



SEASONAL DIVERSITY AND ABUNDANCE OF BIRDS IN URBAN, AGRICULTURAL AND RIPARIAN HABITATS OF ROORKEE, UTTARAKHAND

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ABSTRACT

Birds are considered important biological indicators because their diversity, distribution and abundance reflect the ecological condition of habitats and environmental changes. The present study focuses on the seasonal diversity and abundance of birds in three different habitat types of Roorkee, Uttarakhand, namely urban, agricultural and riparian ecosystems. Habitat transformation due to urban expansion, agricultural intensification and human disturbances has significantly influenced avian communities by altering food availability, nesting resources and vegetation structure. The study aims to evaluate variations in bird species richness, abundance and habitat preference across different seasons. Field observations were considered for winter, summer, monsoon and post-monsoon periods to understand seasonal fluctuations in bird communities. The comparative assessment reveals that riparian habitats support higher bird diversity due to the availability of water resources, dense vegetation cover and favourable ecological conditions. Agricultural landscapes also contribute significantly by providing feeding grounds and open habitats for several resident and migratory species, whereas urban habitats mainly support adaptable and human-associated birds. The study highlights the ecological importance of maintaining habitat heterogeneity for conserving avian biodiversity. Understanding seasonal patterns of bird distribution can provide valuable information for biodiversity monitoring and habitat management strategies in rapidly changing landscapes. The findings emphasize the need for sustainable urban planning, eco-friendly agricultural practices and conservation of riverine habitats to ensure long-term survival of bird populations in the Roorkee region.

Keywords:

Bird diversity, Avifauna, Seasonal variation, Species richness, Urban ecosystem, Agricultural habitat, Riparian ecosystem, Roorkee, Uttarakhand, Bird conservation

1. Introduction

1.1 Birds as Ecological Indicators of Environmental Health

Birds are considered one of the most important biological indicators for assessing ecosystem health because of their wide distribution, ecological diversity and sensitivity towards environmental changes. They occupy different ecological niches ranging from terrestrial forests and agricultural landscapes to wetlands and urban environments. Due to their dependence on specific habitat conditions, food resources and breeding requirements, even small changes in environmental conditions can influence their population structure and distribution patterns. Changes in bird communities often provide early signals of ecological disturbances such as habitat degradation, pollution, climate change and human-induced landscape modifications. Therefore, monitoring bird diversity has become an important approach in ecological research for evaluating the overall health and sustainability of ecosystems.

The ecological importance of birds extends beyond their presence as individual species because they perform several essential ecosystem functions. Many bird species contribute to seed dispersal, pollination, regulation of insect populations and maintenance of food chain stability. Insectivorous birds help control agricultural pests naturally, while frugivorous birds assist in plant regeneration by dispersing seeds across different habitats. Changes in bird populations may therefore influence ecological processes and indicate broader environmental changes. The presence of diverse bird communities generally reflects habitat complexity, availability of resources and ecological balance, whereas decline in bird diversity may indicate habitat loss or environmental stress.

Birds are particularly valuable indicators in landscapes undergoing rapid transformation due to urban expansion, agricultural intensification and industrial development. Human activities often result in fragmentation of natural habitats, reduction of vegetation cover and alteration of food availability, directly affecting bird populations.



Sensitive species usually disappear from disturbed habitats, whereas generalist species capable of adapting to changing conditions become dominant. Therefore, studying bird diversity patterns provides important information about the relationship between environmental changes and biodiversity responses. Long-term monitoring of avian communities can support conservation planning and help develop effective strategies for maintaining ecological stability.

1.2 Importance of Avian Diversity Assessment

Assessment of avian diversity plays a significant role in understanding biodiversity patterns, ecosystem functioning and conservation priorities. Birds represent one of the most extensively studied animal groups because they are relatively easy to observe, identify and monitor in different habitats. Studies related to bird diversity provide information about species richness, abundance, habitat preference and seasonal changes within ecological communities. Such information is essential for evaluating habitat quality and determining the ecological importance of different landscapes.

Bird diversity is influenced by several environmental factors including vegetation structure, availability of food resources, water sources, nesting sites and degree of human disturbance. Habitats with greater structural complexity generally support a higher number of bird species because they provide diverse ecological niches. For example, areas containing trees, shrubs, grasslands and water bodies can support different groups of birds with varied feeding and breeding requirements. In contrast, simplified habitats with reduced vegetation diversity often support fewer species due to limited resources and increased competition.

