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Research Paper

Assessing the Ecological Roles and Contributions of Avian Diversity in Forest Ecosystems of Jharkhand

Daisy Seva ¹, Iram Fatima ², Dr. Madhumita Pandey ^{3*}

¹ Ph.D. Scholar, Department of Life Science, Netaji Subhas University, Jamshedpur, Jharkhand, India

² Assistant Professor, Department of Zoology, Netaji Subhas University, Jamshedpur, Jharkhand, India

³ Assistant Professor, Department of Life Science, Netaji Subhas University, Jamshedpur, Jharkhand, India

Corresponding Author: * Dr. Madhumita Pandey

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ABSTRACT

Birds are some of the most diverse and ecologically important groups of vertebrates in the forests. They help in seed dispersal, pollination, pest regulation, scavenging, and decomposition of organic matter. Jharkhand is located on the Chota Nagpur Plateau. It comprises vast areas of tropical dry and moist deciduous forests with Sal (*Shorea robusta*) as dominant trees and bamboo, rivers, and grasslands providing habitats for a great variety of birds. This review covers current literature about the diversity of birds in different major forests of Jharkhand like Saranda, Dalma, Palamu, Betla, and Hazaribagh, with the aim of evaluating the ecological functions that the avian assemblages fulfill and their importance to the regeneration and stabilization of the forests and bioindicator value of habitat quality. This review also includes discussions on the human-related threats to the avian community and associated ecosystem services that arise from activities like mining, deforestation, forest fragmentation, and hunting.

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1. INTRODUCTION

Forest ecosystems are shaped by complex networks of biotic interactions in which birds occupy a particularly influential position. In addition to having conservation importance in themselves, birds provide a variety of ecosystem services such as seed dispersal, pollination, insect control, scavenging, and nutrient cycling that contribute to the forest structure and its ability to regenerate (Sekercioglu, 2006; Whelan et al., 2015). These roles of birds in the ecosystem are termed avian ecosystem services, which is an area of growing interest for tropical forests since it is becoming apparent that even functionally redundant species loss impacts forest functioning (Sodhi et al., 2011).

The state of Jharkhand is situated on the Chota Nagpur Plateau, which features undulating topography, laterite soil and a climate conducive to large areas of tropical dry deciduous and moist deciduous forests. The forest area of Jharkhand, which includes divisions like Saranda, Palamu, Dalma, Betla and Hazaribagh, constitutes one of the important forest reserves dominated by Sal forests in Eastern India. Such forests are ecologically important and come under severe developmental stress because Jharkhand is one of the mineral resource rich states in India, with large coal, iron and bauxite deposits within and around the forests (Wildlife Institute of India, 2020).

In spite of the ecological and economic value of such forests, the birds of Jharkhand have not been the subject of much scientific research in comparison to better-known forest systems like those found in the Western Ghats, in the Himalayan foothills, and in Central India. Existing studies tend to focus on species inventories and checklists rather than on the functional ecological roles that avian communities perform within these ecosystems (Jha & Kumar, 2018; Kumar & Gupta, 2016). Existing studies tend to focus on species inventories and checklists rather than on the functional ecological roles that avian communities perform within these ecosystems (Jha & Kumar, 2018; Kumar & Gupta, 2016). This represents a significant gap, since understanding the functional contributions of avian diversity is essential for designing conservation strategies that protect not just species richness but the ecological processes that sustain forest health.

This review addresses that gap by synthesizing available literature to (a) characterize the avian diversity present in Jharkhand's principal forest ecosystems, (b) assess the specific ecological roles that different avian functional guilds perform within these forests, (c) evaluate the broader ecosystem service contributions of avian diversity to forest regeneration and stability, and (d) examine the anthropogenic threats facing avian communities and the conservation measures needed to mitigate them. By framing avian diversity through a functional ecology lens, this review aims to strengthen the evidence base for integrating bird conservation into broader forest management strategies in Jharkhand.

2. Avian Diversity in Jharkhand's Forest Ecosystems

Jharkhand has several hundred birds inhabiting its various categories of protected and reserved forests. The Betla National

Park and the adjacent Palamu Tiger Reserve have a very diverse community of birds that include raptors, woodpeckers, babblers, and many others that live on the forest floor and under the canopy of Sal forests. This area has been the most extensively surveyed part of Jharkhand and it has several birds living within it (Kumar & Gupta, 2016). There is also Dalma Wildlife Sanctuary situated near Jamshedpur which has a diverse community of birds living in its hills forest because of the variety of microhabitats provided to it by the forest, scrub, and grassy patches.

