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Distributional Pattern and Avifaunal Diversity in Two Different Areas in Himachal Pradesh, India

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Abstract: Avifaunal diversity in the natural habitats is a subject of significant ecological interest and conservation concern. Himachal Pradesh, situated in the Indian Himalayas, boasts diverse habitats, providing unique niches for avian species. Studying avifauna in distinct habitats elucidates their responses to environmental factors, habitat preferences, and potential conservation implications. Our study investigated avifaunal diversity and distributional patterns in two contrasting habitats within Himachal Pradesh. A total of 73 species of birds belonging to 54 genera, 19 families and 9 orders were encountered during the survey. The number of bird species in Chamba was higher than those in Kangra. The value of species diversity (Shannon-w diversity index H`= 3.8, Simpson diversity D = 0.9665, evenness j`=0.6346) was also higher in Chamba than at Kangra (H`= 3.529, D = 0.9477, j`=0.5327). According to the IUCN Red list two endangered species (*Neophron percnopterus* and *Aquila nipalensis*), and two near-threatened species (*Gypaetus barbatus* and *Psittacula eupatria*) and one vulnerable species (*Catreus wallichii*) were recorded. Additionally, we identified habitat-specific variations in species richness, evenness, and composition, reflecting habitat specialization among avian taxa. Our findings underscore the importance of habitat heterogeneity in shaping avifaunal diversity and distributional patterns in Himachal Pradesh. The assessment of conservation status, particularly the identification of endangered and vulnerable species, underscores the importance of continued monitoring and conservation initiatives to protect these valuable components of the ecosystem. Furthermore, understanding the ecological requirements and habitat preferences of avian communities is essential for effective biodiversity conservation and ecosystem management in this ecologically sensitive region. Future research should focus on long-term monitoring to assess the resilience of avian populations to environmental changes and anthropogenic pressures, thereby ensuring the conservation of Himachal Pradesh's avifaunal diversity for generations to come.

Keywords: Avifaunal diversity, Diversity indices, Natural habitat, Conservation, Abundance.

Introduction:

Birds are one of nature's most fascinating creatures, with a worldwide distribution and a very important role in human society and the ecosystem (Grouw, 2013). The role of the birds as messengers has been well-known from the beginning of time, and they have served as a source of inspiration for ornamentlists and artisans. Birds are biocontrol agents and excellent pollinators of crops as well as birds serve as an insect pest and vermin killers, scavengers, human food, and seed dispersed as they travel from one region to another. Bird pollination is an important integration function because it contributes to the long-term sustainability and diversity of botanical and agricultural resources, resulting in greater productivity, they help to ensure the health and diversity of plant and animal species, improve environmental health, and the preservation of biological diversity (Payra et al., 2017). Birds are an indicator of any ecosystem's environmental health (Collar and Andrew, 1988). A total of 10,000 bird species have been identified worldwide, with the Indian subcontinent home to 13% of all species (Grimmett et al., 2016). Because of the great floral diversity seen at various altitudes, the Himalayan region, which includes the study area, supports a diverse range of avifauna (Mohan and Sondhi, 2017). The Himalayan region is home to certain endemic species of birds, according to numerous earlier studies (Price et al., 2003). The complicated and ensuing meteorological and environmental variables support the Himalayan foothills' reputation as having good ecological variety. The Western Himalayan avifauna is an endangered bird area (Islam and Rahmani, 2004). Due to their ecological adaptability and ability to thrive in both carnivorous and omnivorous habitats, birds make excellent indicators. According to Jarvinen and Vaisanen, 1979; Jarvinen, 1983, their presence is a sign of a healthy ecosystem or habitat. On the other hand, periodic bird species monitoring helps understand ecological changes and habitat restoration strategies.

India currently has 74 species with restricted ranges, with 39 of them limited to the country's geographical borders. Furthermore, 79 bird species in India are at risk of global extinction. In India, 79 bird species are facing the threat of global extinction, with 9 classified as critical species, 10 as endangered species, 57 as vulnerable species, two as conservation dependent, and one as data deficient. In addition, more than 52 are listed as near threatened. The majority of India's remaining bird species are rapidly declining, emphasizing the urgent need for conservation efforts to protect these endangered species (Mulinge, 2023).The data on bird endangerment in the Asia region is especially concerning. The data on bird endangerment in the Asia region is particularly alarming, with 12% of all bird species in Asia being endangered, totaling 323 bird species on the brink of extinction.

Particularly concerning is the fact that 41 bird species in Asia are in critical condition, with an additional 65 species at risk of extinction. This adds up to a total

of 323 bird species in the region facing endangerment. Another 317 near-threatened species are on the verge of being globally endangered. The majority of Asia's vulnerable bird species, over 80% of them, rely on forests as their primary habitat. Almost 30% of Asia's vulnerable bird species rely on grassland, savannah, and shrublands as their primary habitat, but these habitats are only minor for nearly half of these species. Furthermore, artificial habitats such as plantations, artificial wetlands, arable land and so on are of minor importance for the vast majority of threatened species that occur in them (88%), implying that these species are unlikely to survive without nearby seminatural or natural habitats for feeding or breeding. Tropical lowland moist forests are vital for the survival of 70% of endangered forest species, while wetlands are crucial for the survival of 20% of threatened species (Butchart et al., 2004). The current investigation was an attempt to observe bird species in the Chamba and Kangra districts of Himachal Pradesh. This research aims to try to close this gap by conducting field surveys on the avifauna in the study area from July 2021 to July 2022. This area was chosen because it exhibits a variety of habitats, including agricultural fields, water bodies, deodar forests, and shrubs that attract many birds according to their habitats. An ecosystem's health can be determined by creating an avian checklist based on data on abundance.

