Innovations

A Study of Avian Diversity and Temporal Variation in Sailana Wildlife Sanctuary, Madhya Pradesh, India

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Abstract: *This study investigates avian diversity and its temporal variation in Sailana Wildlife Sanctuary, a critical habitat in Madhya Pradesh, India. Over the course of a year during April 2023 to March 2024 (summer, rainy and winter season), systematic surveys were conducted across different sites to assess species richness, abundance, and community composition. A total of 46 bird species, were recorded, highlighting the sanctuary's role as a biodiversity hotspot. Seasonal variations revealed significant shifts in species presence, with an influx of migratory birds during winter and fluctuations in resident bird populations influenced by breeding and resource availability. Species richness peaked during winter season. Key indicator species such as Sarus crane (*Antigone antigone*)and rare taxa were identified, underscoring the importance of habitat conservation and monitoring efforts. This study provides baseline data critical for long-term ecological research and informs management strategies aimed at preserving the sanctuary's avian diversity amid anthropogenic pressures and climate change.*

Keywords: *Avian diversity, temporal variation, migratory birds, species richness, Sailana Wildlife Sanctuary, seasonal abundance.*

Introduction

Biodiversity, encompassing the variety of all life forms on Earth, serves as a crucial indicator of the environmental resources available in a region and how species utilize them. The presence and diversity of species in a particular habitat are significantly shaped by the availability, distribution, and accessibility of biophysical resources **(Rajendran *et al.*, 2014; Kumar and Sahu, 2020)**.Birds are among the most prominent species within Earth's biodiversity. Due to their sensitivity to environmental changes, they serve as key indicators for assessing the health of ecosystems **(Taper *et al.*, 1995; Olechnowski, 2009; Gaur *et al.*, 2019)**. They act as scavengers by removing carcasses and recycling nutrients **(Inger *et al.*, 2016)**, and they also help control agricultural pests such as rodents

and insects **(Maas *et al.*, 2015; Maas *et al.*, 2016)**. Many bird species are involved in pollination **(Nabhan and Buchmann, 1997)**.

Seasonal fluctuations in food resources result in temporal variations in avian diversity. Favorable climatic conditions, such as optimal temperatures, often drive local migrations and attract migratory birds to specific areas **(Joshi and Shrivastava, 2012)**. Microclimatic factors, including temperature, rainfall, humidity, and vegetation cover, play a pivotal role in influencing prey availability and the distribution of bird species in wetland ecosystems. These factors directly or indirectly affect birds' foraging patterns, habitat preferences, reproductive behaviors, and the timing of breeding seasons **(Karr and Freemark, 1983)**.Wetlands and freshwater habitats are crucial for sustaining diverse bird species, supporting both water-dependent and terrestrial birds.The variety and quantity of birds in these habitats serve as crucial markers of the ecosystem's stability and health, underscoring the significance of preserving these places to safeguard avian and general biodiversity **(Rawal*et al.*, 2016).**

Bird ecology is intrinsically linked to rainfall and vegetation, with fluctuations in these elements directly impacting bird populations. Additionally, the biological oxygen demand of aquatic systems can influence bird populations, demonstrating the interconnected nature of environmental variables **(Klemetsen and Knudsen, 2013; Mallin *et al.*, 2016)**. During dry seasons, limited access to water and food resources may force birds to shift their habitat ranges, confining them to locations where their ecological requirements are met. Diverse substrates for nesting, hiding, foraging, and food availability attract niche-specific bird species, thereby increasing species richness **(Tesfahun and Ejigu, 2022)**.

Seasonal variations in rainfall, temperature, and microhabitat conditions influence the availability of food resources for birds **(Mengesha *et al.*, 2011)**.Moreover, various factors operating at multiple spatial and temporal scales can influence species diversity. For instance, local climate, ecotones, competition, habitat structure, and heterogeneity play significant roles in determining species diversity at the local level **(Lomolino, 2001; Gaur *et al.,* 2019)**. These changes, combined with the species-specific sensitivity to habitat types, can alter bird diversity, abundance, and distribution. Furthermore, studies reveal that processes occurring in breeding and wintering grounds significantly shape patterns of habitat occupancy and seasonal abundance among migratory bird species **(Newton, 2008)**.