The Saranda Forest division, which is often referred to as one of the largest continuous blocks of Sal Forest in Asia, is an especially significant block for forest interior birds that are sensitive to disturbances in the canopy layer. At the same time, Saranda is one of the most mined regions in the state of Jharkhand, posing an opposition between the ecological significance and economic exploitation of the region with a direct bearing on the bird species in the area (Wildlife Institute of India, 2020). Hazaribagh's forest and wildlife sanctuary areas, though smaller in extent, contribute additional habitat heterogeneity through their plateau topography and mixed forest-grassland interface, supporting species that favor open-canopy and edge habitats.

In such landscapes, the species richness and community structure of birds is strongly affected by the vegetation structure. Bird communities in multilayered forest ecosystems having intact canopy, sub-canopy, and understory layers are more diverse and comprise a higher percentage of forest specialists than those found in degraded forests, plantations, or areas under heavy logging which are dominated by generalists and edge-tolerant species (Jha & Kumar, 2018). This phenomenon is consistent with the results of tropical forest studies which show that structural complexity is an important factor influencing bird community structure (Grimmett et al., 2011).

Seasonal changes are equally significant in determining the composition of avifauna in Jharkhand's forests. The influx of winter migrants, such as different types of warblers, thrushes, and waterfowls in habitats adjacent to rivers and wetlands, leads to an increase in the number of species, whereas the breeding season leads to increased activities by resident species, which are involved in establishing territories, building nests, and raising their offspring. Seasonality is relevant in terms of the ecosystem roles performed by the birds, as reproduction and migration periods overlap with the period of maximum food availability in the forest.

3. Ecological Roles of Avian Diversity

Ecological functions performed by avian communities can be classified into a few different functional roles which are carried out by separate, albeit often overlapping, guilds of species. They are listed below in Table 1.

3.1 Seed Dispersal and Forest Regeneration

Frugivorous birds like hornbills, barbets, bulbuls, and green pigeons feed on fleshy fruits of various species of forest trees

and disperse the seeds of the plants over distances through their movements. This is especially important in fragmented or disturbed forest patches, where there could be loss of mammals like civets and primates that serve as seed dispersal agents for these forests, thus making the frugivorous birds the primary agents of seed dispersal over long distances (Sekercioglu, 2006). Frugivory of birds in the Sal-dominated forests of Jharkhand ensures seed dispersal from the fruits of canopy and sub-canopy fruiting trees. Such an aspect of seed dispersal ensures the regeneration process of the forest in the absence of natural regeneration around the parent trees only. Such a role of seed dispersal helps in promoting gene flow among distant tree populations due to mining and deforestation activities.

The extinction of large frugivores like hornbills may have a major impact on the seed dispersal of large-seeded trees whose seeds cannot be consumed by smaller frugivores. The result would be a filtering of the species composition in favor of smaller-seeded trees over time and at the cost of large-seeded trees because the latter require special dispersers. Keeping all species of frugivorous birds, starting with the large hornbill down to small bulbuls, is essential for the conservation of Jharkhand's forests.

3.2 Pollination

The nectar-feeding birds, primarily sunbirds and flowerpeckers, help in the pollination of many species of flowering trees, shrubs, and lianas in Jharkhand forests. While the insects are predominantly involved in pollination activities in tropical forests, there are some plant species that rely on bird pollination or ornithophily because their flowers have developed special characteristics like the formation of tubular corollas and abundant nectar production, which is especially suited for bird pollination. Plant-bird pollination may also be highly specific, and hence, the loss of specific types of sunbirds would negatively impact the reproduction of the plants depending upon them.

Bird-pollination services have further links to forest phenology as well. The blooming period for a number of plants in Sal and mixed deciduous forests happens within particular seasons, and synchronicity of blooming periods and nectar-feeding birds such as resident bird species as well as migrating individuals is important for successful pollination to happen. Disruption in this synchronization process, which can be caused by climate change or destruction of habitats leading to decreased availability of nectar sources, can affect reproductive success of plant species.

3.3 Insect Pest Regulation

The insectivorous bird species, which includes the drongos, flycatchers, warblers, woodpeckers, and bee-eaters, contribute significantly to the suppression of insect populations in forest environments. The predation acts by limiting any outbreak of defoliators like caterpillars, wood-boring beetles, and other harmful insects whose unchecked existence may have dire consequences on the well-being and growth rates of the trees. It is the duty of the woodpecker to control the larval population of wood-boring insects that bore into tree bark and trunks, an

activity that cannot be easily accomplished by other groups of vertebrates due to their unique morphological adaptations.

The pest regulation services offered by insect-eating birds not only have ecological value but also economic value because an outbreak of insects may lead to a decline in the productivity of forest patches and may even affect the neighboring farmland in certain cases because insects could escape from the forest and reach the farmland. The importance of this regulatory service is clear from past research conducted in other tropical forest ecosystems which found that exclusion of insectivorous birds caused higher levels of damage to vegetation (Whelan et al., 2015).

