

BIRD MIGRATION PATTERNS AND THEIR ADAPTATION TO THE CHANGING LANDSCAPE OF BHINMAL

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ABSTRACT

In view of the rapid environmental transformations that have been brought about by human activities such as urbanisation, intensification of agriculture, deforestation, and climate change, the purpose of this study is to get an understanding of the migratory patterns and adaptation strategies of bird species that are found in the Bhinmal region of Rajasthan. Bhinmal, which is situated in a biological zone that is semi-arid, serves as a vital stopover for a great number of birds, both seasonal and migratory, particularly during the monsoon and winter months. Finding key migratory species, gaining an understanding of their seasonal patterns of movement, and investigating the implications of changes in land use, diminishing water bodies, and increasing temperatures on their traditional breeding locations and migration routes are the primary objectives of the research. Due to the fact that there have been significant shifts in arrival and departure times, habitat preferences, and feeding behaviours, the study indicates that a great number of bird species are being forced to adapt to the changing climatic conditions. Field observations, species counts, and geographical mapping were the methods that led to this discovery. The population of certain species is decreasing as a result of the destruction of their habitat and the limited availability of resources, while the population of other species has adjusted their migration schedules or the locations where they stop over. For the purpose of preserving the ecological equilibrium in the region and protecting the diversity of birds that inhabit there, it is essential to implement sustainable land management practices, habitat restoration, and community-based conservation efforts. Considering the ecological significance of Bhinmal as a migratory corridor, these findings are very noteworthy.

Keywords: - Migratory Birds, Habitat Adaptation, Landscape Change, Biodiversity Conservation

INTRODUCTION

The yearly movement of birds from one area to another for the purposes of mating, foraging, and survival is a remarkable natural phenomenon known as bird migration. Several environmental variables, including photoperiod, food availability, and temperature, impact these migration patterns. Every year, a great variety of migrating birds make their way to the Bhinmal area of Rajasthan's Jalore district. It is a significant stopping and wintering habitat for resident and migratory bird species due to its semi-arid climate, water bodies, and distinctive topographical characteristics. Bhinmal and its surrounding areas have long been popular destinations for birdwatchers and scientists due to the rich

variety of birdlife that has thrived in the area's many ecosystems, including farmland, marshes, and parts of woodland.

Rapid urbanisation, deforestation, agricultural development, and climate change have all contributed to drastically altering Bhinmal's terrain in recent decades. Traditional bird migratory patterns and breeding behaviours are already being impacted by these changes. Migratory animals have had to change their habits and adapt to new environmental conditions as a result of changes in food and shelter availability caused by habitat loss, decreasing water sources, and greater human activity. The purpose of this research is to learn how different bird species that migrate to Bhinmal are coping with these changes and how they are adapting to their new environment. The project aims to increase knowledge of bird ecology and the need of conservation initiatives in the area via in-depth data analysis and careful field observations.

OBJECTIVE

1. To study seasonal migration patterns of birds in Bhinmal.
2. To assess the impact of landscape changes on bird adaptation.

Methodology

- **Data Collection:** Field observations were conducted throughout the year to monitor bird species' presence, abundance, and behaviors. Secondary data were obtained from ornithological surveys and databases.
- **Species Identification:** Birds were identified using standard field guides, and scientific names were confirmed through taxonomic references.
- **Habitat Assessment:** Land-use patterns were analyzed using satellite imagery and ground-truthing to assess habitat changes over time.

Bird Migration

It is common for there to be a greater number of deaths throughout the breeding and wintering periods of a bird's journey than there are during the actual voyage itself. Therefore, the population dynamics of migratory species and the chance of annual survival are both impacted by bird migration. This is because of the fact that birds migrate. During their journey, birds face a variety of threats, including but not limited to death, adverse weather conditions, hunting, a shortage of food, the destruction of their habitat, excessive hunting, climate change, and impediments that are caused by humans. The presence of these factors contributes significantly to the plight of migratory animals. In the field of migration research, the advent of new technical breakthroughs has made it possible to take innovative methods. By using technology that enables them to track particular individuals over extended periods of time, for example, researchers may be able to get a great deal of knowledge on the physiological characteristics of animals that are migrating. Our understanding of bird physiology, demography, ecology, and behaviour, especially in relation to bird migration, has been significantly improved as a result of the use of this technology. The techniques for thermal detection and selection, the pace of flight, the choice of direction, and the selection of migration locations are the key areas of research

interest that we are primarily interested in. there are more questions that need to be answered before we can fully comprehend the phenomenon of bird migration. In attempt to find a solution to this issue, researchers have developed models of bird migration that are based on individual birds. These models take into consideration a variety of factors, including population-level dynamics, variations in migratory speed and distance, and other factors. Investigations conducted on birds that were kept in captivity have also shed light on the physiological mechanisms that are responsible for avian migration. It is well recognized that factors such as food supplies, weather, competitors, parasites, and diseases all play a part in bird migration; yet, our knowledge of the effect that external factors have on migration is still only partially developed.

