



## Assessment Of Avifaunal Diversity Of Restored Riverine Ecosystem Of Shuklapur Area, Dehradun, India

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### Abstract

The survey was conducted from February to June of 2021. In total, 76 bird species from 16 orders and 35 families were documented in this study in riverine and forest habitat. In Shuklapur Area, order Passeriformes dominated, with 18 families accounting for 53% of all families documented. The majority of the bird species recorded belonged to the Columbidae, Sturnidae, and Cisticolidae families. Out of the total species recorded two belonged to Near Threatened (NT) category IUCN which are Grey-headed Parakeet (*Centropus hastate*) and Alexandrine Parakeet (*Palaeornis eupatria*) and two species from Vulnerable (VN) category of IUCN which are Great hornbill (*Buceros bicornis*) and Indian Spotted Eagle (*Clanga hastate*) were also sighted. 49% of the total avian species recorded were found in forest habitat, 13% in riverine habitat and 38% avian species shares both habitats. Carnivorous feeding habitat was most dominant with 38 avian species which is 50% of the total species found belong to this feeding habit while nectivorous bird species are least in number as only one avian species belongs to this feeding habit. In Shuklapur Area presence of six species of migratory birds were also recorded. Bird assemblage in both type of habitats shows a similar type of pattern. Diversity, richness, evenness, dominance of avian diversity in different seasons and different months were also analyzed. The current research provides a baseline study with respect to floral and faunal diversity conservation in this area.

**Keywords:** Avifauna, Riverine, Diversity, Forest Ecosystem.

### Introduction

Biodiversity is described as "all living things" on the planet, which includes all species and genetic variety. There is a rising awareness of the need to conserve our global biodiversity, as well as the fact that species loss is speeding up (Karbalkar and Umesh, 2009). We have entered a time in which the rate of extinction of species has reached a critical point. Taxonomic information about the biodiversity of a given area or group of living birds is stored in biodiversity databases (organisms). They may contain specimen-level information, species-level information, nomenclature, or any combination of the above (Rajeevan *et al.* 2004). Birds play a vital role in monitoring the health of natural environment (Collar and Andrew, 1988; Koskimies, 1989; Gregory *et al.* 2003). Birds are an important forest resource due to their ecological importance and recreational appeal (Scott and Gottfried, 1983). The variables that determine the quantity and richness of birds, i.e. their diversity, are an essential part of their ecology. Diversity is a classic and popular concept in ecology (Zahl, 1977) and one of most widely respected factor considered for the estimation of conservation potential land ecological value (Tubbs and Blackwood, 1971; Tans, 1974; Gehlbach, 1975; Margules and Usher, 1981; Baskin, 1994). It is a key conservation goal (Kershaw *et al.* 1995) and has been used to assess the performance of conservation initiatives (Hall and Willig, 1994). The density of avian populations can be influenced by a single or interactive factor such as habitat physiognomy, habitat availability, predation, intra-specific and inter-specific resource competition, parasites and illnesses, and weather all have an impact (Lack, 1933; Hilden, 1965; Den Boer and Gradwell, 1970; Andrewartha and Birch, 1984; Begon and Mortimer, 1986; Thiyagesan, 1991). The extent of these elements' effect varies depending on the geographical location, personal habits, and migratory status of the birds (Lack, 1966; von Haartman, 1971; Newton, 1980; van Balen, 1980). Nature's hallmarks are diversity and complexity, because avian diversity is an important component of biodiversity, we're looking at it for conservation and management purposes. Habitat degradation is one of the major cause of the extinction of most of our animals, and under current conditions,

there is every reason to believe that the process will continue (Salim Ali-2002). As a result, it is essential to follow ethical guidelines when learning about the birds unique to their area.

About ten thousand avian species has been reported in the world and Indian sub- continent contributes about 1331 species of the world avian species (Grimmett *et al.*, 2011).