Protected areas, such as National Parks, Wildlife Sanctuaries, and Biosphere Reserves, are essential for safeguarding a country's biodiversity. While human activities in Wildlife Sanctuaries are limited to minimal physical alterations, these areas play a vital role in conserving the region's flora and fauna **(Singh, 2009).**The sanctuary's wild flora and fauna are generally under risk from the pollution caused by the tourists' littering and the abundance of plastic garbage that is scattered throughout the area, Such pollution not only disrupts ecosystems

but also threatens the health and survival of various species. **(Bhonsle and Gaherwal, 2019).**

Materials and Methods

Study area

The Sailana Wildlife Sanctuary is located in the Ratlam district of MadhyaPradesh state and is spread over an area of 12.96 square kilometers. The sanctuary comprises three locations:
Amba range (8.51 square kilometers)
Sherpur (0.91 square kilometers)
Shikarwadi Private Agriculture and Grazing Land (3.54 square kilometers)

Study period

This study was conducted in a period of 1 yearApril 2023 to March 2024and it was divided into three seasons, i.e. summer season (April to June), rainy season (July to October) and winter season (November to March).

Camera: Birds were observed either with the unaided eye or using binoculars (Nikon ACULON A211 10-22x50), and photographs were taken with a digital camera (Nikon Z 50 mirrorless camera) for documentation of the avifauna.

Identification of Birds

The book of Indian birds by Salim Ali (13th edition) (2002)and Birds of India by Bikram Grewal and Garima Bhatia(2016) were used for identifications.

Method

Line Transect method

While walking on a continuous pace, it is easy to locate anddetect all the avian fauna around the transect line. By adoptingline transect method; it is possible to cover a large area in lesstime **(Bibby *et al.*,2000).**

Point count method

Observation points were randomly placed in different habitats. We recordedbird species (seen or heard) within a 25 m radius of each of these point count stationsin a 360° arc for 10 minutes. In addition, opportunistic observations of birds at other times and in other places were included in order to produce a comprehensive checklist of the avifauna of the study area. Field visits were carried out on foot only on dayswith suitable weather conditions (i.e. in the absence of rain or strong wind) **(Bibby *et al.*,2000).**

Results

The Temporal Variation of avian fauna of different study sites (Sherpur, Shikarwadi and Amba Range) during April 2023 to March 2024 (summer, rainy and winter season) were represented in table 1-3.

Temporal variation of birds in Sherpur

Sherpur exhibited a higher diversity of bird species during the rainy and winter seasons, with 43 and 43 species recorded, respectively. The summer season recorded a lower diversity, with only 34 species present. This variation could be attributed to migratory bird patterns and the availability of water and food resources during specific seasons.Species such as *Anas crecca* and *Athene brama* were predominantly observed during the winter season, reflecting their migratory nature (Table: 1).

Temporal variation of birds in Shikarwadi Private Agriculture and Grazing Land

Shikarwadi displayed distinct seasonal patterns, with 42 species recorded during the rainy season and 45 species in winter. Summer saw a lower diversity of 33 species. Species such as *Pavo cristatus*, *Coracias benghalensis*, and *Psittacula krameri* were present across all seasons, indicating their year-round residency. Conversely, species like *Tachybaptus ruficollis* and *Fulica atra* were absent during the summer but were observed during the rainy and winter seasons, reflecting their reliance on seasonal water bodies (Table: 2).

Temporal variation of birds in Amba Range

The Amba Range exhibited the least diversity, particularly during the summer season, with only 27 species present. The rainy and winter seasons saw a marginal increase, with 32 species recorded in rainy season and 33 speciesrecorded in winter season. (Table: 3).