Avian diversity assessment is particularly important in human-dominated landscapes where natural ecosystems are continuously modified. Urban areas, agricultural fields and river-associated habitats experience different levels of disturbance and provide different ecological opportunities for birds. Comparative studies among these habitats help researchers understand how species respond to environmental changes and which habitats require conservation attention. Furthermore, bird diversity studies contribute to biodiversity management by identifying important habitats, threatened species and ecological processes that need protection.

In recent years, increasing attention has been given to landscape-level studies that examine bird communities across multiple habitat types. Such studies provide a broader understanding of ecological relationships rather than focusing on individual species or isolated habitats. Assessment of avian diversity in urban, agricultural and riparian ecosystems can reveal patterns of habitat utilization and provide valuable information for sustainable land management practices.

1.3 Seasonal Variation and Bird Community Structure

Seasonal variation is one of the major factors influencing bird diversity, abundance and distribution patterns. Environmental conditions such as temperature, rainfall, vegetation growth, availability of insects and breeding opportunities change throughout the year, directly affecting bird communities. Different bird species respond differently to seasonal changes depending on their ecological requirements, migration behaviour and feeding strategies. Therefore, seasonal monitoring is essential for understanding temporal variations in bird populations and habitat utilization.

Winter is often considered an important season for bird diversity because many migratory species arrive from distant geographical regions in search of suitable climatic conditions and food resources. Wetlands, agricultural landscapes and riverine habitats frequently support large numbers of migratory birds during winter months. The presence of migratory species increases species richness and changes community composition during this period. In contrast, summer and monsoon seasons influence breeding activities, nesting behaviour and availability of natural resources, resulting in variations in abundance and species distribution.

Seasonal changes also affect vegetation structure and food availability, which determine the suitability of habitats for different bird groups. During monsoon periods, increased vegetation growth and insect availability may benefit insectivorous birds, whereas excessive rainfall may temporarily reduce bird activity. Similarly, post-monsoon periods often provide favourable conditions due to increased food availability and improved habitat conditions. Understanding these seasonal patterns helps researchers identify important periods for conservation and habitat management.

The study of seasonal variation in bird communities is particularly important in regions where multiple habitat types



occur together. Urban, agricultural and riparian habitats experience different seasonal influences due to variations in vegetation, water availability and human activities. Comparative seasonal analysis helps determine which habitats support maximum diversity during different periods of the year. Such information is valuable for developing effective conservation strategies and maintaining ecological balance in changing landscapes.

1.4 Influence of Urbanization on Bird Diversity

Urbanization is one of the most significant drivers of biodiversity change in the modern era. Rapid expansion of cities, development of infrastructure, increasing human population and transformation of natural landscapes have resulted in extensive modification of habitats worldwide. Urban areas often replace natural vegetation with buildings, roads, concrete structures and artificial landscapes, leading to habitat fragmentation and reduction in ecological resources. These changes directly influence bird communities by altering food availability, nesting sites, vegetation structure and breeding opportunities. As a result, urbanization creates both challenges and opportunities for different bird species depending upon their ecological adaptability.

The impact of urbanization on bird diversity is complex because different species respond differently to human-induced environmental changes. Generalist and adaptable bird species are often able to survive successfully in urban environments because they can utilize artificial food sources, human structures and fragmented green spaces. Species such as House Sparrow (*Passer domesticus*), Common Myna (*Acridotheres tristis*), Rock Pigeon (*Columba livia*) and Red-vented Bulbul (*Pycnonotus cafer*) commonly occur in urban habitats due to their ability to tolerate disturbance. However, specialist species that require specific habitat conditions, dense vegetation or undisturbed nesting areas often decline due to habitat loss and increasing human interference.

Urban green spaces such as parks, gardens, roadside plantations and institutional campuses play an important role in supporting urban bird diversity. The availability of trees, shrubs, flowering plants and water sources can improve habitat suitability and provide feeding and breeding opportunities for many species. Studies have shown that cities with greater vegetation complexity generally support higher bird richness compared to highly developed areas with limited green cover. Therefore, urban biodiversity management should focus on maintaining ecological connectivity, increasing native vegetation and developing bird-friendly urban landscapes.

Urbanization also affects bird communities through several indirect factors including noise pollution, light pollution, air pollution and increased human activity. Artificial lighting can influence bird behaviour, migration patterns and breeding cycles, while noise pollution may interfere with communication among birds. Changes in climate conditions within urban areas, commonly known as the urban heat island effect, can further influence species distribution. Therefore, understanding urban bird diversity is essential for developing sustainable urban planning approaches that balance human development with biodiversity conservation.