Methods

Study area

The study was carried out in the natural habitat and their adjoining areas of Chamba (32°33'20.88"N, 76°7'33.31"E.) and Kangra (32.1015°N, 76.2731°E) districts of Himachal Pradesh state (Figure 1). The study area is enriched in shrubs, water streams and deodar forest patches, and agricultural land. Chamba district is the northwestern district of Himachal Pradesh, in India. The climate of the Chamba district is a subtropical or temperate or sub-arctic region, location is situated between 1,185-2,768 meters above sea level. The majority of the land is covered with snow in the winter season, average annual rainfall is around 800mm (Vikram & H., 2014). Various types of trees are present in Chamba region such as alpine, deodar, and blue pine Pinus, but horse chestnut and rhododendron are two common tree species. In Chamba district, there are five wildlife sanctuaries Gamgul-Siyabehi sanctuary (108.40 sq. km), Kalatop-Khajjiar sanctuary (17.17 sq. km) Kugti sanctuary (379 sq. km), Tunda sanctuary (64.22 sq. km), and Sechu-tuan nalla sanctuary (320.29 sq. km). Kangra Valley, nestled in the western Himalayas at an average elevation of 2000ft, is known as strike valley. Agriculture is the primary occupation in this region, situated at 32.1degrees latitude and 76.27 degrees longitude (Sharief et al., 2018) summer season are mild in Kangra district but winter are cold and annual rainfall ranges from 1800-3000mm.

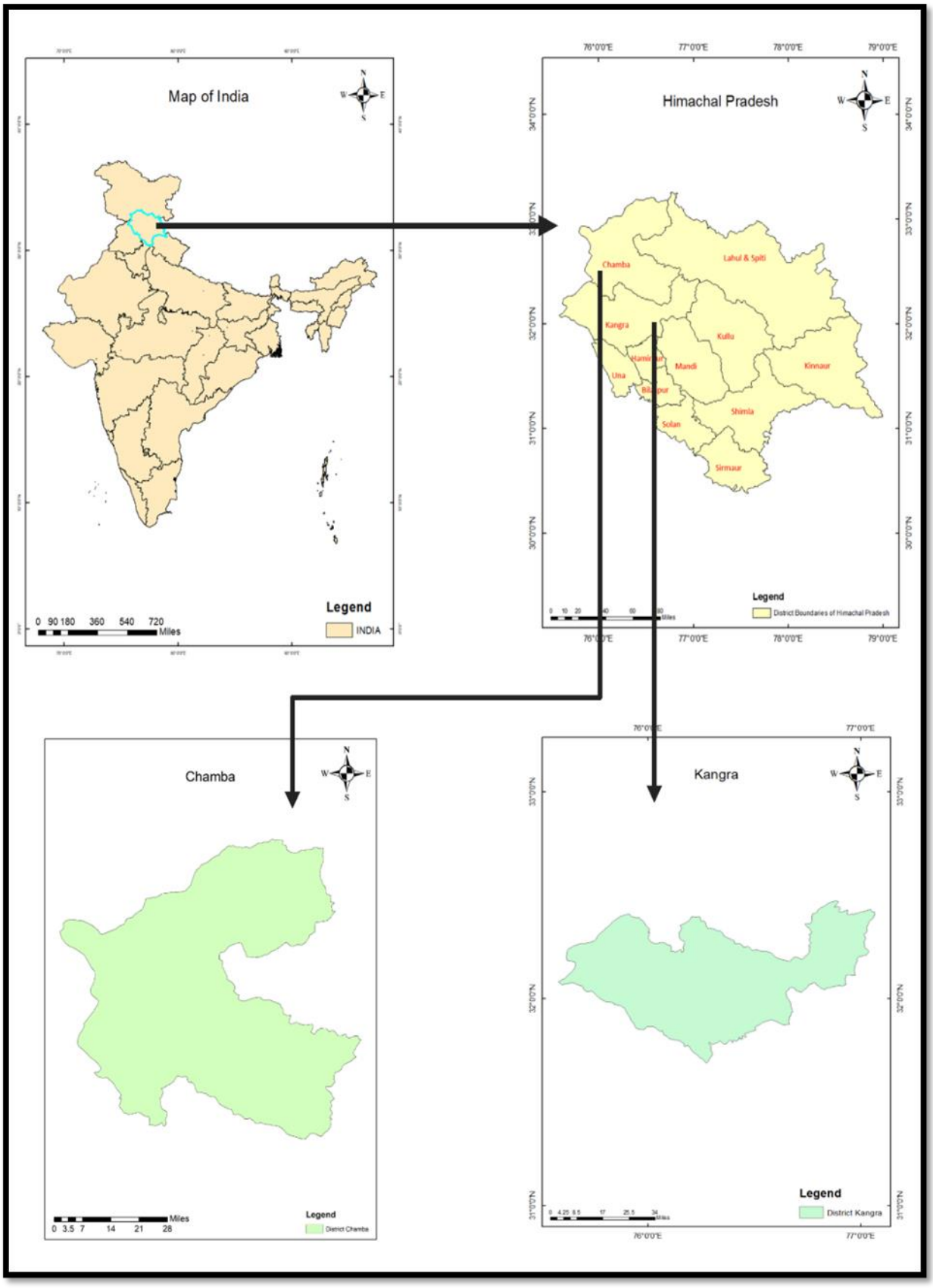

Figure 1: ArcGIS Map of sampling zones

Sampling Strategy:

The avian species survey was conducted from July 2021 to July 2022 in different habitats of districts Chamba and Kangra. The field survey was carried out by using binoculars (Nikon 10X50), Nikon Coolpix P1000 and Canon 700d cameras. The stratified random sampling technique was carried out for sampling (Thakur et al., 2010). The stratified random sampling technique allowed for a more comprehensive and representative study of the avifauna in each area, as it ensured that all habitat types with in the sites were adequately represented in the sampling (Singh & Kumar, 2017). This approach allowed for the collection of scientifically valuable data while saving time, and yielded avian data suitable for mathematical and statistical analysis to better present the results (Dar et al., 2008). Birds were observed through the point count method as described by (Sutherland et al., 2004).The identification of birds was carried out through the published literature and field guides (Ali and Ripley., 1962). The nomenclature follows Manakadan & Pittie (2001). Field data were obtained using the "point counts" method, which is a count from a fixed location, for a fixed period, at any time of the year. This method is suitable for studying highly visible, and/or vocal bird species, in a wide variety of habitats (Sutherland, 2006). In this study, birds were counted from a fixed raising position within a circle of 50 m radius for a specific period of time (10 min) at every point. After 5-min settling period, all birds seen and heard within this 50 m radius were recorded during the 15 min. At least 25 points were established along existing manmade or natural trails in each habitat with approximately 250 m of linear distance between them. Every point was observed for 15 minutes beginning between 5:00 and 7:30 in the morning and between 4:30 and 6:30 in the afternoon, when the birds are usually most active (Thakur et. al.2021). The primary physical characteristics were used for identification, and no bird was ever captured or injured during observation in accordance with animal ethics. All of the birds that were perceived visually or detected through calls within 30 m of the observer were counted. The researchers walked at a slow and constant speed to ensure proper, non-biased observations, and binoculars, tablets, DSLR cameras and photographic field guides were used to confirm the observations. All observations were recorded on the field. The data collected was used to estimate bird diversity and abundance for survey location. This involved using calculating metrics such as species richness, abundance for the data estimation. The results were calculated and interpreted (Ralph et al., 1995; Bibby et al., 2000).