### Material and Methods

**Study Area:** Study area is located in Shuklapur area, Purnnagar, Dehradun, Uttarakhand. It is situated at a distance of 13km from the Clock Tower Dehradun. This area falls under Asharodi forest range of the Uttarakhand Forest Department. The study area falls within 77° 55' 92.6'' & 77° 55' 93.1'' E longitude 30° 18' 66.2'' N latitude. The total area of study area is 1.09 km sq. and the periphery of study area is 5.39 km. at an altitude of 648 meters above sea level. The climate is humid subtropical. Summer temperatures here can reach upto 44 °C (111 °F) for a few days, and hot winds (known as *Loo*) blow across North India. Winter temperatures drop below freezing point, usually ranging between 1 and 20 °C (34 and 68°F), and fog is common, as it is in the plains. The average annual rainfall in this area is 2,073.3 mm (81.63 in). The months of June to September receive the majority of the annual rainfall in the area, with July and August being the wettest. During the monsoon season, heavy and prolonged rains are common. According to studies conducted by HESCO (Himalayan Environmental Studies and Conservation Organization) the average soil moisture is 9.29% and the soil nature is slightly acidic and the discharge of catchment areas is 371lt/sec. The forest type is semi deciduous forest according to Champion and Seth categorization of Indian forest. The forest patch is dominated by trees like Sal (*Shorea robusta*), Rohini (*Mallotus philippensis*) and Dandal (*Xylocarpus longifolia*). Shrubs like Star jasmine (*Jasminum multiflorum*), Curry tree (*Murraya koenigii*), Hill glory bower (*Clerodendrum infortunatum*), Desmodium and Flemingia were commonly found. Lianas like Hiptage (*Hiptage benghalensis*), Gouaniatilifolia, cockspear thorn (*Maclura cochinchinensis*) were also common.

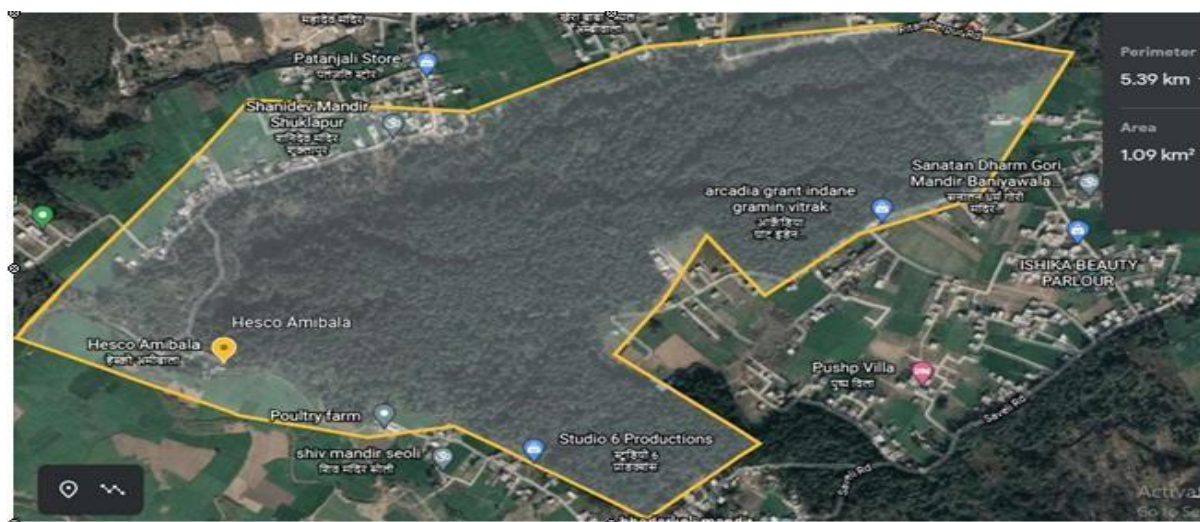


Fig: Study area (Source: Google Earth)

### Methodology:

**Line transect method:** Line transect sampling involves an observer travelling along a designated line of given length recording the number of birds (Webb, 1942; Hayne, 1949; Yapp, 1956). In the riverine habitat line transect method was used. Only on the one side of river, two transects were drawn because the visibility of birds on the other side of river was clear. The length and width of transect was 0.5 km and 0.1 km respectively.

