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COMPARING HISTORICAL AND CURRENT DATA, ON THE DISTRIBUTION OF AVIAN SPECIES; A STUDY, IN TEMPORAL ANALYSIS

"Temporal Analysis of Avian Species Distribution: Contrasting Past and Present Records".

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Abstract

This study is conducted with aims to compare the current and previous avifaunal diversity distribution in South Punjab. The assessment of avifaunal diversity in this area is attempted for the first time with no previous record. Diversity and habitat preferences datafor various birdspecies was collected from May 2017 to April 2019. The study area was consisted of six sub-areas including two in each of the urban, cropland and desert/forest habitats were designated in each district. Linear count method including; direct count (physical presence and voice calls) and indirect count (presence of nests, fecal material, pellets, foot-prints, marks on trees of the birds) techniqueswere used to assess avian diversity. A binocular (32x50) was used to observe the avian species inhabiting the study area. The overall results were summarized with 20 bird species including; 23 genera, 15 families and 13 orders were recorded in current study. While in one of previous study conducted in Rasool Barrage, district Jhelum showed 43 birds' species representing 27 genera, 10 families and 6 orders. The results of this study concluded that diversity and distribution of birds species in South Punjab is mainly affected by landscape gradients and anthropogenic modifications also have great impact. The outcomes of study can be used in conservation biology especially the avian species of South Punjab.

Keywords: Avian, Historical, Current, Temporal, southern Punjab

1. INTRODUCTION

Birds are considered to be the best indicator of ecosystem functioning and health. In developing countries like Pakistan, urbanization and industrialization are the major threat to biodiversity. There are 9993 species of birds are reported throughout the world [1] and more than 2700 species have been reportedin Asia [2]. However, Pakistan have over 668 avian species [3]. Exponential increase in human population has been observed to have impacted the avian species in a number of ways such as; habitat loss, invasive species, deforestation, urbanization, agriculture intensification, industrialization, human-avian negative interactions and climate change [4, 5, 6, 7].The human beings have had a prehistoric relationship with birds since the beginning that is causing decline in birds' populations [8].

Avian distribution is one of the interesting fields that facilitate to understand the pattern and factors affecting distribution of bird species. Further, this field also investigates the spatial distribution of species and how various bird species inhabit and interact in diverse ecosystem [9].It has been observed that the distribution of birds is greatly influenced by a number of factors including; habitat, climate, geographical barriers, variations infood resources and interactions between same and other species. Various modern techniques have been invented to identify the geographical map and distribution of species such as Geographic Information Systems (GIS) and remote sensing technologies. The data generated through these modern techniques are being used to identify the changes, trends and future possible shift of bird's populations [10].Moreover, these studies also helped the ecologist to understand the dynamics of bird's communities. In these types of studies, the researchers first identify the response of birds and their new adaptations toward environmental changes and then make positive efforts for conservation depending on habitat alteration, climate change and human activities [11].Furthermore, understanding the distribution of birds contributes to broader ecological inquiries, such as the relationships between species and their habitats, the role of birds in ecosystem functioning, and the potential for the spread of diseases carried by birds. The information gathered from distribution studies is not only crucial for biodiversity conservation but also aids in shaping policies and management strategies aimed at preserving avian populations and their habitats[12].

The factors that impact on biodiversity are tried to limit in recent decades by proposing several international policies e.g. Habitats Directive and Convention on Biological Diversity. The initial aim of these policies was to eliminate these factors that impacted the biodiversity but the policies are failed to achieve its goal globally. However, positive results have been seen for these policies in specific regions [13].

The species identification has the key position in ecological and conservation studies and without the identification, the achievement of successful morphology of cryptic species is not possible. Recently, molecular biological methods also have been identified to achieve species identification with ever most accuracy [14, 15]. Current study aims to compare the current and previous avifaunal distribution in South Punjab. However, a number of previous studies in nearby regions includeWaite conducted in Salt Range, whereasDonald studied birds of prey in Punjab [16, 17]. Moreover, Ali and Ripley,andRobert have covered birds that are found in the adjacent areas of SouthernPunjab[18, 19].