Data Analysis

Relative Abundance of the observed species was calculated by using the following formula;

Relative abundance (RA) $=\frac{n}{N}$

"Where n is the total number of birds of a particular species and N is the total number of birds of all species"

Different index was used to interpret the data given below:

Dominance (D):

$$D = \sum pi^2$$

Where, pi is the proportional abundance of i^{th}species.

Simpson's Index

$$(1\text{-}D) = \sum pi\ (pi - 1)$$

Where, pi is the proportional abundance of i^{th} species.

Shannon Diversity (H):

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

Where, pi **is** the proportional abundance of i^{th} species.

Evenness:

$$(e^n H/S): e^H/S$$

Where, H is the Shannon Diversity Index and S is the total number of species

Results

During the present study bird communities recorded in Chamba and Kangra districts were varied. The total numbers of birds in Chamba were 329 (individuals) which was higher than Kangra (310 individuals). The checklist in the table represents the bird species recorded in two different areas during the period fromJuly 2021 to July 2022. Ornithological explorations carried out in Chamba and Kangra districts of Himachal Pradesh revealed the presence of 73 species of birds belonging to 54 genera spread over 19 families and 9 orders (**Table 1: Figure 2**). Passeriformes was the most dominant order having 10 families and 29 species followed by Accipitriformes (14 species) and Piciformes (8 species). Furthermore, the lowest order in numbers was Falconiforms (2 species) followed by Coraciiforms (3 species).

Relative Abundance of Bird's Species

Birds' species number and Relative abundance for both the study areas were presented in **Table 2**. In Chamba, the following species were recorded in descending order: Plum-headed parakeet, Slaty-headed parakeet, Rock pigeon, Great barbet and Kalij pheasant. Their numbers were the highest as follows30, 25, 20, 20 and 12 individuals, respectively. Their relative abundances were 0.091, 0.075, 0.060, 0.60 and 0.036 respectively. In Kangra, the highest bird's number was the jungle babbler followed by Plum-headed parakeet, Slaty-headed parakeet, great barbet and white-throated kingfisher in descending order as follows: 40, 35, 32, 15 and 13 individuals and relative abundance of 0.129, 0.112, 0.103, 0.048 and 0.041 respectively.