The Bhinmal region in Rajasthan witnesses the arrival of several remarkable migratory bird species during the winter season, each showcasing unique adaptations to the changing landscape. Among them, the Common Crane (*Grus grus* Linnaeus, 1758) and Demoiselle Crane (*Grus virgo* Linnaeus, 1758) are notable for their graceful presence in open fields and their ability to feed in agricultural landscapes. The Bar-headed Goose (*Anser indicus* Latham, J 1790), famous for its high-altitude flight over the Himalayas, thrives in local wetlands and irrigated fields. The elegant Greater Flamingo (*Phoenicopterus roseus* Pallas, 1811) prefers saline water bodies and adjusts well to temporary wetlands. The Northern Shoveler (*Spatula clypeata* Linnaeus, 1758), a dabbling duck, is often seen in shallow water bodies, adapting to seasonal ponds and canals. Waders like the Ruff (*Calidris pugnax* Linnaeus, 1758) and Black-tailed Godwit (*Limosa limosa* Linnaeus, 1758) frequent muddy shores and marshy lands, using both natural and man-made wetlands for feeding. the Bluethroat (*Luscinia svecica* Linnaeus, 1758), a small yet vibrant songbird, finds refuge in reed beds and crop fields, signaling the rich biodiversity the region supports despite environmental shifts.