2. Materials and methods

2.1. *Study Area.*

The current study was conducted in allthe most important districts of south Punjab, Pakistan including;Multan, Vehari, Khanewal, Bahawalpur, Lodhran, Bahawalnagar, Dera Ghazi Khan, Rahim Yar Khan and Layyah. All of these districts are heavily populated in South Punjab. Further, these districts were divided into study sites. Three sites for data collection were selected from each districts as listed in table 1.

TABLE1: Details of Sampling area showing altitude and latitude

Sampling stations	Habitat Types	Location	Elevation (ft)
District Multan			
Chakbhedda	Forest/desert	N 30º10.297,EO71º30.443	365
Hassan Wali	Crop land	N 30º.07.792.¨E071.27.594	367
Jinnah Park	Urban area	N 30º 10.297.E071°30,451	423
District BahawalPur			
Cholistan 69F	Desert area	N29º.39.890,E072º 28.85	456
Head Islam	Urban area	N29º196.,E072,32.942	466
Bahawalpur Zoo	Urban area	29o23'44 N, 71o41'01 E	388
District Bahawal Nagar			
TilokaLona	Crop land	N29º 56”392.E072º 53.538	533
Latif Abad	Desert area	N29º24”.497,E072º.50.556	510
BWN Zoo	Urban area	N30º.00.192,E072º,16.352	535
Distric Rahim yar Khan			
Chak 46/P	Desert area	N28º,26.275,EO70º31.197	245
City	Urban area	N28º.25,175,EO70.26,020	260
Allaabad	Crop land	N28º,55,125.EO70º52,240	272
District Dera Ghazi Khan			
GOVT College	Urban area	N30º.193,EO70,38.206	6447
ChakPaigha	Crop land	N29º,59.994”E070º38,988	6423
District RajanPur			
Noushera East	Cropland area	N29º,12.946”E070,31.034	4822
MouzaSaidpur	Desert area	N29º,12,699,”E070,33,2865	4856
Fazalpur	Urban area	N29º,17.490,”EO70,27.034	4834

2.2. *Evaluation of Landscape.*

The study area used in this research was consisted of different habitatson the basis ofquality and quantity of vegetation and human habitations. The coordinates were taken for each site and a GIS map was constructed. The habitat types included (1) Urban habitat (UH), consisted of houses, roads and have almost no plantation, (2) Cropland habitat (CLH) consisted of agriculture land and plantations, (3) Desert /forest land habitat (DFH) consisted of sand and as well as forest plantations.

2.3. *Climate.*

South Punjab is normally hot during summer and cold during winter. June and July are the hottest months with 44ºC an average temperature; while 10ºCtemperature during winter (November to January). The terrain is plain, sandy and Contains fertile soil.

FIGURE 1: Map of Study Area (Multan)

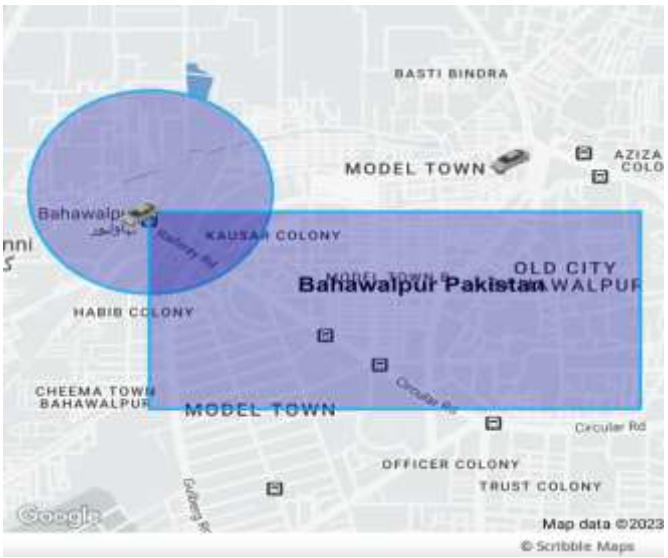

FIGURE 2: Map of Study Area(Bahawalpur)