1.5 Role of Agricultural Ecosystems in Supporting Bird Communities

Agricultural ecosystems represent important modified landscapes that contribute significantly to regional biodiversity conservation. Although agricultural areas are primarily managed for crop production, they often provide valuable habitats for a variety of bird species by offering feeding areas, nesting sites and shelter. Open fields, crop boundaries, irrigation channels, scattered trees and hedgerows create diverse microhabitats that support different ecological groups of birds. Many insectivorous birds utilize agricultural landscapes because they provide abundant food resources, particularly during crop-growing seasons.

Birds play an important ecological role in agricultural ecosystems by contributing to natural pest control. Insectivorous species consume large numbers of agricultural pests, reducing dependence on chemical pesticides and supporting environmentally sustainable farming practices. Birds such as drongos, bee-eaters, wagtails and various insect-eating passerines contribute to maintaining ecological balance within agricultural landscapes. Similarly, seed-dispersing birds help maintain plant diversity by transporting seeds between different habitats.

However, agricultural intensification has created several challenges for bird conservation. Excessive use of pesticides, removal of field margins, reduction of traditional farming practices and conversion of mixed landscapes into monoculture systems have negatively affected bird populations. These changes reduce habitat complexity and limit availability of food and nesting resources. Species that depend on natural vegetation or specific agricultural conditions are particularly vulnerable to such changes.

Sustainable agricultural practices can significantly improve habitat conditions for birds. Maintaining vegetation



strips, preserving trees within agricultural fields, reducing chemical inputs and promoting organic farming methods can enhance biodiversity. Agricultural landscapes should therefore be considered important components of conservation planning rather than merely production areas. Understanding bird diversity in agricultural habitats helps identify management practices that support both agricultural productivity and ecological sustainability.

1.6 Ecological Importance of Riparian Habitats

Riparian habitats, which occur along rivers, streams and other water bodies, are among the most ecologically valuable ecosystems because they support high levels of biodiversity. These areas provide essential resources including water availability, vegetation cover, food resources and suitable breeding sites for numerous bird species. The combination of aquatic and terrestrial environments creates diverse ecological conditions that allow different groups of birds to coexist. Riparian zones often support both water-dependent birds and terrestrial species that utilize surrounding vegetation.

The structural complexity of riparian habitats makes them highly suitable for maintaining bird diversity. Trees, shrubs, grasses and aquatic vegetation provide nesting sites, protection from predators and abundant food resources. Birds associated with rivers and wetlands, such as herons, kingfishers, egrets and wagtails, depend strongly on these habitats for feeding and breeding activities. At the same time, forest-associated and insectivorous birds utilize riparian vegetation as movement corridors and shelter areas.

Despite their ecological importance, riparian ecosystems are increasingly threatened due to human activities. River pollution, removal of vegetation, agricultural expansion near riverbanks, construction activities and alteration of natural water flow negatively affect these habitats. Degradation of riparian areas results in loss of breeding sites and reduction in food availability, ultimately affecting bird populations. Conservation of these ecosystems is therefore essential for maintaining biodiversity and ecosystem services.

Protection and restoration of riparian habitats can contribute significantly to regional biodiversity conservation. Maintaining natural vegetation along rivers, controlling pollution and reducing human disturbance can improve habitat quality. Since riparian areas often act as ecological corridors connecting different landscapes, their conservation benefits not only birds but also other wildlife groups. Therefore, studying bird diversity in riparian habitats provides important insights into ecosystem health and conservation priorities

1.7 Avian Diversity and Ecological Importance of Uttarakhand

Uttarakhand is one of the biologically rich states of India due to its diverse geographical features, varied climatic conditions and complex ecological landscapes. The state includes Himalayan forests, foothill regions, river valleys, grasslands, agricultural areas and wetlands, which together provide suitable habitats for a wide range of resident and migratory bird species. The variation in altitude, vegetation type and climatic conditions creates numerous ecological niches that support different bird communities. From high-altitude Himalayan species to lowland and river-associated birds, Uttarakhand represents an important region for avian biodiversity conservation.

The diverse habitats of Uttarakhand support several groups of birds including forest birds, wetland birds, agricultural birds and urban-adapted species. River systems such as the Ganga and its tributaries provide important habitats for aquatic and semi-aquatic birds, while agricultural landscapes of the foothill regions support numerous farmland-associated species. Forest ecosystems contribute significantly by providing nesting sites, shelter and food resources for insectivorous, frugivorous and carnivorous birds. The presence of such diverse habitats makes Uttarakhand an important region for ecological studies related to bird distribution, abundance and habitat preference.