Table 1 :- Temporal Variation of birds in Sherpur during summer, rainy and winter season

Scientific Names of Species	**Family**	**Summer**	**Rainy**	**Winter**
Pavo cristatus	Phasianidae	-	+	-
Ortygornis pondicerianus	Phasianidae	-	-	-
Anas poecilorhyncha	Anatidae	+	+	+
Dendrocygna javanica	Anatidae	+	+	+
Tadorna ferruginea	Anatidae	+	+	+
Anas crecca	Anatidae	-	-	+
Ocyceros birostris	Bucerotidae	-	+	+

Coracias benghalensis	Coraciidae	+	+	+
Halcyon smyrnensis	Alcedinidae	+	+	+
Aleedo atthis	Alcedinidae	+	+	+
Merops orientalis	Meropidae	-	+	+
Eudynamys scolopaceus	Cuculidae	+	+	+
Centropus sinensis	Cuculidae	+	+	+
Psittacula krameri	Psittacidae	+	+	+
Athene brama	Strigidae	-	+	+
Columba livia	Columbidae	+	+	+
Spilopelia senegalensis	Columbidae	+	+	+
Antigone antigone	Gruidae	+	+	+
Amaurornis phoenicurus	Rallidae	+	+	+
Fulica atra	Rallidae	+	+	+
Vanellus indicus	Charadriidae	+	+	+
Himantopus himantopus	Recurvirostridae	+	+	+
Milvus migrans	Accipitridae	-	-	-
Tachyspiza badia	Accipitridae	+	+	+
Tachybaptus ruficollis	Podicipedidae	+	+	+
Microcarbo niger	Phalacrocoracidae	-	+	+
Bubulcus ibis	Ardeidae	+	+	+
Ardea alba	Ardeidae	+	+	+
Ardea intermedia	Ardeidae	+	+	+
Ardeola grayii	Ardeidae	+	+	+
Threskiornis melanocephalus	Threskiornithidae	-	+	+
Dicrurus maerocercus	Dicruridae	+	+	+
Corvus macrorhynchos	Corvidae	-	-	-
Corvus splendens	Corvidae	+	+	+
Acridotheres tristis	Sturnidae	+	+	+
Sturnia pagodarum	Sturnidae	-	-	+
Pycnonotus cafer	Pycnonotidae	+	+	+
Argya striata	Leiothrichidae	+	+	+
Argya malcolmi	Leiothrichidae	+	-	-
Prinia socialis	Cisticolidae	+	+	+
Mirafra erythroptera	Alaudidae	+	+	+
Cinnyris asiaticus	Nectariniidae	+	+	+
Ploceus philippinus	Ploceidae	-	+	+
Passer domesticus	Passeridae	+	+	+

Euodice malabarica	Estrildidae	-	+	-
Saxicoloides fulicatus	Muscicapidae	+	+	+
Saxicola maurus	Muscicapidae	-	+	+
Copsychus saularis	Muscicapidae	+	+	+
Anthus rufulus	Motacillidae	-	+	+

Keys = (+) indicates presence and (-) indicates absence of species.

Table 2:- Temporal Variation of birds in Shikarwadi Private Agriculture and Grazing Land during summer, rainy and winter season.

Scientific Names of Species	**Family**	**Summer**	**Rainy**	**Winter**
Pavo cristatus	Phasianidae	+	+	+
Ortygornis pondicerianus	Phasianidae	-	+	+
Anas poecilorhyncha	Anatidae	-	+	+
Dendrocygna javanica	Anatidae	-	-	+
Tadorna ferruginea	Anatidae	-	-	-
Anas crecca	Anatidae	-	-	-
Ocyceros birostris	Bucerotidae	+	+	+
Coracias benghalensis	Coraciidae	+	+	+
Halcyon smyrnensis	Alcedinidae	+	+	+
Aleedo atthis	Alcedinidae	+	+	+
Merops orientalis	Meropidae	-	+	+
Eudynamys scolopaceus	Cuculidae	+	+	+
Centropus sinensis	Cuculidae	+	+	+
Psittacula krameri	Psittacidae	+	+	+
Athene brama	Strigidae	-	-	+
Columba livia	Columbidae	+	+	+
Spilopelia senegalensis	Columbidae	+	+	+
Antigone antigone	Gruidae	-	-	-
Amaurornis phoenicurus	Rallidae	-	+	+
Fulica atra	Rallidae	-	+	+
Vanellus indicus	Charadriidae	+	+	+
Himantopus himantopus	Recurvirostridae	+	+	+
Milvus migrans	Accipitridae	+	+	+
Tachyspiza badia	Accipitridae	+	+	+
Tachybaptus ruficollis	Podicipedidae	-	-	+
Microcarbo niger	Phalacrocoracidae	+	+	+