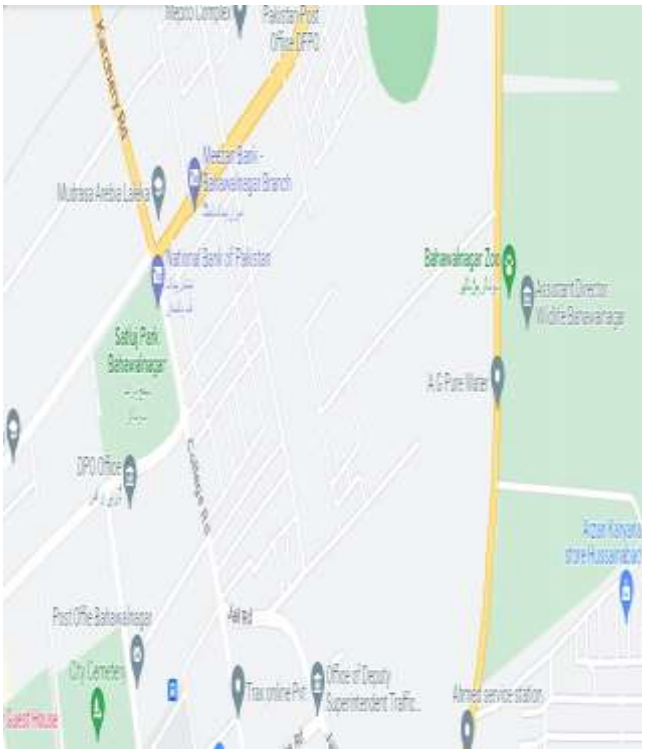

FIGURE 3: Map of Study Area (Bahawalnagar)**FIGURE 4:** Map of Study Area (Dera GhaziKhan)

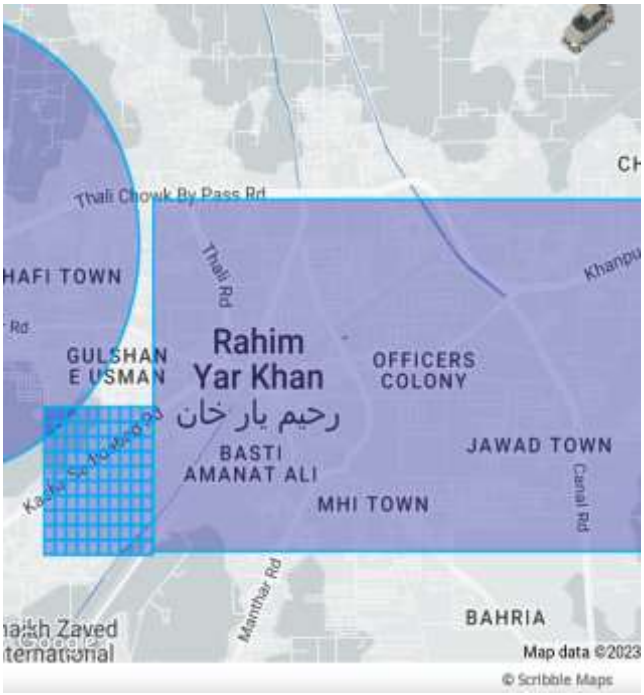

FIGURE 5: Map of Study Area (Rajanpur) **FIGURE 6:** Map of Study Area (Rahim Yar Khan)

2.4. *Floral Diversity*.