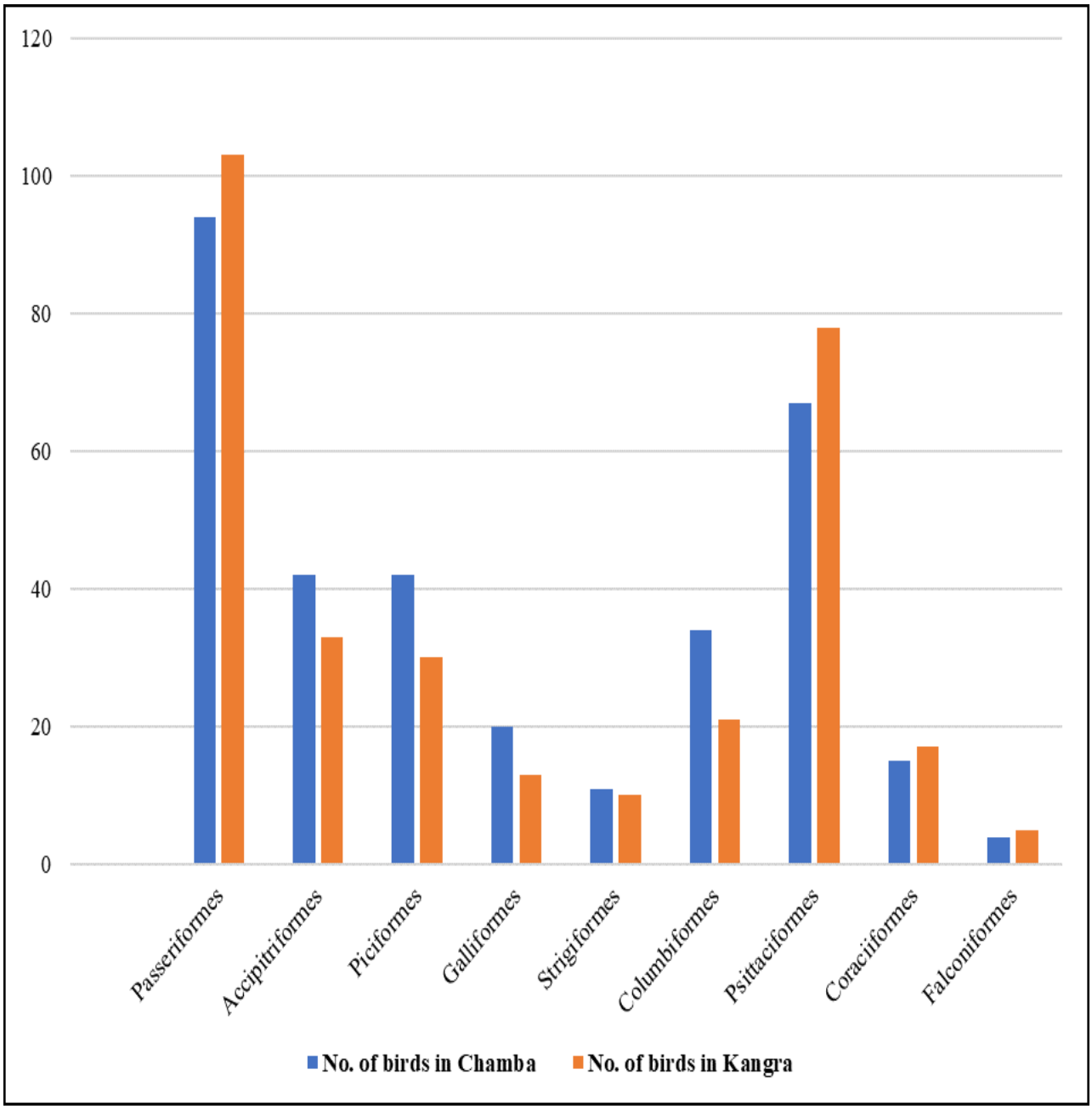

Figure 2: Various individuals in particular order

Diversity Indices-A diversity index is a numerical representation of the number of distinct species present in a community as well as the distribution of individuals within those species. The relative abundances of the bird species (%) were calculated using the equation N/n, where N is the species × the total number of individuals captured and n is the total number of all species.Chamba had the highest value of Shannon-w diversity index (H`= 3.8) and Simpson diversity (D = 0.9665) than Kangra (H`= 3.529) and (D = 0.9477) while evenness (j`) was higher in Chamba (0.6346) and Kangra (0.5327) **(Table 3).**Conservation status was determined using the data provided by the International Union for the

Conservation of Nature (IUCN 2014), Out of these 73 species, two endangered species Egyptian Vulture, (*Neophron percnopterus*) and Steppe eagle (*Aquila nipalensis*) and two near-threatened species Bearded vulture (*Gypaetus barbatus*) and Alexandrine parakeet (*Psittacula eupatria*) and one vulnerable species Cheer pheasant (*Catreus wallichii*) were sighted (**Table 4**).

Discussion:

Birds have been used as "bio-monitors" since they are good environmental monitors. The term "ecological bio-indicators" refers to species or groups of species whose ecological characteristics—such as abundance, presence/absence, and other characteristics—reflect the biotic or abiotic environment of the ecosystem. A total of 73 species of birds belonging to 9 orders 19 families and 54 genera were recorded in this study. Passeriformes was the most dominant order representing 29 species. Singh and Banyal, (2013) also found Passeriformes as a dominant order in Khajjiar Lake, Chamba. Shah et al. (2016) have also reported the dominance of Passeriformes in Kalatop-Khajjiar Wildlife Sanctuary, Chamba. Similarly, Sharief et al., (2018) have found Passeriformes as a dominant order in Pong reservoir. Other researchers like Singh (2015) and Negi & Banyal (2015) have also found the maximum diversity of birds belonging to Passeriformes in Mandi areas of Himachal Pradesh.

During the current study there were 4 species of owls in Chamba, 3 species of vultures, 5 species of eagle, 3 species of buzzard, 5 species of raptors, 5 species of pheasants, 3 species of kingfisher, 6 species of flycatchers, 2 species of sunbirds, 1 species of minivet and 10 species of finch, 2 species of barbet, 3 species of drongo, 6 species of woodpecker, 4 species of dove, 5 species of thrush and 4 species of parakeet, 2 species of babbler. Jungle babbler and crested drongo were absent in Chamba district due to unfavourable climatic conditions i.e. absence of warm habitat. In Kangra district, bearded vulture, long legged buzzard, chukar partridge, long tailed minivet, European gold finch, red-fronted serin, lesser yellow nape, scaly-bellied woodpecker, speckled piculet, alpine thrush, chestnut thrush and Himalayan shrike babbler were not found.

The number of bird species in an area is typically influenced by the availability of essential resources such as food, water, and shelter, as well as favourable atmospheric conditions. The Plum-headed parakeet had the highest relative abundance of 0.091 in Chamba, while in Kangra, jungle babbler had the highest relative abundance (0.129). Ahmed and Kumar (2022) found the highest relative abundance of Blak kite followed by Large Billed crow in Banihal, Ramban, Jammu and Kashmir. Issa (2019) has found the highest relative abundance of House sparrow (0.21) in resident wild birds in Sharkia Governorate, Egypt. According to the data, the Shannon-w diversity index and Simpson diversity of Chamba (3.808, 3.529) had highest value than that of Kangra (0.966, 0.947). The analysis of diversity shows high diversity of avifauna in Chamba (H`= 3.8, D = 0.9665&j =0.6346) and Kangra (H`= 3.529, D = 0.9477, j`=0.5327). Similarly, Arachchi et al.

(2022) found higher species diversity in tea field (H`=3.19), stream vegetation (H`=3.06), organic farm ((H`=3.02) in Palampur, Kangra, Himachal Pradesh.

Conclusions:

In conclusion, the findings of this study offer valuable insights into the avian diversity of Chamba and Kangra districts in Himachal Pradesh. The observed variations in bird communities between the two districts, with Chamba showing higher total numbers, suggest potential differences in habitat suitability and environmental conditions. Through a detailed assessment of bird species and their relative abundance, this study enhances our understanding of avian diversity and distribution patterns, providing a crucial foundation for informed conservation strategies in these areas. Furthermore, the diversity indices calculated in this study contribute significant information to our understanding of avian communities in Himachal Pradesh, guiding future research and conservation efforts aimed at preserving the region's rich biodiversity. The assessment of conservation status, particularly the identification of endangered and vulnerable species, underscores the importance of continued monitoring and conservation initiatives to protect these valuable components of the ecosystem. Overall, this study contributes to the growing body of knowledge on avian biodiversity in Chamba and Kangra districts, catalysing further research and conservation endeavours aimed at safeguarding these invaluable natural resources for generations to come.

List of Abbreviations:

IUCN: International Union for Conservation of Nature
LC: Least concern
NT: Near threatened
EN: Endangered
VU: Vulnerable

Declarations

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Consent for publication: Taken from all authors
Availability of data and material: Not applicable
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Authors' contributions: RK, SK- Conceptualization, VS, DM -Original draft preparation, VS- Bird photography and instrumentation, ML Thakur- Birds identification, KT- Reviewing and editing, all authors have read and agreed to the published version of the manuscript.