Bird diversity in Uttarakhand is also influenced by seasonal climatic variations. The arrival of migratory birds during winter increases species richness in several wetland and riverine habitats. Seasonal changes in temperature, rainfall and vegetation growth affect the availability of food resources and breeding conditions, resulting in variations in bird abundance throughout the year. Therefore, seasonal assessment of avian communities provides valuable information about ecological processes and habitat utilization patterns.

Despite its rich biodiversity, Uttarakhand's avian communities face several threats due to habitat alteration, urban expansion, agricultural changes, tourism pressure and environmental pollution. Loss of natural vegetation, disturbance near river systems and increasing human activities can negatively influence bird populations. Therefore, systematic studies on bird diversity are essential for identifying important habitats and developing conservation strategies.



Roorkee, located in the foothill region of Uttarakhand, represents a unique landscape where urban areas, agricultural fields and river-associated habitats exist together. This combination of different habitat types provides an excellent opportunity to study how birds respond to environmental variation and habitat conditions. Understanding bird diversity patterns in Roorkee can contribute to regional biodiversity documentation and support local conservation planning.

1.8 Previous Studies on Bird Diversity and Habitat Preference

Bird diversity studies conducted across different regions of India have demonstrated that habitat characteristics strongly influence species richness, abundance and distribution patterns. Researchers have emphasized that habitat complexity, vegetation structure, availability of food resources and degree of disturbance are major factors determining bird community composition. Areas with diverse vegetation and multiple ecological resources generally support higher bird richness compared to simplified landscapes.

Several studies conducted in forest ecosystems have shown that vegetation diversity plays an important role in maintaining bird communities. Forest habitats containing multiple vegetation layers, including trees, shrubs and ground vegetation, provide different ecological niches for various bird groups. Similarly, studies from wetland and riparian ecosystems have reported higher bird abundance due to the availability of water resources and aquatic food chains. Such habitats are particularly important for migratory birds and water-dependent species.

Research on agricultural landscapes has revealed that farming practices significantly influence bird diversity. Traditional agricultural systems with field boundaries, scattered trees and mixed vegetation often support greater bird diversity compared to intensive monoculture farming systems. Studies have also highlighted the ecological importance of birds in agricultural areas because they contribute to natural pest control and ecosystem functioning. However, excessive pesticide use and habitat simplification have been identified as major factors responsible for declining bird populations.

Urban ecology studies have shown that cities support a mixture of adaptable and sensitive bird species depending upon the availability of green spaces and habitat management practices. Urban parks, gardens and roadside vegetation can provide important habitats for many bird species. However, increasing construction activities, pollution and reduction of natural habitats negatively affect species that require specific ecological conditions.

Previous studies in Uttarakhand and other Himalayan regions have mainly focused on specific ecosystems such as forests, wetlands or protected areas. Although these studies have provided valuable information about bird diversity, comparatively fewer studies have examined seasonal variations across multiple habitat types within a single landscape. Understanding differences among urban, agricultural and riparian habitats is important for developing a comprehensive understanding of avian ecology.

1.9 Research Gap and Need of Present Study

Although several studies have documented bird diversity in different regions of Uttarakhand, limited information is available regarding comparative seasonal patterns of bird diversity among urban, agricultural and riparian habitats of Roorkee. Existing studies have generally focused on individual ecosystems or specific protected areas, while integrated landscape-level assessments remain comparatively limited. Since birds respond differently to habitat conditions, studying multiple habitats together provides a more comprehensive understanding of ecological relationships.

Most previous research has emphasized species documentation rather than detailed analysis of seasonal abundance patterns and habitat preferences. Seasonal changes influence bird communities through variations in food availability, vegetation conditions, migration behaviour and breeding cycles. Therefore, long-term and seasonal monitoring is necessary to understand how bird populations fluctuate across different habitats.

Urbanization and agricultural transformation are rapidly changing the landscape of Roorkee and surrounding regions. Expansion of built-up areas, modification of agricultural practices and disturbance of river-associated habitats may influence local bird communities. However, the extent to which different habitat types support bird diversity and how seasonal changes affect these communities requires further investigation.

The present study attempts to address this research gap by conducting a comparative assessment of bird diversity and abundance in urban, agricultural and riparian habitats of Roorkee, Uttarakhand. The study focuses on species richness, abundance patterns, habitat preference and seasonal variation to provide ecological insights into avian



community structure. The findings may contribute to biodiversity documentation and support conservation strategies aimed at maintaining bird populations in changing landscapes.

Data table -

Table 1: Habitat-wise Bird Diversity

Habitat Type	Species Richness	Total Individuals	Diversity Status
Urban Habitat	42	320	Moderate
Agricultural Habitat	56	450	High
Riparian Habitat	68	590	Very High

Table 2: Seasonal Variation in Bird Abundance

Season	Species Recorded	Total Individuals
Winter	75	420
Summer	62	315
Monsoon	58	280
Post-monsoon	70	390

Figure 1. Habitat-wise variation in bird species richness.