The study area have prominently desert vegetation includes; herbaceous or stunted scrub, drought-resistant treesespecially found in eastern side. In mountainous region, gum arabic acacia and euphorbia are predominantly found. The khajri (or khejri) trees (Prosopis cineraria) were observed throughout the plain region of study area.Furthermore, plain areas are also dominantly vegetated with various plants such as;athel (Tamarixaphylla), Indian plum (Zizyphusmauritiana), jand (Prosopis cineraria), goose grass (Eleusinecompressa), shisham (Dalbergiasissoo), kans grass (Saccharumspontaneurn), and Kikar or thorn-tree (Acacia nilotica) [20]. Most common weed

species of the study area include common cocklebur (Xanthium strumarium), prostrate spurge (Euphorbia prostrata L.),burragokharu (Tribulusterrestris L.), white-top weed (Partheniumhy sterophorus), Indian doab (Cynodondactylon), slender amaranth (Amaranthusviridis), devil's horsewhip (Achyranthesaspera), and marijuana (Cannabis sativa). Wheat (Triticumaestivum), pea plants (Pisumsativum) and rice (Oryza sativa) are the prominent crop [21].

2.5. *Methodology.*

The data regarding diversity and habitat preferences of various avian specises were collected from May 2017 to April 2019. Six sub-areas, two in each of the urban, cropland and desert/forest habitats will be designated in each district and avian diversity will be assessed through linear count method using direct count (physical presence and voice calls) and indirect count (presence of nests, fecal material, pellets, foot-prints, marks on trees of the birds) techniques. Binoculars (32x50) will be used to observe the avian species inhabiting the study area. Roberts [22], Mirza and Wasiq[3] and Grimmett et al. [23] were consulted for morphological identification of the species. The collected data was interpreted through computer-based software PAST version 2.17C and Dominance (D), Shannon-Wiener diversity index (H'), Simpson Index (S), Margalef (R) and Evenness (E) were recorded following [24]. Census Index was computed using formula;
Census Index = n/area Where n = numbers of birds

3. Results

Total 20 species were observed including; 23 genera, 15 families and 12 orders. Further, 1762 common and endangered birds belonging to 20 species, 23 genera, 15 families and 12 orders were observed. Dominance, Census Index, Shannon-Wiener diversity index, Simpson Index, Margalef Index and Evenness were recorded as 0.138, 2.531, 2.62, 0.86, 6.38 and 0.27, respectively (Table 3). Different parameters such as body mass, ground-foraging, habitat breadth and migratory status showed non-significant ($P > 0.0$) negative relationships in various models (such as; best/non-phylogenetically models), whereas two parameters such as; diet breadth and nest height showed non-significant ($P > 0.0$) positive connections.

TABLE 2: Comparison of Bird Species Counts in Punjab, Pakistan: Previous vs. Current

Species	**Previous**	**Current**
Tetraxtetrax	17	19
Clangahastate	136	144
Falco jugger	43	22
Chiamydotis undulate	36	45
Falco naumani	101	130
Cirusmacrourus	91	99
Charadtnae	153	123
Laticilliaburnesil	62	45
Falco cherrag	106	33
Vanellus gregarious	55	65
Aythaferina	222	205
Columbia livia	228	145
Splenderscorvus	255	267
Upupaepops	128	133
Passer domesticus	424	532
HoplopterusIndecus	115	118
Pycnonotuscafer	238	321
Acridothereginginimus	143	140
Psittakrameri	185	198
Bubulcus ibis	116	145