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References

1. Ahmed, B. & Kumar, S. (2022). Status and Diversity of birds in and around Banihal, Ramban, Jammu and Kashmir. Journal of Entomology and Zoology Studies, 10(5), 415–420.
2. Ali, S. A. L. I. M., & Ripley, S. D. (1962). The Bombay Natural History Society. World Health Organisation bird migration study project. Journal of the Bombay Natural History Society, 59(1), 100-130.
3. Butchart, S. H. M., Stattersfield, A. J., Bennun, L. A., Shutes, S. M., Akçakaya, H. R., Baillie, J. E. M., ... & Mace, G. M. (2004). Measuring global trends in the status of biodiversity: Red List Indices for birds. PLoS biology, 2(12), e383.
4. Dar, T. A., HABIB, B., Khan, J. A., Kushwaha, S., & Mendiratta, N. (2008). Bird community structure in Phakot and Pathri Rao watershed areas in Uttarakhand, India. International Journal of Ecology and Environmental Sciences, 34(2), 193-205.
5. Grimmett, R., Inskipp, C., & Inskipp, T. (2016). Birds of the Indian Subcontinent: India, Pakistan, Sri Lanka, Nepal, Bhutan, Bangladesh and the Maldives. Bloomsbury Publishing.
6. Islam, M. Z., & Rahmani, A. R. (2004). Important Bird Areas in India: priority sites for conservation. Indian Bird Conservation Network: Bombay Natural History Society and Birdlife International (UK), 1133.
7. Issa, M. A. A. (2019). Diversity and abundance of wild birds'species in two different habitats at Sharkia Governorate, Egypt. The Journal of Basic and Applied Zoology, 80, 1-7.
8. Järvinen, O., & Väisänen, R. A. (1979). Changes in bird populations as criteria of environmental changes. Ecography, 2(2), 75-80.
9. Kottawa-Arachchi, J. D., Thakur, G., Dwivedi, A., Tshering, R., Samimi, H. M., Chaudhary, Y., & Chaudhary, H. K. (2022). Factors Affecting Avifaunal Diversity in Selected Agro-Ecosystems of Himachal Pradesh Agricultural University, Palampur, Himachal Pradesh, India. Zoodiversity, 56(1).
10. Manakadan, R., & Pittie, A. (2001). Standardised common and scientific names of the birds of the Indian subcontinent. Buceros, 6(1), 1-37.
11. Mohan, D., & Sondhi, S. (2017). An updated checklist and bibliography of the birds of Uttarakhand. Published by Uttarakhand Forest Department, Dehradun. Pp. i-vi, 1-92.

12. Mulinge, J. (2023). Effects of Environmental change on species diversity. International Journal of Biology, 3(1), 43-53.
13. Negi, R. K., &Banyal, H. S. (2015). Avifauna of Rakchham-Chhitkul Wildlife Sanctuary District Kinnaur, Himachal Pradesh, India. IOSR Journal of Pharmacy and Biological Sciences, 18-25.
14. Payra, A., Mondal, K., Mishra, R. K., & Rout, S. (2017). Status and diversity of avifauna in coastal areas of South Bengal, India. World Scientific News, (74), 209-237.
15. Price, T., Zee, J., Jamdar, K., &Jamdar, N. (2003). Bird species diversity along the Himalaya: a comparison of Himachal Pradesh with Kashmir. Journal of the Bombay Natural History Society, 100(2&3), 394â.
16. Ralph, C. J., Droege, S., & Sauer, J. R. (1995). Managing and monitoring birds using point counts: standards and applications. In: Ralph, C. John; Sauer, John R.; Droege, Sam, technical editors. 1995. Monitoring bird populations by point counts. Gen. Tech. Rep. PSW-GTR-149. Albany, CA: US Department of Agriculture, Forest Service, Pacific Southwest Research Station: p. 161-168, 149.
17. Shah, T. A., Ahuja, V., Anandam, M., & Srinivasulu, C. (2016). Avifauna of Chamba District, Himachal Pradesh, India with emphasis on Kalatop-Khajjiar Wildlife Sanctuary and its surroundings. Journal of Threatened Taxa, 8(1), 8333-8357.
18. Sharief, A., Paliwal, S., Sidhu, A. K., & Kubendran, T. (2018). Studies on bird diversity of pong dam wildlife sanctuary, Kangra, Himachal Pradesh, India. Journal of Entomology and Zoology Studies, 6(4), 904-912.
19. Singh, D. (2015). b. Avifaunal diversity of Mandi district, Himachal Pradesh, India. International Journal of Current Research in Life Sciences, 4(11), 452-458.
20. Singh, H., & Kumar, P. (2017). A brief overview of vegetation of Pangi valley (Chamba, Himachal Pradesh): A high altitude region of northwest Himalaya, India. Biosciences Biotechnology Research Asia, 14(2), 625-630.
21. Singh, V., &Banyal, H. S. (2013, December). Avian Fauna of Khajjiar Lake, District Chamba, Himachal Pradesh, India. In Proceedings of the Zoological Society (Vol. 66, pp. 130-136). Springer India.
22. Singh, V., &Banyal, H. S. (2014). Biodiversity in Khajjiar Lake of Himachal Pradesh, India: Threats and conservation. International Journal of Biodiversity and Conservation, 6(7), 495-501.
23. Sun, T. T., Eichner, R., NELsoN, W. G., Tseng, C. S., WEIss, R. A., JARvINEN, M., & Woodcock-Mitchell, J. (1983). Keratin classes: molecular markers for different types of epithelial differentiation. Journal of Investigative Dermatology, 81(1), S109-S115.
24. Sutherland, W. J. (Ed.). (2006). Ecological census techniques: a handbook. Cambridge university press.

25. Sutherland, W. J., Pullin, A. S., Dolman, P. M., & Knight, T. M. (2004). The need for evidence-based conservation. Trends in ecology & evolution, 19(6), 305-308.
26. Thakur, K., Sharma, S., Kumar, R., & Thakur, M. L. (2021). Exploring the Population Status of Galliformes in Mandi District, Himachal Pradesh, India. Bulletin of Pure & Applied Sciences-Zoology, 40(2), 285-290.
27. Thakur, M. L., Mattu, V. K., Lal, H., Sharma, V. N., Raj, H., & Thakur, V. (2010). Avifauna of Arki Hills, Solan (Himachal Pradesh), India. Indian Birds, 5(6), 162-166.