**Point count method:** A point count is a tally of all birds detected by sight and sound by a single observer located at a fixed position during a specified period of time (Ralph, et al. 1993). In the forest habitat point count method was used. In the forest region after every 200m a point was selected and standing on that point for 10min. all the birds observed carefully with their voices in the radius of 25m.

### Measurement of diversity

$$\text{Diversity index} = H = - \sum P_i \ln P_i$$

Where,  $P_i = S / N$   $S$  = number of individuals of one species  $N$  = total number of all individuals in the sample  $\ln$  = logarithm to base  $e$ .

### Measurement of species richness

Species richness ( $S$ ) refers to the number of species living in a particular area (Moore, 2013). Margalef's index was used as a simple measure of species richness (Margalef, 1958). Margalef's index =  $(S - 1) / \ln N$

Where,  $S$  = total number of species  $N$  = total number of individuals in the sample  $\ln$  = natural logarithm.

### Measurement of evenness

For calculating the evenness of species, the Pielou's Evenness Index (e) was used (Pielou, 1966).  $e = H / \ln S$  Where, H = Shannon – Wiener diversity index S = total number of species in the sample.

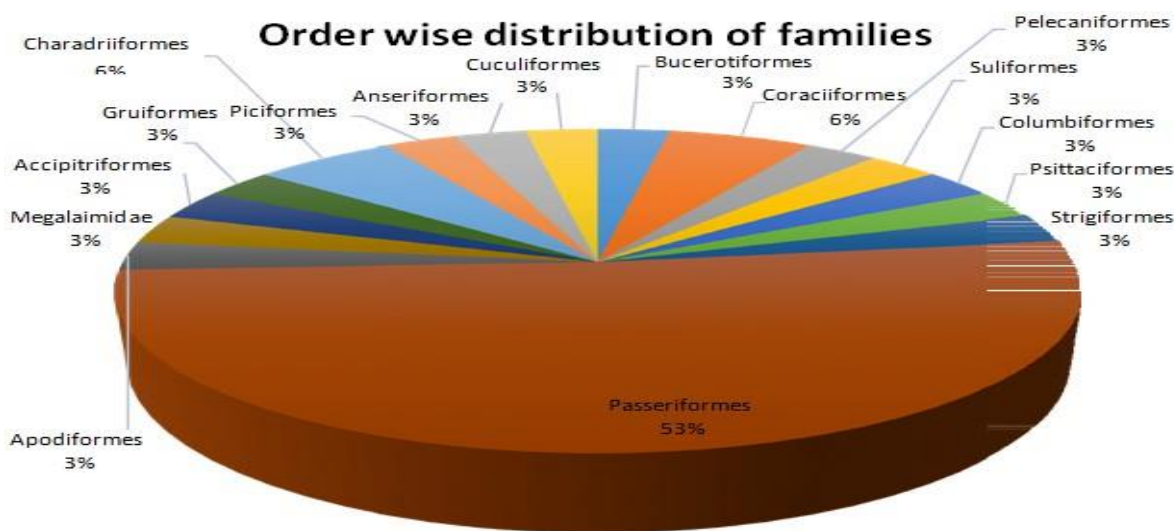
**Measurement of dominance**

$CDI = (y_1 + y_2) / y$

Where,  $y_1$  = abundance of the most abundant species,  $y_2$  = abundance of second most abundant species,  $y$  = total abundance for all the species.