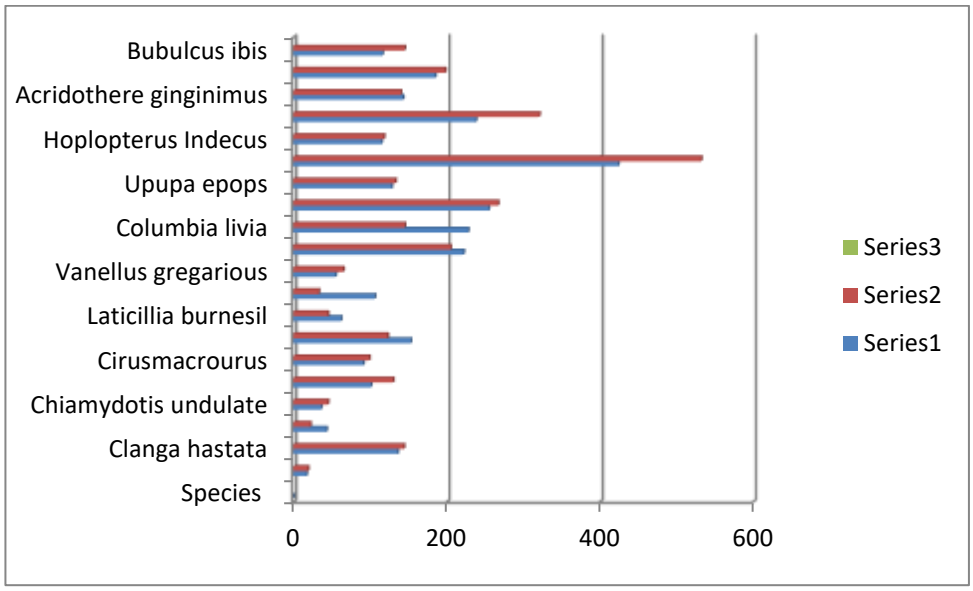

FIGURE7: Current and previous record of birds

TABLE 3: Measurement of Avian Diversity in southern Punjab

NO OF SP	Scientific Name	Common name	Family	Order	FH	Distribution	Ststus	Bahawaln	Bahawalp	Rahimyar	Multan	Lodhran	Vehari	Khaniwal	DG khan	Layah	Rajanpur	N
1	Tetrax tetrax	Little busterd	Otididae	Otidiformes	Omnivores	WV	NT	2	5	4	1	0	1	0	0	1	3	17
2	Clanga hastata	Indian spotted eagle	Accipitridae	Accipitriformes	Birds of prey	Vagarant	VU	13	7	23	12	23	17	22	10	7	1	136
3	Falco jugger	Leggar falcon	Falconidae	Falconiforms	Birds of prey	Vagarant	NT	1	4	7	2	0	3	9	12	3	2	43
4	Chiamydotis undulate	Houbara bustard	Otididae	Otidiformes	Birds of prey	WV	VU	0	5	3	2	7	4	6	6	2	1	36
5	Falco naumani	Leggar falcon	Falconidae	Falconiforms	Omnivores	Vaga rant	NT	12	23	10	3	7	4	5	17	11	9	101
6	Cirusmacrourus	Pallid hurrier	Accipitridae	Accipitriformes	Birds of prey	Vagarant	NT	9	12	6	11	13	17	8	4	6	2	91
7	Charadtnae	Plover	Charadridae	Charadriformes	Birds of prey	RV	EN	4	23	17	22	7	12	32	21	7	8	153
8	Laticillia burnesil	Grass babbler	pellorneidae	passeriformes	Omnivores	wv	NT	12	2	5	0	4	21	4	3	12	9	62
9	Falco cherrag	Saker falcon	Falconidae	Falconiforms	Carnivores	RV	EN	8	23	22	5	8	5	23	10	9	3	106
10	Vanellus gregarious	Sociable lapwing	Charadridae	Charadriformes	vagarant	RV	CR	0	3	5	8	12	10	2	5	6	4	55
11	Aytha ferina	Common pochard	Anatidae	Anseriforms	Omnivores	WV	LC	22	34	61	34	9	11	9	22	12	8	222
12	Columbia livia	Rock pigeon	Columbidae	Columbiformes	Granivores	RV	LC	9	16	15	43	61	32	7	19	18	8	228
13	Splenders corvus	House crow	Corvidae	Cuculiformes	Omnivores	RV	LC	11	13	43	27	52	17	19	21	41	11	255
14	Upupa epops	Common hoopoe	Upupidae	Coraciformes	Carnivores	RV	LC	23	12	9	13	27	12	9	10	2	11	128
15	Passer domesticus	House sparrow	Passeridae	Passeriormes	Omnivores	RV	LC	55	32	67	85	32	44	23	20	28	38	424
16	Hoplopterus Indecus	Red watted lapwing	Charadrius	Charadriformes	Insectivoure	RV	LC	12	23	10	3	7	4	5	17	22	9	115
17	Pycnonotus cafer	Red vented bul bul	Pycnonotidae	Passeriormes	Omnivores	RV	LC	37	21	8	25	27	9	19	26	23	43	238
18	Acridothere ginginimus	bankmyna	Sturnidae	Passeriormes	Insectivoure	RV	LC	4	23	27	22	7	12	32	21	17	8	143
19	Psitta krameri	Rose ring parakeet	psittacidae	Psittaciformes	Omnivores	RV	LC	28	19	28	32	6	10	18	21	18	5	185
20	Bubulcus ibis	Cattle egret	Ardeidae	Peleconiformes	carnivores	Migratory	LC	12	23	10	3	7	4	5	17	22	19	116