Figure1. Bird migration

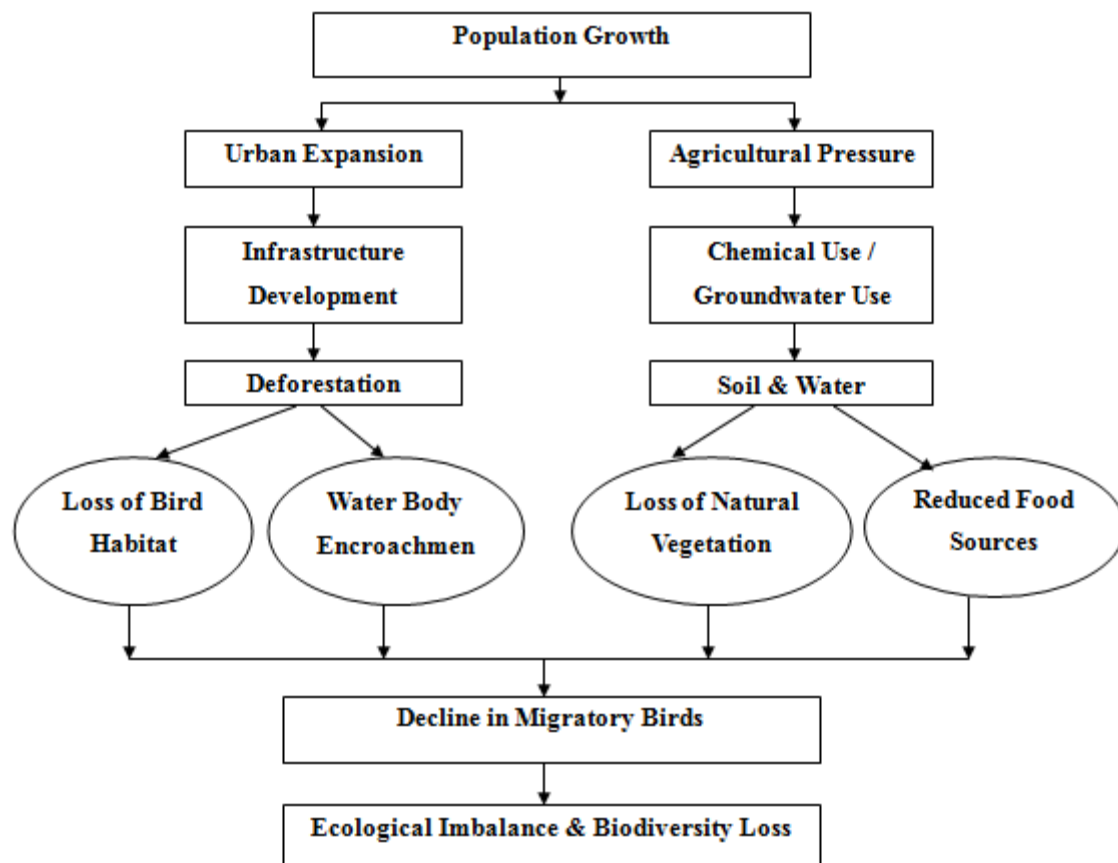


Figure 2: Major Migratory Bird Species Observed in the Bhinmal Region

Table 1: Migratory Birds Observed in Bhinmal, Jalore, Rajasthan

S. No.	Common Name	Scientific Name (Author, Year)	Migratory Status
01	Gadwall	<i>Mareca strepera</i> (Linnaeus, 1758)	Winter Migrant
02	Common Teal	<i>Anas crecca</i> (Linnaeus, 1758)	Winter Migrant
03	Eurasian Marsh Harrier	<i>Circus aeruginosus</i> (Linnaeus, 1758)	Winter Migrant
04	Osprey	<i>Pandion haliaetus</i> (Linnaeus, 1758)	Winter Migrant
05	Common Kestrel	<i>Falco tinnunculus</i> (Linnaeus, 1758)	Winter Migrant
06	Moustached Warbler	<i>Acrocephalus melanopogon</i> (Temminck, 1823)	Winter Migrant
07	Paddyfield Warbler	<i>Acrocephalus agricola</i> (Jerdon, 1845)	Winter Migrant
08	Bar-headed Goose	<i>Anser indicus</i> (Latham, 1790)	Winter Migrant
09	Northern Pintail	<i>Anas acuta</i> (Linnaeus, 1758)	Winter Migrant
10	Black-tailed Godwit	<i>Limosa limosa</i> (Linnaeus, 1758)	Winter Migrant
11	Greater Flamingo	<i>Phoenicopterus roseus</i> (Pallas, 1811)	Winter Migrant
12	Northern Shoveler	<i>Spatula clypeata</i> (Linnaeus, 1758)	Winter Migrant
13	Ruff	<i>Calidris pugnax</i> (Linnaeus, 1758)	Winter Migrant
14	Bluethroat	<i>Luscinia svecica</i> (Linnaeus, 1758)	Winter Migrant
15	Northern Shoveler	<i>Spatula clypeata</i> (Linnaeus, 1758)	Winter Migrant
16	Common Crane	<i>Grus grus</i> (Linnaeus, 1758)	Winter Migrant
17	Demoiselle Crane	<i>Anthropoides virgo</i> (Linnaeus, 1758)	Winter Migrant

Impact Factors and Human Landscape Interaction in Bhinmal Region



Extensive taxonomic research has shown that many tropical migratory bird species travel great distances to nest in temperate or boreal regions. This shows that while trying to comprehend the migratory life cycle, it is important to take evolutionary causes and selection into account. While much research on migratory populations' speciation has concentrated on breeding grounds as the primary site of selection, it is essential to include the non-breeding months as well. These investigations are justified by the fact that tropical immigrant species do not use breeding areas due to their distinctive morphology.

To comprehend the development and mating habits of migratory species, one must take into account the migratory life cycle, including the reproductive and non-reproductive habitats of the species. The significance of taking into account migratory behaviour in both its reproductive and non-reproductive forms has been reinforced by recent research in bird ecology. An increase in competitive aggression may result from the annual migration of hundreds of species and countless individuals to tropical regions for the purpose of mating. These results show how migratory evolution has shaped the traits of migrant animals. To sum up, the abundant taxonomic data and discoveries about migratory species imply that evolution and natural selection are pivotal in the migration life cycle, especially for tropical immigrant species. Migrants' looks and competitive behaviour may be better understood by delving into their reproductive and non-reproductive parts. A large number of species invade tropical areas annually for mating purposes, lending credence to the idea of migratory evolution.