Bubulcus ibis	Ardeidae	+	+	+
Ardea alba	Ardeidae	+	+	+
Ardea intermedia	Ardeidae	+	+	+
Ardeola grayii	Ardeidae	+	+	+
Threskiornis melanocephalus	Threskiornithidae	-	-	+
Dicrurus maerocercus	Dicruridae	+	+	+
Corvus macrorhynchos	Corvidae	-	+	+
Corvus splendens	Corvidae	+	+	+
Acridotheres tristis	Sturnidae	+	+	+
Sturnia pagodarum	Sturnidae	+	+	+
Pycnonotus cafer	Pycnonotidae	+	+	+
Argya striata	Leiothrichidae	+	+	+
Argya malcolmi	Leiothrichidae	+	+	+
Prinia socialis	Cisticolidae	+	+	+
Mirafra erythroptera	Alaudidae	+	+	+
Cinnyris asiaticus	Nectariniidae	+	+	+
Ploceus philippinus	Ploceidae	-	+	-
Passer domesticus	Passeridae	+	+	+
Euodice malabarica	Estrildidae	+	+	+
Saxicoloides fulicatus	Muscicapidae	+	+	+
Saxicola maurus	Muscicapidae	-	+	+
Copsychus saularis	Muscicapidae	+	+	+
Anthus rufulus	Motacillidae	-	+	+

Keys = (+) indicates presence and (-) indicates absence of species.

Table 3:- Temporal Variation of birds in Amba range during summer, rainy and winter season.

Scientific Names of Species	**Family**	**Summer**	**Rainy**	**Winter**
Pavo cristatus	Phasianidae	-	-	-
Ortygornis pondicerianus	Phasianidae	+	+	+
Anas poecilorhyncha	Anatidae	-	-	+
Dendrocygna javanica	Anatidae	-	-	-
Tadorna ferruginea	Anatidae	-	-	-
Anas crecca	Anatidae	-	-	-
Ocyceros birostris	Bucerotidae	-	-	-
Coracias benghalensis	Coraciidae	+	+	+
Halcyon smyrnensis	Alcedinidae	+	+	+
Aleedo atthis	Alcedinidae	-	+	-

Merops orientalis	Meropidae	-	+	+
Eudynamys scolopaceus	Cuculidae	-	-	-
Centropus sinensis	Cuculidae	+	+	+
Psittacula krameri	Psittacidae	+	+	+
Athene brama	Strigidae	-	-	+
Columba livia	Columbidae	+	+	+
Spilopelia senegalensis	Columbidae	+	+	+
Antigone antigone	Gruidae	-	-	-
Amaurornis phoenicurus	Rallidae	-	+	-
Fulica atra	Rallidae	-	-	-
Vanellus indicus	Charadriidae	+	+	+
Himantopus himantopus	Recurvirostridae	+	+	+
Milvus migrans	Accipitridae	+	+	+
Tachyspiza badia	Accipitridae	-	-	-
Tachybaptus ruficollis	Podicipedidae	-	-	-
Microcarbo niger	Phalacrocoracidae	-	-	-
Bubulcus ibis	Ardeidae	+	+	+
Ardea alba	Ardeidae	+	+	+
Ardea intermedia	Ardeidae	-	-	-
Ardeola grayii	Ardeidae	+	+	+
Threskiornis melanocephalus	Threskiornithidae	-	-	-
Dicrurus maerocercus	Dicruridae	+	+	+
Corvus macrorhynchos	Corvidae	+	+	+
Corvus splendens	Corvidae	+	+	+
Acridotheres tristis	Sturnidae	+	+	+
Sturnia pagodarum	Sturnidae	-	-	-
Pycnonotus cafer	Pycnonotidae	+	+	+
Argya striata	Leiothrichidae	+	+	+
Argya malcolmi	Leiothrichidae	+	+	+
Prinia socialis	Cisticolidae	+	+	+
Mirafra erythroptera	Alaudidae	+	+	+
Cinnyris asiaticus	Nectariniidae	+	+	+
Ploceus philippinus	Ploceidae	-	+	+
Passer domesticus	Passeridae	+	+	+
Euodice malabarica	Estrildidae	-	-	+
Saxicoloides fulicatus	Muscicapidae	+	+	+
Saxicola maurus	Muscicapidae	-	+	+

Copsychus saularis	Muscicapidae	+	+	+
Anthus rufulus	Motacillidae	+	+	+

Keys = (+) indicates presence and (-) indicates absence of species.