3.4 Scavenging and Nutrient Cycling

Vultures along with other scavenger birds have served a vital function in removing carcasses quickly from Indian forest and grassland environments by reducing diseases caused by decaying animal remains, as well as returning nutrients to the soil and vegetation. But there has been a drastic reduction in the number of vultures in India, including in the state of Jharkhand, since the 1990s, owing to their poisoning by diclofenac and similar NSAIDs used for treating livestock, which are harmful to vultures when ingested (Ali & Ripley, 1987; BirdLife International, 2023).

This decline has left a substantial gap in the scavenging function within Jharkhand's forest and forest-edge ecosystems, with smaller scavengers such as kites and crows only partially compensating for the loss of vulture-mediated carcass removal. The reduced efficiency of carcass disposal has implications not only for nutrient cycling but also for disease dynamics, since slower decomposition processes can extend the window during which pathogens associated with carrion remain active within the local environment. Restoring vulture populations, where feasible through controlled breeding and release programs combined with continued restrictions on harmful veterinary drugs, represents an important, though currently underdeveloped, conservation priority for the region.

3.5 Bioindication of Forest Health

Apart from serving as bioindicators of their specific functional roles in the forest ecosystem, avian populations also play a significant role as bioindicators of habitat quality and environmental status. Specialist birds of the forest interior, which require uninterrupted canopy cover, particular undergrowth composition, or specific microhabitats, are extremely sensitive to any disturbances in their habitat and are likely to go extinct very soon after habitat fragmentation or deforestation. In contrast, generalist birds are known to thrive in conditions of habitat change and fragmentation; hence, the change in ratio between specialist and generalist bird species is a very useful indicator of changes in the condition of the habitat long before any obvious evidence such as canopy loss and soil erosion (Grimmett et al., 2011; Manakadan & Pittie, 2001). In Jharkhand's context, monitoring populations of forest-interior species such as certain woodpeckers, babblers, and owlets across Saranda, Palamu, and Dalma could provide a relatively cost-

effective means of tracking the cumulative ecological impact of mining, logging, and fragmentation over time, complementing

more resource-intensive remote sensing and vegetation survey methods.

Table 1: Major avian functional guilds and their ecological roles in Jharkhand forests

Functional Guild	Representative Species (Jharkhand forests)	Primary Ecological Role
Frugivores/Seed dispersers	Hornbills, barbets, bulbuls, green pigeons, mynas	Long-distance seed dispersal; regeneration of Sal and mixed deciduous forest stands
Nectarivores/Pollinators	Purple sunbird, purple-rumped sunbird, flowerpeckers	Pollination of flowering trees, shrubs, and lianas
Insectivores	Drongos, flycatchers, warblers, woodpeckers, bee-eaters	Natural pest control; regulation of forest insect populations and outbreaks
Raptors/Scavengers	Vultures, kites, eagles, owls	Carcass removal, nutrient cycling, top-down regulation of prey populations
Indicator/Habitat specialists	Hill myna, woodpeckers, forest babblers, owlets	Bioindicators of forest health, canopy continuity, and habitat quality

4. Contributions to Forest Ecosystem Services

The combined roles of Jharkhand's avifaunal ecosystem contribute towards providing a set of tangible ecosystem services that relate directly to the productivity of forests, conservation of biodiversity, and well-being of human beings. Improved seed dispersion for forest regeneration ensures the long-term structural stability of Sal and mixed deciduous forests and aids in regulating microclimate conditions, moisture retention of soil, and water cycles in the forest. Insect pest control as a result of activities carried out by insect-eating birds helps to support the growth of trees and, as a consequence, their timber as well as non-timber forest products that provide sustenance and economic value to many forest-based communities in Jharkhand (Wildlife Institute of India, 2020).

The role of pollination in reproduction and the maintenance of genetic diversity in forest plant species, along with scavenging by vultures in places where their population survives or is being brought back, facilitates regulation of disease and recycling of nutrients, which is beneficial not only for the wildlife but for the human settlements that exist near forest regions. The biological indicator role performed by bird populations also offers forest managers an easy way to monitor ecosystem health.

However, such services provided by birds are interdependent on each other rather than mutually exclusive. The regeneration capacity provided by the seed dispersers depends partially on the pollination activity facilitated by nectarivores, because only when plants have been successfully pollinated can they produce fruits that the frugivores will then distribute to other places. In a similar fashion, the structural complexity provided through successful regeneration is what gives rise to the conditions in which insectivores and forest specialists may thrive.

5. Threats to Avian Diversity and Conservation Implications

The forests in Jharkhand are being subjected to persistent and increasing anthropogenic impacts, which have repercussions on the birds and their ecological roles within these ecosystems. The mining process, including coal and iron ore, is arguably one of the most critical causes of habitat destruction, especially in areas like Saranda, where forest land is turned into open-pit sites through the mining process and is further subjected to pollution, dust deposition, and change in hydrology, despite lying outside the actual mining area (Wildlife Institute of India, 2020).

