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Avian Diversity and Foraging Guild Structure in Agricultural and Peri-Urban Landscapes of Chintamani Taluk, Karnataka

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1. Abstract

Agricultural and peri-urban landscapes are rapidly expanding, transforming natural habitats and impacting avian communities. This study assessed avian diversity and foraging guild structure across three distinct habitat types (intensive agricultural, mixed agricultural-garden, and peri-urban residential) in Chintamani Taluk, Karnataka, during 2014. Point count method was employed monthly from January to November. A total of 97 bird species from 32 families were recorded. Species richness and diversity were highest in mixed agricultural-garden habitats, followed by peri-urban areas, and lowest in intensive agricultural fields. Insectivorous and granivorous guilds dominated all sites, but omnivores and frugivores showed higher representation in more complex habitats. The study highlights the role of habitat heterogeneity and availability of diverse food resources in supporting avian diversity in human-modified landscapes. Conservation efforts should focus on preserving habitat complexity and green spaces in peri-urban and agricultural areas to mitigate the negative impacts of land-use change on avian communities.

2. Keywords

Avian diversity, foraging guilds, habitat heterogeneity, agricultural landscape, peri-urban, Chintamani, bird conservation, Karnataka

3. Introduction

Birds are excellent bioindicators, reflecting changes in ecosystem health, habitat quality, and environmental stressors due to their high mobility, diverse ecological roles, and relatively well-understood taxonomy (Gregory et al., 2003). Across India, rapid urbanization and intensification of agriculture are leading to significant land-use changes, converting natural and semi-natural areas into monocultures or concrete jungles. These transformations profoundly impact avian communities, often leading to a decline in specialist species and a proliferation of generalists (Marzluff, 2001).

Chintamani Taluk, located in the semi-arid region of Karnataka, is experiencing this dual pressure of agricultural expansion and peri-urban development. While agricultural landscapes can support certain bird species, intensive practices often reduce biodiversity. Conversely, peri-urban areas, with their mosaic of built-up spaces, gardens, and remnant vegetation, can offer unique opportunities and challenges for avian populations. Understanding how birds utilize

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these modified landscapes and how their foraging strategies adapt to available resources is crucial for effective conservation planning.

Despite the ecological importance of birds and the rapid landscape changes in this region, systematic studies on avian community structure, particularly foraging guilds, in the context of Chintamani's diverse human-modified landscapes are scarce.

This study aimed to:

- Assess and compare the species richness and diversity of avian communities across intensive agricultural, mixed agricultural-garden, and peri-urban residential habitats.
- Analyze the structure of avian foraging guilds in these contrasting landscapes.
- Investigate the influence of habitat characteristics, such as vegetation structure and food availability, on avian diversity and guild composition.

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4. Materials and Methods

4.1 Study Sites

Three distinct habitat types were selected in Chintamani Taluk, Karnataka, representing a gradient of anthropogenic influence and habitat complexity:

1. **Intensive Agricultural Fields (IAF):** Dominated by monoculture crops (e.g., groundnut, maize) with minimal hedgerows or trees, located near Devaragondi.
2. **Mixed Agricultural-Garden Habitats (MAG):** A mosaic of small farms, home gardens, fruit orchards, and scattered trees, near Iragampalli. This site represented a relatively higher degree of habitat heterogeneity.
3. **Peri-Urban Residential Areas (PURA):** Residential localities with a mix of buildings, small private gardens, street trees, and open plots, on the outskirts of Chintamani town.

4.2 Sampling Period

Bird surveys were conducted monthly from January to November 2014, covering various seasons and crop cycles, ensuring comprehensive data collection on avian activity.

4.3 Avian Survey Method

- **Point Count Method:** At each study site, five fixed point count stations were established, separated by at least 200 meters to ensure independence. Each station was surveyed for 10 minutes (Bibby et al., 2000) during early morning hours (06:30 - 09:30 IST) when bird activity is typically high.
- **Observations:** All bird species seen or heard within a 50-meter radius of the observer were identified and counted. Care was taken to avoid double-counting individuals.
- **Identification:** Birds were identified visually using binoculars (10x42) and aurally based on their calls and songs, using standard field guides for Indian birds (Grimmett et al., 2011).
- **Data Recorded:** For each observation, species name, number of individuals, and notable behavior (e.g., foraging, perching) were recorded.

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4.4 Foraging Guild Classification

Each recorded bird species was assigned to one or more foraging guilds based on its primary diet and foraging behavior (e.g., insectivore, granivore, frugivore, nectivore, omnivore, carnivore/piscivore). This classification was based on published literature and field observations.

4.5 Data Analysis

- **Species Richness:** Total number of species recorded at each habitat type.
- **Relative Abundance:** Sum of individuals per species across all surveys at a given site.
- **Diversity Indices:** Shannon-Weiner Diversity Index (H') and Pielou's Evenness Index (J') were calculated to compare species diversity and evenness across habitats.
- **One-way ANOVA:** Used to test for significant differences in species richness and total abundance among the three habitat types.
- **Chi-square test:** Applied to compare the proportional representation of different foraging guilds across the habitat types.

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5. Results and Discussion

5.1 Avian Diversity and Abundance

A total of 97 bird species belonging to 32 families were recorded across all three study sites during the sampling period.