Table 1: Birds species observed at selected sampling regions along with common name

Order	**Family**	**Genus**	**species**	**Common name**
Strigiformes	Strigidae	*Glaucidium*	*cuculoides*	Asian barred owlet
		Otus	*sunia*	Oriental Scops owl
		Otus	*spilosphalus*	Mountain scops owl
		Otus	*bakkamoena*	Indian scops owl
Accipitriformes	Accipitridae	*Gypaetus*	*barbatus*	Bearded vulture
		Gypus	*fulvus*	Griffon vulture
		Neophron	*percnopterus*	Egyptian vulture
		Aquilla	*nipalensis*	Steppe eagle
		Hieraaetus	*pennatus*	Booted eagle
		Spilornius	*cheeia*	Crested serpent eagle
		Nisaetus	*nipalensis*	Mountain hawk eagle
		Aquilla	*fasciata*	Bonelli's eagle
		Buteo	*rufinus*	Long legged buzzard
		Buteo	*refectus*	Himalayan buzzard
		Buteo	*buteo*	Common buzzard
		Accipiter	*nisus*	Eurasian sparrowhawk
		Accipiter	*badius*	Shikra
		Circus	*cyaneus*	Hen harrier
Falconiformes	Falconidae	*Falco*	*tinnunculus*	Common kestrel
		Falco	*subbuteo*	Eurasian hobby
Galliformes	Phasianidae	*Lophura*	*leucomelanos*	Kalij pheasant
		Alectoris	*chukar*	Chukarpatridge
		Lophophorus	*impejanus*	Monal
		Catreus	*walichi*	Cheer pheasant

		Gallus	*gallus*	Red jungle fowl
Coraciiformes	Alcedinidae	*Alcedo*	*atthis*	Common kingfisher
		Halcyon	*smyrensis*	White-throated kingfisher
		Megaceryle	*lugubris*	Crested kingfisher
Passeriformes	Fringillidae	*Pyrrhula*	*erythrocephala*	Red-headed bullfinch
		Chloris	*spinoides*	Yellow breasted green finch
		Leucodticte	*nemoricola*	Plain mountain finch
		Pyrrhula	*aurantiaca*	Orange bull finch
		Carduelis	*carduelis*	European Gold finch
		Carpodacus	*erythrinus*	Common rose finch
		Carpodacus	*rodochroa*	Pink-browed rose finch
		Fringilla	*montifringilla*	Brambling finch
		Callacanthis	*burtoni*	Spectacled finch
		Serinus	*pusillus*	Red-fronted serin
	Dicruridae	*Dicrurus*	*hottentottus*	Hair crested drongo
		Dicrurus	*macrocercus*	Black drongo
		Dicrurus	*leucophaeus*	Ashy drongo
	Muscicapidae	*Myophonus*	*caeruleus*	Blue-whistling thrush
		Eumyias	*thalassinus*	Verditer flycatcher
		Ficedula	*superciliaris*	Ultra marine flycatcher
		Muscicapa	*sibirica*	Dark-sided flycatcher
		Ficedula	*tricolor*	Slaty blue flycatcher
	Turdidae	*Zoothera*	*mollissima*	Alpine thrush
		Turdus	*rubrocanus*	Chestnut thrush
	Leiothrichidae	*Pterorhinus*	*albogularis*	White-throated

				laughing thrush
		Trochalopteron	*erythrocephalum*	Chestnut-crowned laughing thrush
		Argya	*striata*	Jungle babbler
	Vireonidae	*Pteruthius*	*ripleyi*	Himalayan shrike babbler
	Monarchidae	*Terpsiphone*	*paradisi*	Indian Paradise flycatcher
	Stenostiridae	*Culicicapa*	*ceylonesis*	Grey-headed canary flycatcher
	Nectariniidae	*Aethopyga*	*siparaja*	Crimson sunbird
		Cinnyris	*asiaticus*	Purple sunbird
	Campephagidae	*Pericrocotus*	*ethologus*	Long-tailed minivet
Piciformes	Megalaimidae	*Psilopogon*	*virens*	Great barbet
		Psilopogon	*asiaticus*	Blue-throated barbet
	Picidae	*Picumnus*	*innominatus*	Speckled piculet
		Picus	*squamatus*	Scaly-bellied woodpecker
		Dendrocoptes	*macei*	Fulvous-breasted woodpecker
		Dendrocoptes	*auriceps*	Brown-fronted woodpecker
		Picus	*chlorolophus*	Lesser yellow nape
		Picus	*canus*	Grey-headed woodpecker
Columbiformes	Columbidae	*Columba*	*livia*	Rock pigeon
		Treron	*sthenurus*	Wedge-tailed green

				pigeon
		Streptopelia	*orientalis*	Oriental turtle dove
		Streptopelia	*decaocto*	Eurasian collared dove
Psittaciformes	Psittaculidae	*Psittacula*	*cyanocephala*	Plum-headed parakeet
		Psittacula	*himalayana*	Slaty headed parakeet
		Psittacula	*krameri*	Rose -ringed parakeet
		Psittacula	*eupatria*	Alexandrine parakeet

Table 2: Relative abundance of birds presents in Chamba and Kangra

Scientific name	**Sampling zone 1 Chamba**	**Relative abundance (Pi)**	**LN Pi**	**Pi*LN(Pi)**	**Sampling zone 2 Kangra**	**Relative abundance (Pi)**	**LNPi**	**Pi*LN(Pi)**
Glaucidium cuculoides	5	0.0152	-4.1866	-0.0636	4	0.0129	-4.3503	-0.0561
Otus sunia	2	0.00608	-5.1029	-0.031	3	0.00968	-4.638	-0.0449
Otus spilocephalus	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Otus bakkamoena	3	0.00912	-4.6974	-0.0428	2	0.00645	-5.0434	-0.0325
Gypaetus barbatus	1	0.00304	-5.7961	-0.0176	0	0	0	0
Gyps fulvus	7	0.02128	-3.8501	-0.0819	4	0.0129	-4.3503	-0.0561
Neophron percnopterus	2	0.00608	-5.1029	-0.031	5	0.01613	-4.1271	-0.0666
Aquila nipalensis	12	0.03647	-3.3112	-0.1208	5	0.01613	-4.1271	-0.0666
Hieraaetus pennatus	1	0.00304	-5.7961	-0.0176	2	0.00645	-5.0434	-0.0325
Spilornis cheeia	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Nisaetus nipalensi	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Aquila fasciata	3	0.00912	-4.6974	-0.0428	2	0.00645	-5.0434	-0.0325