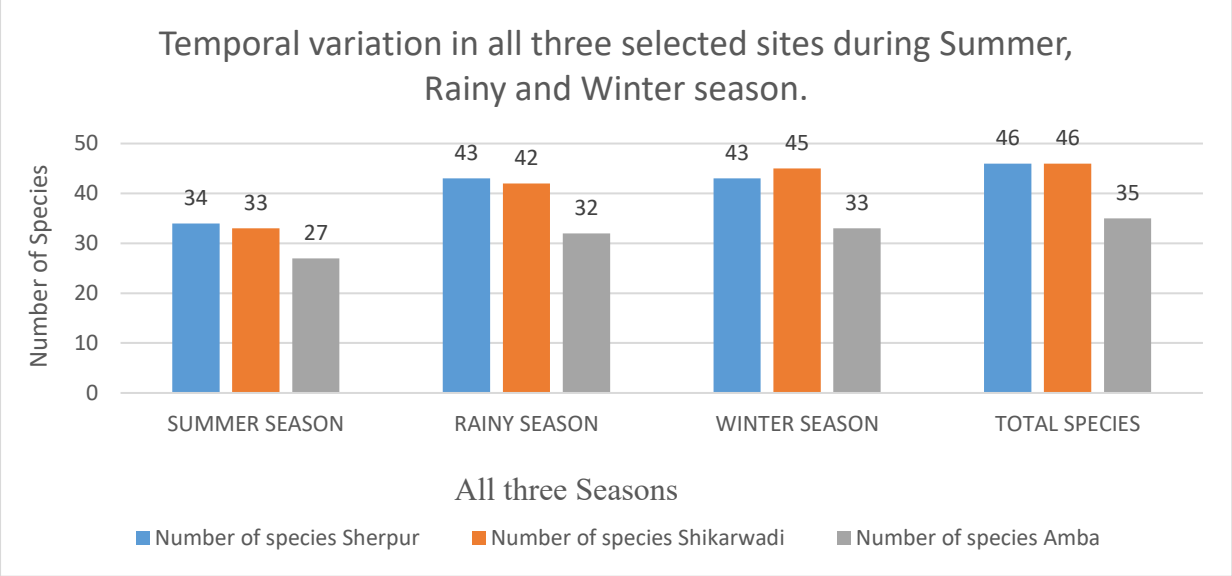

Figure 1:- Graphical representation of temporal variation in all three seasons in Sherpur, Shikarwadi and Amba range during April 2023 to March 2024