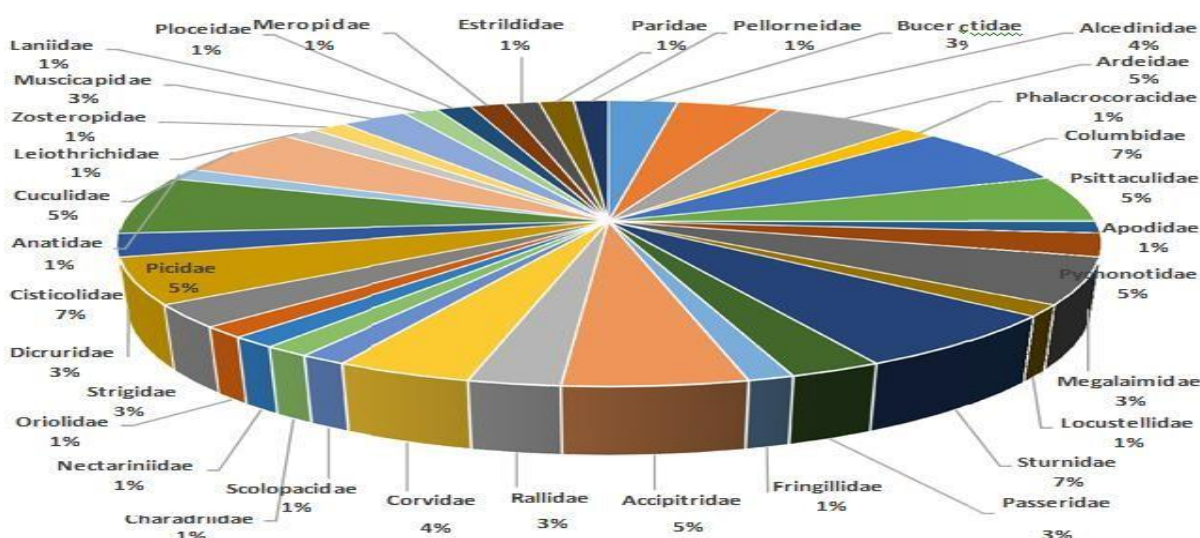
**Results and Discussions**

**Avian diversity of Shuklapur Area** The current study attempted to collect important information on the bird biodiversity of the Shuklapur Area. The periodic survey of the study region, which was undertaken from February 2021 to June 2021, revealed a high level of bird diversity. During the study period, 76 avian species from 16 orders and 35 families were identified. Identified avian species belonged to 16 orders, namely, Bucerotiformes, Coraciiformes, Pelecaniformes, Suliformes, Columbiformes, Psittaciformes, Strigiformes, Passeriformes, Apodiformes, Megalaimidae, Accipitriformes, Gruiformes, Charadriiformes, Piciformes, Anseriformes, Cuculiformes, Bucerotiformes, Coraciiformes, Pelecaniformes, Suliformes, Columbiformes, Psittaciformes, Strigiformes, Passeriformes, Apodiformes, Megalaimidae, Accipitriformes, Gruiformes, Charadriiformes, Piciformes, Anseriformes, Cuculiformes. According to the research, the order Passeriformes had the most families (18), accounting for 53% of total families recorded.



*Fig: Percentage of avian families belonging to different orders*

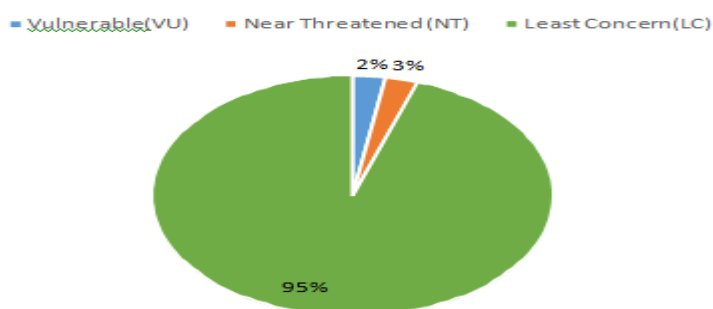
According to study, the most species (5) belonged to the families Columbidae, Sturnidae, and Cisticolidae, accounting for 7 % each of all documented species. Fig. illustrates the percentage of avian species belonging to different families.