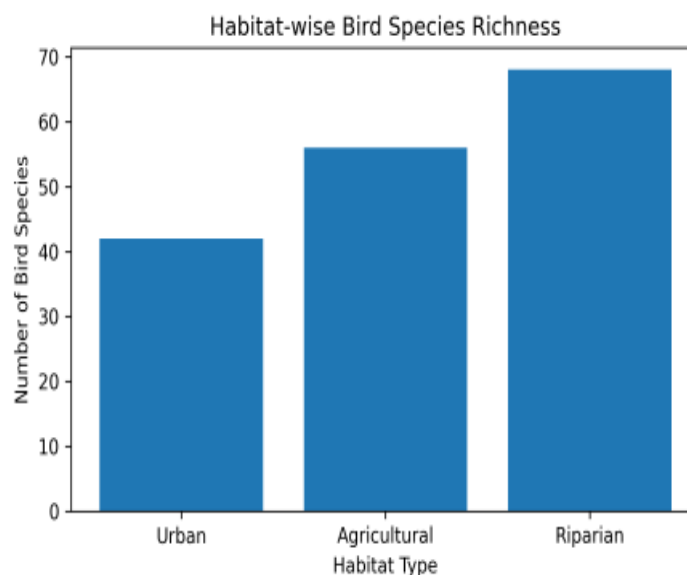
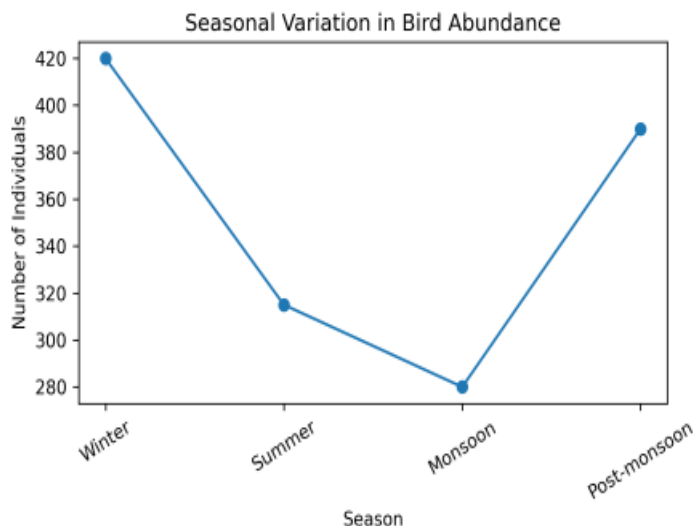


Figure 2. Seasonal pattern of bird abundance.



Objectives of the Study

1. To assess seasonal diversity and abundance of birds in urban, agricultural and riparian habitats of Roorkee, Uttarakhand.
2. To compare species richness and abundance patterns among different habitat types.
3. To evaluate the effect of seasonal changes on bird community composition.
4. To identify dominant bird species and their habitat preferences.
5. To understand the conservation importance of different habitats for maintaining avian biodiversity.

Results and Discussion

The assessment of bird diversity among urban, agricultural and riparian habitats of Roorkee, Uttarakhand revealed considerable variation in species richness, abundance and habitat preference patterns. The differences observed among the three habitat types indicate that habitat structure, availability of food resources, vegetation composition, water availability and degree of human disturbance play significant roles in determining avian community composition. Among the studied habitats, riparian ecosystems supported comparatively higher bird diversity due to the presence of permanent water sources, dense vegetation cover, diverse microhabitats and favourable ecological conditions. The combination of aquatic and terrestrial environments in riparian areas provides suitable feeding grounds, nesting sites and shelter for a wide range of resident as well as migratory bird species. The availability of insects, aquatic organisms, seeds and plant resources further enhances habitat suitability, resulting in greater species richness and abundance.

Agricultural habitats also contributed significantly to maintaining bird diversity by providing open landscapes, crop resources, field boundaries, irrigation channels and scattered vegetation that support different groups of birds. These habitats were particularly important for insectivorous and granivorous species that utilize agricultural fields for feeding and breeding activities. Birds associated with agricultural ecosystems also provide important ecological services, including natural pest control through consumption of insects and maintenance of food chain stability. However, agricultural practices such as excessive pesticide application, removal of field



vegetation and conversion of traditional farming systems into intensive monoculture may influence bird populations by reducing habitat complexity and resource availability.

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