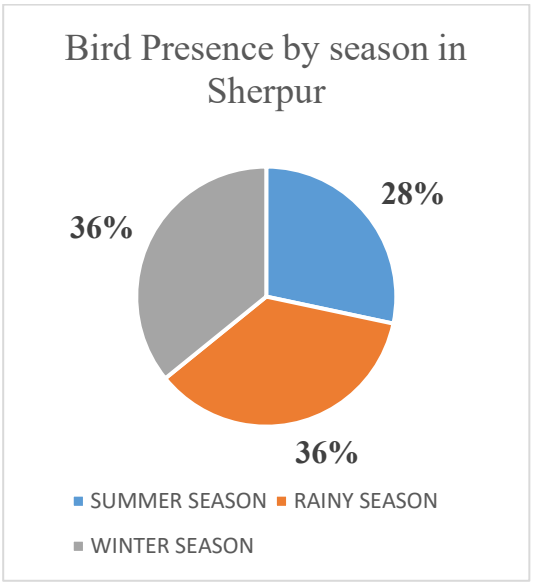

Figure 2:- Proportion of Bird Presence by season in Sherpur

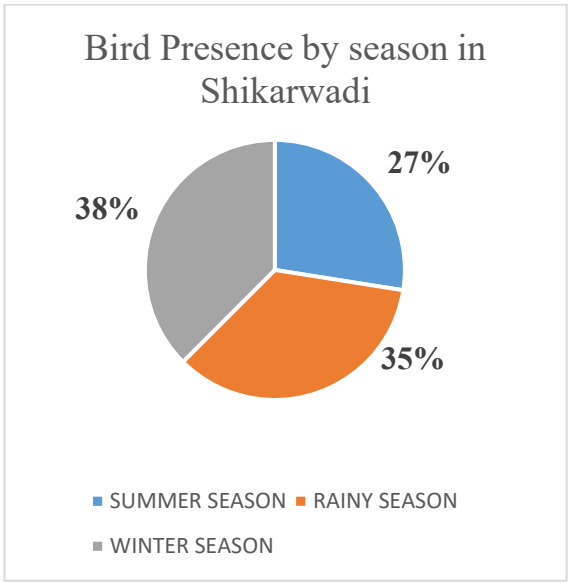

Figure 3:- Proportion of Bird Presence by season in Shikarwadi

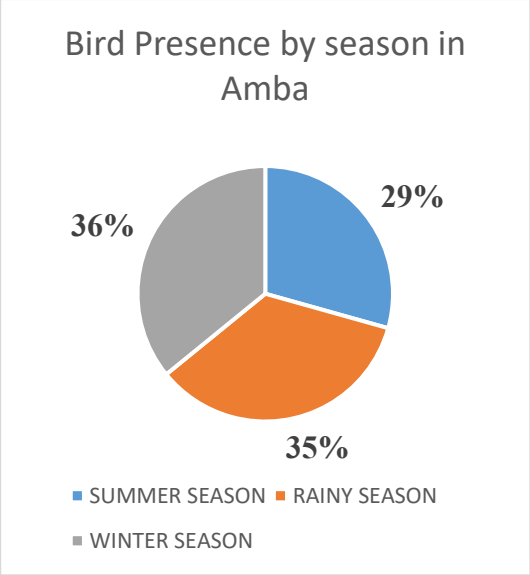

Figure4:- Proportion of Bird Presence by season in Amba

Discussions

In general, the results of this study imply that the area supports a number of bird species despite its small size. All the study sites vary in their area size; they also have distinct kinds of wetlands, grasslands, and agricultural fields. So, there is disparity in the distribution of birds among all three sites. This could be due to the presence of heterogeneous habitats making it unique for birds.

Sherpur, with its diverse habitat features, supported the highest diversity (Figure 1) of 46 species along with Shikarwadi, particularly during resource-rich seasons. Notably, species such as *Anas poecilorhyncha*, *Dendrocygna javanica* and *Antigone antigone* were consistently present in all seasons in sherpur, suggesting their adaptability to the habitat conditions. The seasonal availability of food and other resources affects the abundance of bird species, which is determined mainly by the vegetation structure and composition that is correlated with abundance and habitat use **(Waterhouse *et al.*, 2002).** The presence of several Anatidae (ducks, geese, swans) species across seasons, with potentially higher abundance during the rainy and winter seasons, suggests the presence of suitable aquatic habitats in Sherpur. The vegetation composition, being a major part of their habitat, influences the abundance of bird species. Again, the vegetation composition and structure are affected by rainfall patterns, which change between winter and rainy seasons. The availability of a bird species depends on the characteristic of the habitat, which is greatly influenced by vegetation changes along with geographical and environmental gradients **(Lee and Rotenberry, 2005).**The overall trendof sherpur suggest that water availability and seasonal vegetation play critical roles in influencing bird diversity. Migratory species such as *Anas crecca* and *Tadorna ferruginea* were

predominantly observed in winter, aligning with their known migratory behaviors to escape harsher climates. Resident species like *Coracias benghalensis* and *Pycnonotus cafer* exhibited consistent presence across seasons, indicating their adaptability to varying conditions. Different seasons play an important role in the diversity and distribution of birds as seasonality affects food and shelter availability, which impacts breeding success and ultimately the survival of bird species **(Mengesha and Bekele, 2008).**