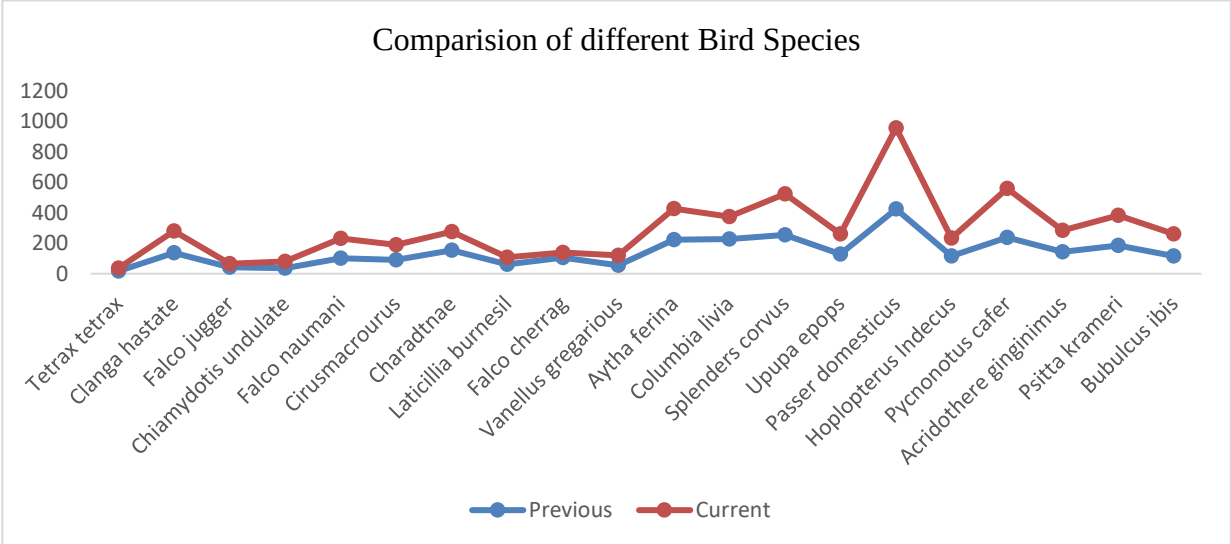

FIGURE 8: Comparison of Previous and Current Bird Species

The comparison of different bird species has been elaborated in the tables and graphical forms. The current and previous status of the bird species was mentioned (Figure 7 & 8).

4. Discussion

The present study aimed to elucidate the changes in the distribution of avian species over time through a comprehensive temporal analysis of historical and current data. The comparison between these datasets has provided valuable insights into the dynamic nature of avian populations and the underlying factors influencing their distribution patterns. This discussion section focuses on interpreting the findings, exploring their implications, and identifying avenues for future research [25].