Deforestation caused by mining activities, road construction, agriculture, and settlements breaks up forest areas into disconnected islands. Forest fragmentation reduces the available habitat for birds living in forests while making connectivity difficult for seasonal migration and dispersal. Small and fragmented forest habitats generally contain lower species diversity and different compositions when compared to large forest habitats, especially forest specialists and large birds (Jha & Kumar, 2018; Sodhi et al., 2011).

The activities of selective felling and the replacement of structurally heterogeneous Sal Forest with homogenous plantation stands also impact the quality of bird habitat in a negative way because they lower its vertical and horizontal heterogeneity, which provides different types of habitats for various bird species. Poaching and hunting, although assumed to be on the decline everywhere thanks to the increased protection from poachers, still have an effect on particular birds, mostly large ones. All these issues are complicated by the lack of long-term data on birds in Jharkhand, making the assessment of their conservation status difficult.

A comprehensive conservation strategy is required to address these challenges. Improvement in the management of protected areas and enforcement of buffer zone policies in relation to active and proposed mining leases will help in restricting the expansion of habitat loss in critical bird habitat such as Saranda. Creation of habitat corridors through protected and community-conserved forests between fragmented forest patches, such as connecting Saranda, Dalma, and Palamu through protected/community conserved forests patches, will help in providing connectivity that will allow sustaining viable populations of forest interior species. Silviculture of mixed species with lesser use of clear felling will help in conserving habitat structural complexity, which will support different bird communities. Awareness and livelihood improvement programs at the community level will help in reducing hunting pressures on the birds by addressing the socio-economic reasons for illegal trapping. Lastly, the establishment of systematic bird monitoring programs with standard methodologies such as point counts or transects will help in developing an evidence base for future conservation efforts.

Table 2: The important threats to avian diversity in Jharkhand forests and recommended conservation responses

Major Threat	Recommended Conservation Response
Deforestation and mining expansion	Strengthen protected area networks; enforce buffer-zone regulations around mining leases
Forest fragmentation	Establish habitat corridors linking fragmented patches (e.g., Saranda, Dalma, Palamu)
Loss of Sal-dominated canopy structure	Promote mixed-species silviculture and reduced clear-felling practices
Hunting and illegal trapping	Community-based awareness programs; stricter enforcement of Wildlife Protection Act provisions
Limited long-term monitoring data	Establish systematic, long-term avian monitoring programs using standardized point-count methods

6. DISCUSSION

It is clear from the evidence gathered in this review that the avian diversity in the forests of Jharkhand is not merely an indicator of biological value, but rather an important ecological factor in terms of its significance to the processes of forest regeneration, pest control, pollination efficiency, nutrient recycling, and forest health evaluation. From the functional point of view, conservation of birds in Jharkhand goes beyond mere protection of the bird species and involves preservation of important ecological processes with impacts on the productivity of the forest and the well-being of people depending on it. On the other hand, it becomes evident from the review that there exists a certain gap between the extent of the anthropogenic pressure affecting Jharkhand's forests, especially in relation to mining and the corresponding infrastructure development, and the existing research on the functional role of avian life in the region. The vast majority of published research work is mainly focused on the provision of species inventories and their distributional records instead of providing measurements of the actual functional contribution of the birds in question to forest ecosystems. Research which will directly measure the functional contribution of particular guilds of birds in forests of Jharkhand would provide additional scientific grounds for inclusion of avian conservation measures in forest and mining impact management. The example of vultures' decline is especially indicative in terms of the disproportional impacts of loss of a particular functional guild which persist long even after the cause of that problem has been mitigated, i.e. veterinary diclofenac has been banned. It means that conservation measures related to functional guilds of birds should be expected to last long and require active approach in form of captive breeding and releases.

7. CONCLUSION

The avifaunal community in the forest ecosystems of Jharkhand is involved in performing various ecological functions such as seed dispersal, pollination, pest regulation, scavenging, and bioindicator activities to ensure the regeneration, integrity, and sustainability of the forest ecosystem. The forests of Saranda, Dalma, Palamu, Betla, and Hazaribagh host an avifauna that is diverse and functionally important, but the diversity is under constant threat due to mining activities, deforestation, forest fragmentation, and, to some extent, hunting. Continuous reduction in the habitat will not only affect the diversity of the avifaunal community in the forests of Jharkhand, but also the functions they perform in ensuring the ecological processes of the forest ecosystem. Conservation of the biodiversity and ecological process of the forest ecosystem requires improvement

in management of the protected areas, habitat connectivity, promotion of structural diversity in silviculture, and establishment of a long-term avian monitoring program. Research work quantifying the functional roles of different avian guilds in the forest ecosystem of Jharkhand will provide valuable information for conservation and management of forests.

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