Shikarwadi's agricultural and grazing lands, while moderately diverse, demonstrated seasonal dependence, with water bodies playing a pivotal role in attracting species during the rainy and winter seasons. As *Anas poecilorhyncha, Dendrocygna javanica, Amaurornis phoenicurus, Fulica atra, and Threskiornis melanocephalus where only present* during the rainy and winter seasons. This findings underscore the critical role of habitat and seasonal dynamics in shaping avian diversity and abundance. Also, Shikarwadi and Amba Range showed highest percentage of species in winter season with 38% and 36% respectively (Figure 3, Figure 4), while there was equal distribution of 36% each in rainy and winter in Sherpur range (Figure 2) which again was in line with the **(Joshi and Shrivastava, 2012)**that species richness (S=58) was highest during winter season in comparison to summer and rainy season. Family Ardeidae was dominant in both sherpur and shikarwadi throughout the summer, rainy and winter season with four species each of *Bubulcus ibis, Ardea alba, Ardea intermedia, and Ardeola grayii.*Which correlates well with the observation of**(Bhonsle*et al.*, 2019)**in whichArdeidaewas foundto be rich with 7 species and with the highest relative diversity (RD) index (RD value=8.8).

The Amba Range, characterized by relatively drier conditions, exhibited the lowest diversity, particularly during summer with just a mere presence of 27 bird species. The absence of certain species in summer, like in the Amba Range, suggests that high temperatures and dry conditions may not be suitable for all species. The low summer diversity may be linked to the drier conditions in this habitat, which might deter both resident and migratory species. Species such as *Merops orientalis* and *Anthus rufulus* were present during the rainy and winter seasons but absent in summer, further supporting the influence of seasonal resource availability. Seasonal movement patterns, habitat changes at local and regional levels, large-scale population changes, and climatic conditions could be the reasons for significant seasonal variation in the abundance of bird species **(Gaston *et al.*, 2000; Aynalem and Bekele, 2008;Gaur *et al.*, 2019).**

These results align with established ecological principles that emphasize the influence of habitat structure and seasonal variations on avian diversity. The presence of migratory species during specific seasons, such as *Anas crecca* predominantly observed during the winter season, reflects their migratory nature and underscores the importance of these habitats as critical stopover and wintering sites. The fundamental requirements of migratory birds in the wintering site include climate and a favorable habitat ensuring food availability and safety.

Conservation efforts should focus on maintaining habitat quality, particularly water resources, to support both resident and migratory bird populations.

Conclusion

The temporal variation in bird species across Sherpur, Shikarwadi, and Amba Range underscores the complex interplay between climate, habitat preference, migration, and human impact. The aim of the present study was to examine the fluctuation in the number of species with the change in seasons. The highest number of birds were recorded in Shikarwadi (45) in the winter season, and the least number were recorded in the Amba Range during the summer season (27). Thus, the present study highlights the activity of bird watching, conservation, awareness, and sustenance of avian diversity, especially promoting tourism in these spaces as it generates revenue, which is further used in maintenance and development. In conclusion, continued monitoring and research can provide further insights into these patterns, aiding in conservation efforts and habitat management strategies.

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Image 1 :- *Ardeola grayii*

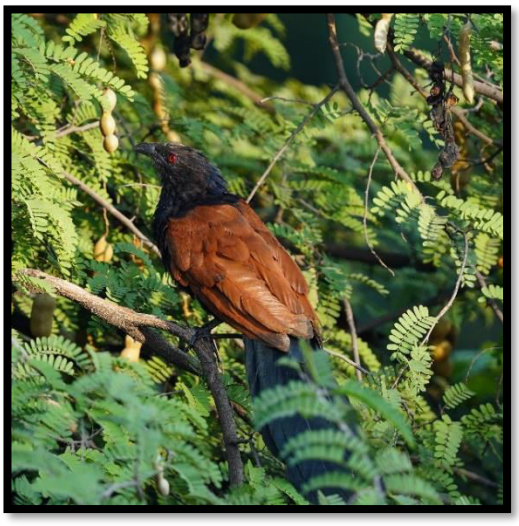

Image 2 :- *Centropus sinensis*

Image 3 :- *Pycnonotus cafer*

Image 4 :- *Halcyon smyrnensis*

Image 5 :- *Vanellus indicus*

Image 6 :- *Dicrurus maerocercus*

Image 7 :- *Eudynamys scolopaceus*

Image 8 :- *Coracias benghalensis*

Image 9 :- *Merops orientalis*

Image 10 :- *Acridotheres tristis*

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