The present study revealed that 20 bird species representing 23 genera, 15 families and 13 orders were recorded from the study area. While some previous studies conducted in nearby areas showed that 43 birds species representing 27 genera, 10 families and 6 orders from Rasool barrage; district Jhelum [26] while 32 species belonging to 17 families and 6 orders during their survey to river Ravi [27]. Our analysis also revealed significant temporal shifts in the distribution of avian species within the study area. It has been seen that a number of species that were predominant in past but their population declined currently, due to various factors such as; climate change, habitat loss and different anthropogenic activities. These decreases in population size emphasize to take serious measures to prevent further loss of biodiversity[28].

Conversely, certain avian species have exhibited an expansion in their distribution range. These species may have benefited from changing environmental conditions or adapted to new habitats. The success of these species highlights the complex interplay between ecological resilience and adaptability in the face of environmental changes[29].The comparison of historical and current data underscores the profound impact of human activities on avian distribution. Urbanization, deforestation, and agricultural expansion have led to habitat fragmentation and loss, resulting in significant changes in avian communities. The decline of forest-dependent species and the proliferation of urban-adapted species exemplify the transformative influence of human-driven land use changes. Conservation strategies must address these challenges to mitigate further disruptions to avian ecosystems[30].

Climate change emerges as a potential driver of avian distribution shifts. Our results indicated that the changes in distribution ranges of certain species have correlation with temperature and precipitation modification. However, the relationship between climate change and modification in avian habitat modification was observed to be a potential factor but couldn’t be established. Future research could provide a comprehensive understanding of dynamics and elaborate the impact of climate change on avian population [31].

Our results suggested avian species such as;Paddy Field Pipit (Anthusrufulus), Bee-eaters (Merops spp.) and Ashy Prinia (Priniasocialis)will move to a new location in south Punjab due to wide spread agriculture activity. The findings of this study have direct implications for avian conservation efforts. The decline of historically abundant species signals the need for targeted conservation strategies that address specific habitat requirements and mitigate human-induced threats. Conservation initiatives should encompass habitat restoration, protected area establishment, and community engagement to ensure the long-term survival of these species.The success of certain species in adapting to urban environments underscores the importance of urban conservation planning. Green spaces, urban forests, and sustainable urban design can contribute to creating habitats that support diverse avian communities even within densely populated areas [32].

5. Conclusion

Analyzing the distribution patterns of present and past bird species provides valuable insights into their evolutionary history, migration patterns, and adaptation to changing environments. Thisshed light on the effects of historical climate changes on avian populations. Further, current analysis also leads to contemporary conservation efforts. By studying historical distributions and identifying factors that led to the decline or extinction of certain species, conservationists can develop strategies

to protect and restore habitats, prevent further loss of biodiversity, and potentially reintroduce species into suitable areas. The presence of closely related species on separate landmasses suggests that these landmasses were once connected, and the separation over time led to speciation and the formation of distinct species.Studying the distribution of present and past bird species drives the development of innovative methodologies in fields such as paleontology, molecular biology, genetics, and geographic information systems (GIS). These advances can have broader applications beyond avian research. Research on bird distributions engages the public and fosters appreciation for biodiversity and the natural world. It provides a platform for education and outreach, encouraging individuals to understand and support conservation efforts. The factors such as landscape gradients mainly affect the distribution and diversity of avian species. In current study, various statistical models were applied to predict the avian diversity and distribution in given landscape gradients. Further, it is also noted that the anthropogenic changes had great impact on avian species. It is recommended that the conservation and restoration of avian species, especially forest diversity highly depends on to measure it on large-scale first. However, small green spaces and corridors are important for avian conservation in the urban habitats from where large forest patches have declined. Further, the conservation plans should also be made for the management of urbanization.

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