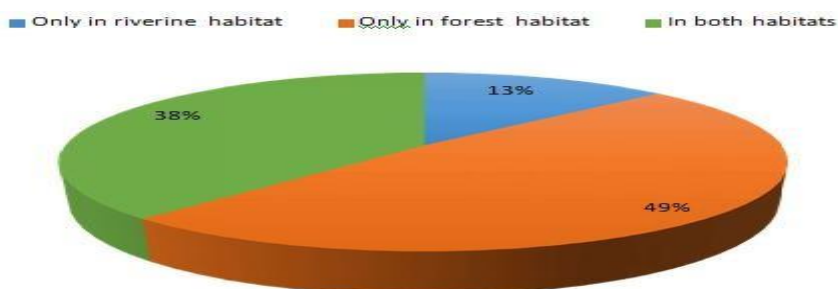
*Fig. Percentage of avian species belonging to different families*



Different avian species observed in the Shuklapur Area were listed as per their IUCN status for recommendation of conservation actions. The observed avian species were compared to the IUCN's most recent Red Data List. As a result, avian species were classified as Least Concern (LC), Endangered (EN), Vulnerable (VU), Critically Endangered (CR), and Near Threatened (NT) by the IUCN.



As mentioned, the study was undertaken in separated two different habitats: forest and riverine. Out of the total number of species, 10 are found exclusively cited in the riverine habitat, accounting for 13% of the total; 37 are found only in the forest habitat, accounting for 49% of the total; and 29 are found in both habitat, accounting for 38% of the overall bird diversity found in the area.



Bird composition in riverine habitats was found to be different in between February (winter) and June (summer) (0.60), while in forest habitats, there was dissimilarity in composition between February (winter) and March-April (spring) and June (summer) (> 0.68). In contrast, species composition was more or less similar between spring and summer season (< 0.50).

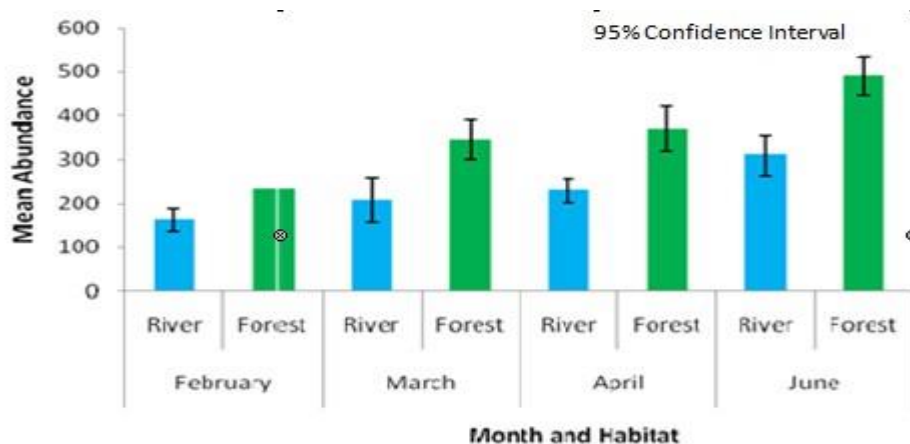
|        |             | February    | March       | April       | June        |
|--------|-------------|-------------|-------------|-------------|-------------|
|        |             | Riverine    | February    | 0           | 0.38        |
|        | March       | 0.38        | 0           | 0.28        | <b>0.36</b> |
|        | April       | 0.49        | 0.28        | 0           | <b>0.34</b> |
|        | June        | 0.60        | 0.36        | 0.34        | <b>0</b>    |
| Forest |             | February    | March       | April       | <b>June</b> |
|        | February    | 0           | 0.72        | 0.68        | <b>0.81</b> |
|        | March       | 0.72        | 0           | 0.38        | <b>0.39</b> |
|        | April       | 0.68        | 0.38        | 0           | <b>0.45</b> |
|        | <b>June</b> | <b>0.81</b> | <b>0.39</b> | <b>0.45</b> | <b>0</b>    |

**Diversity, richness, evenness and dominance of birds in riverine and forest habitats**

|        | Riverine    |             |             |             | Forest      |             |             |             |
|--------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|        | Diversity   | Richness    | Evenness    | Dominance   | Diversity   | Richness    | Evenness    | Dominance   |
| Winter | 3.19        | 3.95        | 0.96        | 0.15        | 2.73        | 3.01        | 0.93        | <b>0.24</b> |
| Spring | 3.15        | 4.34        | 0.91        | 0.18        | 3.18        | 4.84        | 0.88        | <b>0.18</b> |
| Summer | <b>3.32</b> | <b>4.62</b> | <b>0.92</b> | <b>0.14</b> | <b>3.63</b> | <b>6.30</b> | <b>0.92</b> | <b>0.12</b> |