Buteo rufinus	1	0.00304	-5.7961	-0.0176	0	0	0	0
Buteo refectus	2	0.00608	-5.1029	-0.031	1	0.00323	-5.7366	-0.0185
Buteo buteo	1	0.00304	-5.7961	-0.0176	2	0.00645	-5.0434	-0.0325
Falco tinnunculus	2	0.00608	-5.1029	-0.031	2	0.00645	-5.0434	-0.0325
Accipiter nisus	4	0.01216	-4.4098	-0.0536	5	0.01613	-4.1271	-0.0666
Falco subbuteo	2	0.00608	-5.1029	-0.031	3	0.00968	-4.638	-0.0449
Accipiter badius	5	0.0152	-4.1866	-0.0636	4	0.0129	-4.3503	-0.0561
Circus cyaneus	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Gallus gallus	3	0.00912	-4.6974	-0.0428	2	0.00645	-5.0434	-0.0325
Lophura leucomelanos	12	0.03647	-3.3112	-0.1208	9	0.02903	-3.5393	-0.1028
Alectoris chukar	2	0.00608	-5.1029	-0.031	0	0	0	0
Lophophorus	2	0.00608	-5.1029	-0.031	1	0.00323	-5.7366	-0.0185
Catreus wallichii	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Alcedo atthis	2	0.00608	-5.1029	-0.031	3	0.00968	-4.638	-0.0449

Halcyon smyrnensis	10	0.0304	-3.4935	-0.1062	13	0.04194	-3.1716	-0.133
Megacery lelugubris	3	0.00912	-4.6974	-0.0428	1	0.00323	-5.7366	-0.0185
Terpsiphone	5	0.0152	-4.1866	-0.0636	2	0.00645	-5.0434	-0.0325
Eumyias thalassinus	4	0.01216	-4.4098	-0.0536	3	0.00968	-4.638	-0.0449
Ficedula superciliaris	2	0.00608	-5.1029	-0.031	2	0.00645	-5.0434	-0.0325
Culicicapa ceylonenis	2	0.00608	-5.1029	-0.031	1	0.00323	-5.7366	-0.0185
Muscicapa sibirica	3	0.00912	-4.6974	-0.0428	2	0.00645	-5.0434	-0.0325
Ficedula tricolor	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Aethopyga siparaja	4	0.01216	-4.4098	-0.0536	3	0.00968	-4.638	-0.0449
Cinnyris asiaticus	3	0.00912	-4.6974	-0.0428	4	0.0129	-4.3503	-0.0561
Pericrocotus ethologus	6	0.01824	-4.0043	-0.073	0	0	0	0
Pyrrhula erythrocephala	9	0.02736	-3.5988	-0.0984	4	0.0129	-4.3503	-0.0561
Chloris spinoides	2	0.00608	-5.1029	-0.031	2	0.00645	-5.0434	-0.0325
Leucosticte nemoricola	2	0.00608	-5.1029	-0.031	2	0.00645	-5.0434	-0.0325

Pyrrhula aurantiaca	3	0.00912	-4.6974	-0.0428	4	0.0129	-4.3503	-0.0561
Carduelis carduelis	2	0.00608	-5.1029	-0.031	0	0	0	0
Carpodacus erythrinus	8	0.02432	-3.7166	-0.0904	5	0.01613	-4.1271	-0.0666
Carpodacus rodochroa	5	0.0152	-4.1866	-0.0636	2	0.00645	-5.0434	-0.0325
Fringilla montifringilla	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Callacanthis burtoni	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Serinu spusillus	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Psilopogon virens	20	0.06079	-2.8003	-0.1702	15	0.04839	-3.0285	-0.1465
Psilopogon asiaticus	5	0.0152	-4.1866	-0.0636	4	0.0129	-4.3503	-0.0561
Dicrurus hottentottus	0	0	0	0	4	0.0129	-4.3503	-0.0561
Dicrurus macrocercus	4	0.01216	-4.4098	-0.0536	3	0.00968	-4.638	-0.0449
Dicrurus leucophaeus	5	0.0152	-4.1866	-0.0636	7	0.02258	-3.7907	-0.0856
Picus canus	2	0.00608	-5.1029	-0.031	3	0.00968	-4.638	-0.0449

Picus chlorolophus	4	0.01216	-4.4098	-0.0536	0	0	0	0
Dendrocoptes auriceps	5	0.0152	-4.1866	-0.0636	4	0.0129	-4.3503	-0.0561
Dendrocopos macei	2	0.00608	-5.1029	-0.031	2	0.00645	-5.0434	-0.0325
Picus squamatus	3	0.00912	-4.6974	-0.0428	1	0.00323	-5.7366	-0.0185
Picumnus innominatus	1	0.00304	-5.7961	-0.0176	1	0.00323	-5.7366	-0.0185
Columba livia	20	0.06079	-2.8003	-0.1702	12	0.03871	-3.2517	-0.1259
Treron sphenurus	2	0.00608	-5.1029	-0.031	2	0.00645	-5.0434	-0.0325
Streptopelia orientalis	8	0.02432	-3.7166	-0.0904	5	0.01613	-4.1271	-0.0666
Streptopelia decaocto	4	0.01216	-4.4098	-0.0536	2	0.00645	-5.0434	-0.0325
Myophonus caeruleus	7	0.02128	-3.8501	-0.0819	4	0.0129	-4.3503	-0.0561
Zoothera mollissima	2	0.00608	-5.1029	-0.031	0	0	0	0
Turdus rubrocanus	3	0.00912	-4.6974	-0.0428	0	0	0	0
Pterorhinus albogularis	5	0.0152	-4.1866	-0.0636	4	0.0129	-4.3503	-0.0561
Trochalopteron erythrocephalum	2	0.00608	-5.1029	-0.031	1	0.00323	-5.7366	-0.0185

Psittacula cyanocephla	30	0.09119	-2.3949	-0.2184	35	0.1129	-2.1812	-0.2463
Psittacula himalayana	25	0.07599	-2.5772	-0.1958	32	0.10323	-2.2708	-0.2344
Psittacula krameri	10	0.0304	-3.4935	-0.1062	7	0.02258	-3.7907	-0.0856
Psittacula eupatria	2	0.00608	-5.1029	-0.031	4	0.0129	-4.3503	-0.0561
Argya striata	0	0		0	40	0.12903	-2.0477	-0.2642
Pteruthius ripleyi	2	0.00608	-5.1029	-0.031	0	0	0	0

