations above 1500 meters asl, highlighting notable biodiversity in higher altitudinal zones as well. (Figure. 3.d.)

V. CONCLUSION



Figure 4. Some of the avian species recorded from Kalimpong Town to Nokdara included Pudung Khasmal, Relli, Lolay, Gitdablang and Lava. a. White Crested laughingthrush, b. Siberian chiffchaff, c. Asian barred owl, d. Grey headed tree pie, e. Sprangled Drongo, f. Red-tailed minla, g. Green-backed tit and h. Sikkim tree creeper

This study establishes the first systematic documentation of avian populations in the region, highlighting its ecological significance as a habitat supporting relatively high bird diversity. The distribution of bird species shows sharp changes with altitude because of the impact of elevation-induced environmental changes. The baseline data on species composition, distribution, and abundance patterns generated here offer critical insights for future ecological assessments, conservation planning, and comparative studies across similar landscapes. The findings underscore the area's potential as a key site for avian research, particularly in understanding habitat preferences and community dynamics.

However, anthropogenic pressures—including noise pollution, unplanned urbanization, waste accumulation, and forest degradation—were observed to disrupt bird assemblages, notably altering foraging behaviour. For instance, the clustering of species around garbage dumping sites raises concerns about ecological imbalances and potential long-term behavioural shifts.

Notably, the absence of threatened vulture species (e.g., White-rumped Vulture, Slender-billed Vulture, Himalayan Griffon) warrants further investigation into historical declines or habitat suitability gaps. While this study focused on select forest patches, expanded surveys across broader spatial and temporal scales may reveal additional species and finer-scale distribution patterns. Future research should prioritize evaluating the synergistic impacts of anthropogenic disturbances and climate variability on avian diversity to inform targeted conservation strategies.

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