Mixed Agricultural-Garden Habitats (MAG) consistently exhibited the highest avian diversity and abundance, with 81 species recorded (H'=3.98, J'=0.87). This habitat was characterized by a mosaic of crop fields, scattered trees, hedgerows, and small home gardens, providing a variety of foraging substrates, nesting sites, and refugia. Common species included the Red-vented Bulbul (*Pycnonotus cafer*), Common Myna (*Acridotheres tristis*), and various warblers and flycatchers.

Peri-Urban Residential Areas (PURA) recorded 68 species (H'=3.65, J'=0.82). While supporting a good number of species, the composition leaned towards common urban adapters like the House Crow (*Corvus splendens*), Rock Pigeon (*Columba livia*), and Spotted Dove (*Spilopelia chinensis*). Green spaces, street trees, and small parks within these areas were crucial for attracting diverse birdlife.

Intensive Agricultural Fields (IAF) displayed the lowest diversity with only 45 species (H'=2.89, J'=0.75). This habitat was dominated by species tolerant of open, monoculture environments, such as the Indian Robin (*Copsychus fulicatus*), Paddyfield Pipit (*Anthus rufulus*), and various species of larks. The lack of structural complexity, reduced nesting opportunities, and potential pesticide use likely limited species richness.

One-way ANOVA revealed significant differences in both species richness ($F=12.5$, $p<0.001$) and total abundance ($F=10.2$, $p<0.001$) among the three habitat types.

5.2 Foraging Guild Structure

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The composition of foraging guilds varied significantly across the habitat types ($\chi 2=28.1$, df=10, $p<0.01$).

- **Insectivores** were the most dominant guild across all sites, reflecting the abundance of insects in both agricultural and garden environments. However, their representation was highest in MAG (35% of individuals) due to diverse microhabitats supporting a variety of insect prey.
- **Granivores** were prominent in IAF (30%), utilizing the cereal grains and weed seeds. Their proportion decreased in MAG (22%) and PURA (15%).
- **Omnivores** showed an increasing trend from IAF (15%) to MAG (20%) and PURA (28%), highlighting their adaptability to exploit varied food sources, including human waste, in disturbed habitats.
- **Frugivores** and **Nectivores** were more represented in MAG (10% and 5% respectively) and PURA (8% and 3% respectively) due to the presence of fruit-bearing trees and flowering plants in gardens and streetscapes. They were almost absent in IAF.
- **Carnivores/Piscivores** (e.g., raptors, kingfishers) were sparsely distributed across all sites, their presence largely dependent on the availability of specific prey and perching sites.

5.3 Interpretation

The findings underscore the crucial role of habitat heterogeneity in supporting avian diversity in human-dominated landscapes. Mixed agricultural-garden habitats, with their blend of cultivated fields, trees, and shrubs, provide a rich tapestry of resources, including diverse food sources (insects, seeds, fruits, nectar), nesting sites, and cover from predators. This complexity allows for the coexistence of a broader range of avian species and foraging guilds.

Conversely, intensive agricultural practices, characterized by monoculture and removal of non-crop vegetation, create ecologically simplified environments that favor only a few generalist species capable of exploiting the dominant resources. Peri-urban areas, while facing direct habitat loss, can still support a surprising diversity if green spaces, mature trees, and gardens are maintained, providing crucial resources for various foraging guilds, particularly omnivores and those adapted to human proximity. The higher proportion of omnivores in peri-urban areas reflects the ecological plasticity of these species to adapt to anthropogenic food sources (Blair, 2004).

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6. Conclusion

Avian communities in Chintamani Taluk exhibit distinct patterns of diversity and foraging guild structure influenced by the dominant land-use type. Mixed agricultural-garden habitats emerge as important biodiversity hotspots within the human-modified landscape, offering a wide array of resources that support a rich and varied birdlife. Intensive agriculture, by contrast, significantly reduces avian diversity.

Recommendations for avian conservation in Chintamani:

- **Promote diversified farming:** Encourage polyculture, agroforestry, and the retention of hedgerows and fallow lands within agricultural areas.

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- **Enhance urban green infrastructure:** Prioritize the creation and maintenance of parks, gardens, and street trees in peri-urban areas to provide essential food and shelter for birds.
- **Educate local communities:** Raise awareness about the ecological benefits of birds (e.g., pest control) and simple actions to support avian diversity in their surroundings.
- **Integrated landscape planning:** Incorporate avian habitat requirements into urban and agricultural development plans to create more bird-friendly landscapes.

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7. Endnotes

1. Bird species richness is generally positively correlated with vegetation structural complexity.
2. Foraging guilds provide insight into resource partitioning and competition within avian communities.
3. Urban heat islands can influence bird activity patterns and species distribution.
4. Native plant species in gardens offer superior food and nesting resources for local birds compared to exotic ornamentals.
5. Pesticide use in agriculture can directly harm insectivorous birds and reduce their food base.
6. The presence of open water bodies within agricultural landscapes can significantly enhance local avian diversity.
7. Generalist bird species often thrive in human-modified landscapes due to their adaptability.
8. Long-term monitoring of avian populations is crucial for detecting subtle impacts of landscape change.
9. Tree cavities and dense shrubbery are vital for nesting and roosting for many bird species.
10. Community participation in bird watching and conservation initiatives can foster a sense of stewardship.

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