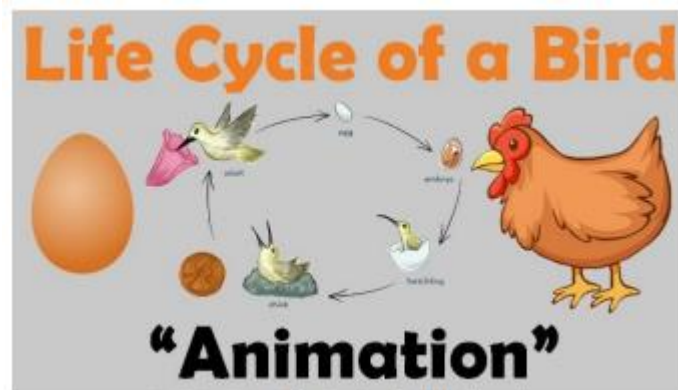


Figure3. Life cycle of bird migration

Timing of Breeding in Bird Migration

Birds have significant phenotypic plasticity, allowing them to alter their appearance in response to environmental stimuli. A solitary modifying gene is believed to account for this adaptability, allowing some populations to rapidly acclimatize to novel conditions, such as those induced by climate change. Birds exhibit phenotypic plasticity across several domains, including food, habitat selection, migratory behaviours, phenology, and reproductive output. One illustration of the extraordinary flexibility shown by several bird species is their modification of mating calls in response to fluctuating weather patterns in their habitats. Due to changes in their local environment, individuals may choose for various breeding dates. There are strong genetic relationships between breeding timing and clutch size, significantly influencing reproductive success.

Several aspects of reproduction may be substantially influenced if the timing of reproduction is altered due to climate change. Birds that breed exclusively during certain seasons are significantly dependent on the progression of time. Evidence indicates that reproductive timing is correlated with seasonal variations in the success of some bird species' clutches. In theory, long-distance migratory birds ought to respond rapidly to prolonged warming trends. Previous studies on pied flycatchers identified an association between optimal breeding timing and enhanced reproductive success; recent study from the Netherlands indicates the contrary. Pied flycatchers moving from their study zone to Russia may arrive prematurely in the Netherlands, adversely affecting reproduction. Reproductive timing may be affected by variables outside migratory constraints. Birds have tremendous phenotypic plasticity, enabling them to modify their behaviour and reproductive strategies in response to unforeseen external stimuli such as climate change. Diverse species and groups may adapt variably owing to distinct constraints.

Problems faced by birds during migration

Birds encounter several risks during migration, including natural calamities (such as thunderstorms, sandstorms, illnesses, and predation) and manmade activities (such as wind farms, pollution, oil spills, radiation, artificial lighting, habitat destruction, and hunting). Consequently, several populations of migratory bird species are seeing a reduction. The deterioration is often the result of many interconnected events. In India, the primary challenges faced by migrating birds are as follows.

1. **Harvesting of fishes:** Fish are often collected from the wetland areas by the people who reside in the regions that are next to the wetland areas. There is a correlation between the harvesting of fish and the disturbance of birds, which in turn leads to the birds experiencing fear.

2. **Human disturbance:** Herders and tourists are often observed roaming in the sections of wetlands that are next to one another. The grazing of their animals not only affects the natural resources that are available, but it also causes chaos for the birds. In the areas that surround the lakes, this kind of grazing produces soil erosion, which in turn increases the amount of siltation that occurs in the lakes.

3. **Agricultural encroachment:** In many instances, the marsh areas that are next to our land invade our territory. They remove the plant cover that is situated in the vicinity of the wetland regions where they are positioned. When it comes to irrigation, these farms often make use of the water that is derived from the lakes.

The exploitation of aquatic reeds/ vegetation: Reeds from the water are often harvested by the locals from the wetland regions, which results in the destruction of the environment. On the other hand, some plants, such as *Ipomoea carnea* and *Eichhornia crassipes*, spread at a rapid rate, which leads to a reduction in the surface area that is used by the majority of migrating birds. Some of the plants, such as *Eichhornia crassipes*, *Lemna perpusilla*, *Marsilea quadrifolia* and *Wolffia globosa* are known as common surface-covering plants. These plants are responsible for the formation of a thick green covering on the surface.

4. **Poaching of birds:** Local poachers often take migrating birds from marsh areas so they may sell them. On the other hand, forest authorities are quite quick to put a stop to operations of this kind.

5. **Pollution:** Wetland ecosystems are the most fragile and complicated ecosystems since they are unable to clean themselves. This is because they lack the cleaning ability. As a consequence of this, they are susceptible to the buildup of contamination. When you are in the neighbourhood of the banks of the wetland regions, it is not unusual to come across individuals who are tossing away water bottles, plastic wrappers, and bags. As a consequence of people who live in close proximity to wetland regions depositing rubbish in the neighbourhood of wetland areas, the water and the environment that surrounds the wetland areas get progressively polluted. This is something that is often seen. According to findings from recent studies, the effects of light pollution on nocturnally migratory passerines are far more severe than those had on other species of passerines.