There was a significant difference (95% CI) in the mean abundance of birds between riverine and forest habitats across three months (March, April and June). The mean abundance of birds was higher in forest than riverine habitats. In

riverine habitat, a significant difference was found between the month of February and June, whereas, no significant difference was found between the abundance in March and April. In forest habitats, there was significant difference in the abundance of birds between summer (June) and spring (March-April). Abundance of forest habitat was excluded from any interpretation due to lack considerable replicates ( $n=2$ ).



*Fig: Mean Abundance of species in different months and habitat*

**Main Issues:** There are agricultural areas on one side of the study area's riverine zone. This generates a lot of anthropogenic pressure in the riverine zone, which disturbs the habitat of bird diversity. Fertilizers and pesticides are used in huge quantities in agricultural areas, and these chemicals drain straight into the river. As a result, the river's water quality is deteriorating, adversely affecting aquatic species and the avian diversity that feeds on them. Water from the river is hauled for irrigation purpose, decreasing the water level in the river and affecting aquatic life once more. On the river's bank, a cemetery is present. When the corpses are burned, the discarded clothes and other materials end up in rivers, affecting the growth of hydrophytes. As a result, avian species such as the Common Moorhen and White-breasted Waterhen that feed on these hydrophytes are being affected.

The analysis of seasonal assemblage of bird species in both type of habitat shows a similar pattern, the assemblage in spring and summer were more similar than winter season this is because of departure of winter visitor in latter months. Similarity of assemblage in spring and summer seasons shows the presence of summer visitors in Shuklapur Area. With the presence of summer and winter visitor, it is clear that the Shuklapur Area provides a diverse feeding and breeding habitats for both winter and summer visitors. By analyzing the data of Shuklapur Area in riverine habitats, diversity of avian species was highest during summer season and lowest in spring seasons. Similarly, in forests, highest avian diversity was recorded in summer but lowest during winter season. In riverine habitat, richness was highest during summer season and lowest in winter season. Same in the forest habitat, highest richness was recorded in summer season and the lowest richness was recorded during the winter season. In riverine habitat, evenness was highest in winter season (0.96) and was lowest during spring (0.91). In the forest habitat, evenness was highest during the winter and was lowest during the spring (0.88). In riverine habitat, dominance was highest in spring (0.18) and was lowest in summer season (0.12). Similarly, several studies have shown the difference in species richness of different habitats like Joshi and Bhatt (2015) in Doon Valley, Uttarakhand; Veeramani *et al.* (2018) in Nilgiris, South India; Sohil and Sharma (2020).

### Conclusion

This study results and observations can have significant implications for site specific bird conservation at micro level and cultivate better knowledge of how birds interact with different habitats and what factors affect their diversity. As the study area is located at the outskirts of the Dehradun city with minimum commercial activities, the isolated location of Shuklapur Area benefits in terms of the protection & conservation of flora and fauna. The fruiting trees planted around the HESCO campus is a major attraction to a great number of avian species. The rejuvenated Shuklapur river also plays a vital role in maintaining the ecosystem and attracts numerous resident and migratory bird species by providing a suitable feeding and breeding habitat. During the study, one major anthropogenic pressure that was recorded was the negative consequences in land use change due to the expanding human settlement and agricultural fields on avian habitat, which could have a significant impact on avian habitat in the coming future. This has been a unique study in Shuklapur Area that was carried out for the first time, and it aids in recording a profile of the total avian diversity, their abundance, richness, and evenness, which will be useful creating a baseline data for future studies in this area.

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The present research did not receive any financial support.

### CONFLICT OF INTEREST

The authors declare that there is not any conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, and redundancy has been completely observed by the authors.

### LIFE SCIENCE REPORTING

No life science threat was practiced in this research.

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