Table 3: Diversity indices of Birds

	Sampling zone 1 Chamba	**Sampling zone 2 Kangra**
Individuals	329	310
Dominance_D	0.03351	0.05226
Simpson_1-D	0.9665	0.9477
Shannon_H	3.808	3.529
Evenness_e^H/S	0.6346	0.5327
Brillouin	3.493	3.235
Menhinick	3.914	3.635
Margalef	12.08	10.98
Equitability_J	0.8933	0.8486
Fisher_alpha	27.83	24.48
Berger-Parker	0.09119	0.129
Chao-1	75.33	71.5

Table 4: List of birds present in selected sampling zones along with IUCN status

S.No.	Common Name	Scientific Name	IUCN
OWLS			
1.	Asian barred owlet	*Glaucidium cuculoides*	LC
2.	Oriental Scops owl	*Otus sunia*	LC
3.	Mountain scops owl	*Otus spilocephalus*	LC
4.	Indian scops owl	*Otus bakkamoena*	LC
VULTURES			
1.	Bearded vulture	*Gypaetus barbatus*	NT
2.	Griffon vulture	*Gyps fulvus*	LC
3.	Egyptian vulture	*Neophron percnopterus*	EN
EAGLES			
1.	Steppe eagle	*Aquila nipalensis*	EN
2.	Booted eagle	*Hieraaetus pennatus*	LC
3.	Crested serpent eagle	*Spilornis cheeia*	LC
4.	Mountain hawk eagle	*Nisaetus nipalensis*	LC
5.	Bonelli's eagle	*Aquila fasciata*	LC
BUZZARD			
1.	Long legged buzzard	*Buteo rufinus*	LC
2.	Himalayan buzzard	*Buteo refectus*	LC
3.	Common buzzard	*Buteo buteo*	LC
RAPTORS			
1.	Common kestrel	*Falco tinnunculus*	LC
2.	Eurasian sparrowhawk	*Accipiter nisus*	LC
3.	Eurasian hobby	*Falco subbuteo*	LC

4.	Shikra	*Accipiter badius*	LC
5.	Hen harrier	*Circus cyaneus*	LC
PHEASANTS			
1.	Red jungle fowl	*Gallus gallus*	LC
2.	Kalij pheasant	*Lophura leucomelanos*	LC
3.	Chukar patridge	*Alectoris chukar*	LC
4.	Monal	*Lophophorus*	LC
5.	Cheer pheasant	*Catreus wallichii*	VU
KINGFISHERS			
1.	Common kingfisher	*Alcedo atthis*	LC
2.	White throated kingfisher	*Halcyon smyrnensis*	LC
3.	Crested kingfisher	*Megaceryle lugubris*	LC
FLYCATCHERS			
1.	Indian Paradise flycatcher	*Terpsiphone paradisi*	LC
2.	Verditer flycatcher	*Eumyias thalassinus*	LC
3.	Ultra marine flycatcher	*Ficedula superciliaris*	LC
4.	Grey-headed canary flycatcher	*Culicicapa ceylonenis*	LC
5.	Dark-sided flycatcher	*Muscicapa sibirica*	LC
6.	Slaty blue flycatcher	*Ficedula tricolor*	LC
SUNBIRDS			
1.	Crimson sunbird	*Aethopyga siparaja*	LC
2.	Purple sunbird	*Cinnyris asiaticus*	LC
Minivet			
1.	Long-tailed minivet	*Pericrocotus ethologus*	LC
FINCH			
1.	Red-headed bullfinch	*Pyrrhula erythrocephala*	LC

2.	Yellow breasted green finch	*Chloris spinoides*	LC
3.	Plain mountain finch	*Leucosticte nemoricola*	LC
4.	Orange bull finch	*Pyrrhula aurantiaca*	LC
5.	European Gold finch	*Carduelis carduelis*	LC
6.	Common rose finch	*Carpodacus erythrinus*	LC
7.	Pink-browed rose finch	*Carpodacus rodochroa*	LC
8.	Brambling finch	*Fringilla montifringilla*	LC
9.	Spectacled finch	*Callacanthis burtoni*	LC
10.	Red-fronted serin	*Serinu spusillus*	LC
BARBET			
1.	Great barbet	*Psilopogon virens*	LC
2.	Blue-throated barbet	*Psilopogon asiaticus*	LC
DRONGO			
1.	Hair crested drongo	*Dicrurus hottentottus*	LC
2.	Black drongo	*Dicrurus macrocercus*	LC
3.	Ashy drongo	*Dicrurus leucophaeus*	LC
WOODPECKER			
1.	Grey-headed woodpecker	*Picus canus*	LC
2.	Lesser yellow nape	*Picus chlorolophus*	LC
3.	Brown-fronted woodpecker	*Dendrocoptes auriceps*	LC
4.	Fulvous-breasted woodpecker	*Dendrocopos macei*	LC
5.	Scaly-bellied woodpecker	*Picus squamatus*	LC
6.	Speckled piculet	*Picumnus innominatus*	LC
DOVE			
1.	Rock pigeon	*Columba livia*	LC
2.	Wedge-tailed green pigeon	*Treron sphenurus*	LC

3.	Oriental turtle dove	*Streptopelia orientalis*	LC
4.	Eurasian collared dove	*Streptopelia decaocto*	LC
THRUSH			
1.	Blue-whistling thrush	*Myophonus caeruleus*	LC
2.	Alpine thrush	*Zoothera mollissima*	LC
3.	Chestnut thrush	*Turdus rubrocanus*	LC
4.	White-throated laughing thrush	*Pterorhinus albogulris*	LC
5.	Chestnut-crowned laughing thrush	*Trochalopteron erythrocephalum*	LC
PARAKEET			
1.	Plum-headed parakeet	*Psittacula cyanocephla*	LC
2.	Slaty headed parakeet	*Psittacula himalayana*	LC
3.	Rose -ringed parakeet	*Psittacula krameri*	LC
4.	Alexandrine parakeet	*Psittacula eupatria*	NT
BABBLER			
1.	Jungle babbler	*Argya striata*	LC
2.	Himalayan shrike babbler	*Pteruthius ripleyi*	LC