Hotspots for Bird Migration in India

The presence of a large number of water bodies, inland and coastal wetlands, marsh areas, and ponds are major attractions for migratory birds in India. India is home to a wide variety of wetlands, ranging from high-altitude trans-Himalayan lakes such as Tso Moriri, Pangong Tso, Tso Kar, and Chander Taal to coastal wetlands comprising salt marshes, lagoons, bottomland hardwood swamps, fresh marshes, mangrove swamps, and shrubby depressions. Most of these wetlands are very rich in primary production and thus attract a large number of birds. Some of these wetlands are designated as 'Wetlands of International Importance' due to their incomparable ecosystems with immense conservation value and ecosystem services.

There are a significant number of water bodies, inland and coastal wetland regions, marshy areas, and ponds in India, all of which are key attractions for migrating birds. There are many different types of wetland ecosystems that can be found in India. These include high-altitude trans-Himalayan lakes like Tso Moriri, Pangong Tso, Tso Kar, and Chander Taal, as well as coastal wetland ecosystems that include salt marshes, lagoons, bottomland hardwood swamps, fresh marshes, mangrove swamps, and shrubby depressions. A significant number of birds are drawn to the majority of these wetland areas because they include a high concentration of primary production. Due to the unmatched ecosystems that they contain, as well as the enormous conservation value and ecosystem services that they provide, several of these wetland areas have been recognized as "Wetlands of International Importance."

At the moment, India is home to a total of 1,243 wetland areas, which includes 75 Ramsar wetland areas, 115 major wetland areas, and 1,053 smaller wetland areas. On February 1, 1982, India became a signatory to the "Convention on Wetlands," also referred to as the Ramsar Convention. India currently has 13,266.77 square kilometres of Ramsar sites and holds the top spot in South Asia and the third spot in Asia in terms of the number of Ramsar sites. Notable wetlands that attract a large number of winter migratory birds include Keoladeo National Park and Sambhar Lake in Rajasthan, Bhoj Wetland in Madhya Pradesh, Kabartal Wetland in Bihar, Deepor Beel in Assam, Loktak Lake in Manipur, Bhitarkanika Mangroves and Hirakud Reservoir in Odisha, East Kolkata Wetlands and Sunderbans Wetland in West Bengal, Kolleru Lake in Andhra Pradesh, Point Calimere Bird Sanctuary and Pichavaram Mangrove in Tamil Nadu, Ashtamudi Wetland and Sasthamkotta Lake in Kerala, and Nanda Lake in Goa. A significant number of migratory birds can also be found in bird sanctuaries located in wetland habitats such as the Patna Bird Sanctuary, Nawabganj Bird Sanctuary, Lakh Bahosi Sanctuary, and Sandi Bird Sanctuary in Uttar Pradesh; Kanwar Lake Bird Sanctuary in Bihar; Khichan Bird Sanctuary in Rajasthan; Pulicat Lake on the Tamil Nadu–Andhra Pradesh border; D'Ering Wildlife Sanctuary in Arunachal Pradesh; the Rann of Kutch in Gujarat; Kumarakom Bird Sanctuary in Kerala; and Ranganathittu Bird Sanctuary in Karnataka.

CONCLUSION

The examination of avian migratory patterns and their adaptation to the changing landscape of Bhinmal provides insight into the remarkable resilience and flexibility of bird species in response to habitat alterations. Due to urbanisation, agricultural development, deforestation, and climate change impacting natural habitats, migratory birds are increasingly altering their migration routes, stopover locations, and nesting practices to adapt to the evolving ecological conditions. Bhinmal's unique geographical setting and seasonal water supplies consistently attract a diverse array of migratory species. Consequently, it serves as a crucial environment for ornithological study that remains little explored. Nonetheless, habitat degradation, reduced food availability, and human-induced disturbances threaten the long-term sustainability of this region as a migratory hub. These changes not only affect migratory patterns but also jeopardise the existence of several bird species. It is essential to implement localised conservation strategies, enhance awareness, and promote habitat restoration to preserve biological equilibrium and ensure that Bhinmal remains a secure and resource-abundant refuge for migratory birds. Integrated research and conservation planning are essential for safeguarding the region's biodiversity, since the adaption mechanisms seen in birds also indicate the ecosystem's health.

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