

Study of Pelagic Bird Diversity and Seasonality Patterns along Rabindranath Tagore Beach of Karwar Coastline, Karnataka

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Abstract

The present study investigated the diversity and seasonal patterns of pelagic birds along the Rabindranath Tagore Beach of Karwar coastline, Karnataka, India from January to April 2023. Using distance sampling methodology, we documented only two pelagic bird species—Brown-headed Gull (*Chroicocephalus brunnicephalus*) and Black-headed Gull (*Chroicocephalus ridibundus*)—compared to eight non-pelagic species. Pelagic bird diversity decreased significantly during summer months, with Shannon's Diversity Index declining from 1.0736 in post-winter to 1.5722 in summer, while Shannon's Evenness increased from 0.3221 to 0.3892. The low pelagic species richness contrasts with the region's potential importance for seabirds, likely reflecting ecosystem pressures from fishing activities, tourism development, and plastic pollution. This research highlights the urgent need for extended monitoring and conservation measures to protect vulnerable pelagic bird populations along the Karnataka coast.

Keywords: Pelagic Birds, Diversity, Seasonality, Karnataka Coast, Conservation, Marine Ecosystems

1. Introduction

Pelagic birds, also known as oceanic birds, represent a specialized group of avian species that spend the majority of their lives in the open ocean rather than in waters adjacent to land or inland water bodies [1]. These birds exhibit remarkable adaptations to marine environments, including exceptional swimming abilities, prolonged flight capabilities allowing some species to remain airborne for weeks, and specialized salt glands that extract excess salt from seawater [2]. Their ecological significance extends beyond marine environments through nutrient cycling, as they transport substantial quantities of marine-derived nutrients to terrestrial and coastal ecosystems through guano deposition [3].

Globally, pelagic birds face numerous anthropogenic threats, including plastic pollution, oil spills, climate change-induced alterations in prey availability, and bycatch in fishing operations [2,4]. The problem of plastic pollution is particularly acute, as many seabirds mistake plastic debris for prey, leading to internal injuries, digestive tract obstructions, and toxic effects from ingested chemicals [4]. It is estimated that more than 99% of all seabird species will have ingested plastic debris by 2050 [4], underscoring the vulnerability of these marine-adapted species.

India's extensive coastline, particularly the Karnataka coast, provides potential habitat for diverse marine avian species. The Karwar region in Uttara Kannada district features a unique sheltered coastline flanked by small islands that create favorable conditions for marine life, including seabirds [3]. However, rapid development activities, including port expansion projects under the Sagarmala programme, threaten these coastal ecosystems [3]. The Karwar port expansion, approved despite the area's designation as a Critically Vulnerable Coastal Area, poses significant risks through habitat degradation, increased pollution, and potential oil spills [3].

The current study represents the first systematic assessment of pelagic bird diversity along the Rabindranath Tagore Beach of Karwar coastline. We aimed to: (1) document the diversity of pelagic and non-pelagic bird species in the study area; (2) analyze seasonal variations in species composition between post-winter and summer periods; and (3) assess the conservation implications of our findings in the context of ongoing coastal development. This research establishes an important baseline for understanding pelagic bird populations along the Karnataka coast and informs future conservation strategies.

2. Methodology

2.1 Study Area

The study was conducted along the Rabindranath Tagore Beach (Latitude: 14.8107°N, Longitude: 74.1266°E) in Karwar Taluka of Uttara Kannada district, Karnataka (Figure 1). This coastal region is characterized by a hot, humid climate with heavy rainfall influenced by proximity to the Arabian Sea. The study area was divided into two zones along a 500-nautical-mile transect parallel to the coastline:

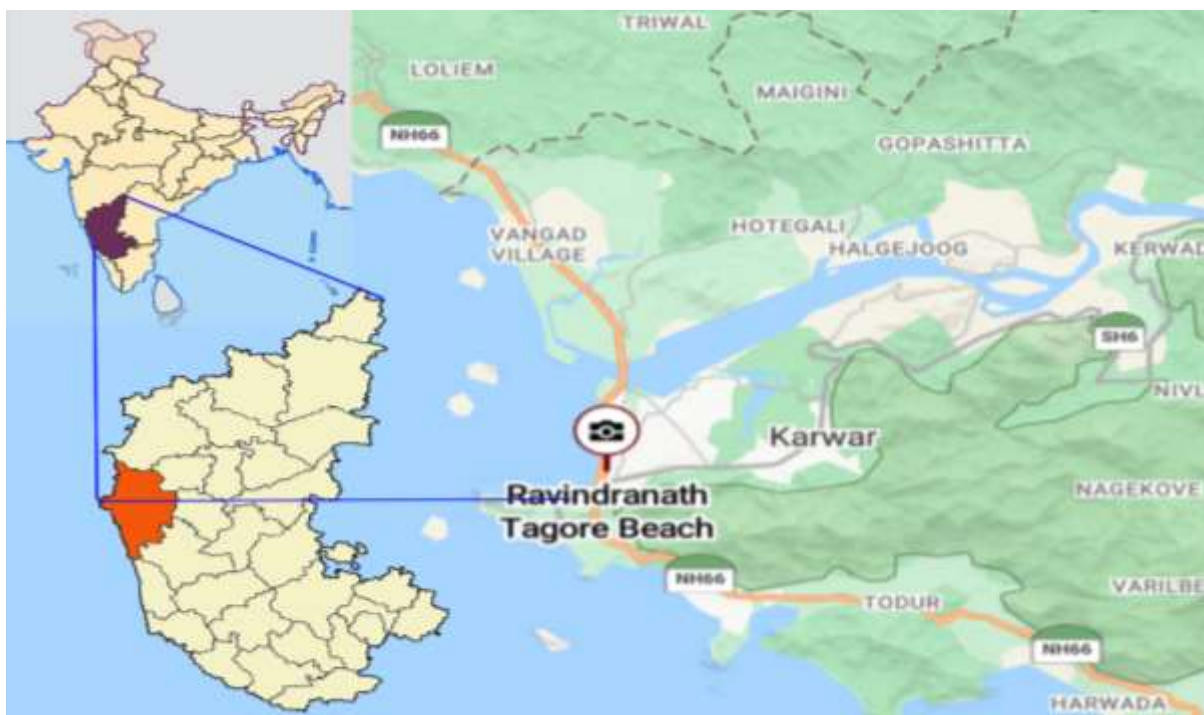


Fig.1 :Map showing study station in and around Karwar Coastline

Area A-B: Characterized by high tourist and fishing activities, including water sports, religious ceremonies, and picnics. This section has normal water depth with designated swimming areas.

Area B-C: Experiences minimal tourist activity even during peak seasons, with increasing depth toward the northern side and restricted access for water sports and swimming due to safety regulations.

The Karwar coastline represents a sheltered ecosystem flanked by small islands that create favorable conditions for marine life, including fish populations that serve as prey for pelagic birds [5]. However, the area faces increasing anthropogenic pressure from tourism, fishing activities, and ongoing port development projects [5].

2.2 Data Collection

Field observations were conducted twice weekly (Tuesdays and Fridays) from January to April 2023, covering both post-winter (January-February) and summer (March-April) seasons. Observation sessions occurred during two time periods daily: 7:00-9:30 AM and 4:00-5:45 PM, coinciding with peak bird activity.

We employed the distance sampling method [Buckland et al., 2001] along a 1km transect within a 0.5km buffer zone. Data collection included:

Direct observation: Visual identification and photographic documentation of pelagic and non-pelagic bird species.

Indirect evidence: Collection of data on feathers, claw marks, and fecal matter to supplement direct observations.

Environmental parameters: Recording of weather conditions, temperature, humidity, tourist density, and topographic conditions.

Stakeholder interviews: Formal and informal discussions with local fishermen, community members, and amateur wildlife enthusiasts to gather ecological insights and historical context.

2.3 Data Analysis

Collected data were analyzed using PAST (Palaeontological Statistics) software to calculate:

Species Richness: Simple count of different species present in the study area.

Shannon's Diversity Index (H'): Calculated as

$$H' = -\sum p_i \ln(p_i),$$

where p_i is the proportion of individuals found in the i th species.

Shannon's Evenness (E): Derived as

$$E = H' / \ln(S),$$

where S is the total number of species.

These quantitative measures helped assess the diversity and distribution patterns of both pelagic and non-pelagic birds across seasons.

1. Results and Discussion

3.1 Species Documentation

Our study documented a total of 10 bird species along the Rabindranath Tagore Beach transect, comprising only two pelagic species and eight non-pelagic species (Table 1).

The dominant pelagic species observed were the Brown-headed Gull and Black-headed Gull, while non-pelagic species were dominated by kites and waders. The limited diversity of pelagic birds contrasts with the wider variety known to frequent the Karnataka coast, including species like the Sooty Shearwater, Brown Booby, and various skuas [2].

3.2 Seasonal Variation

We observed notable seasonal variations in species abundance and diversity between post-winter and summer periods (Table 2). The pelagic bird population decreased substantially during summer months, with only Brown-headed Gulls remaining in the area, while non-pelagic species richness increased.

Table 1: Checklist of documented bird species

Common name	Scientific name	Status	Pelagic (P) / Non-Pelagic (NP)
Brown headed gull	<i>Chroicocephalus brunnicephalus</i>	LC	P
Black headed gull	<i>Chroicocephalus ridibundus</i>	LC	P
Black Kite	<i>Milvus migrans</i>	LC	NP
Common Greenshank	<i>Tringa nebularia</i>	LC	NP
Little Egret	<i>Egretta garzetta</i>	LC	NP
Brahminy Kite	<i>Haliastur indus</i>	LC	NP
Common Sandpiper	<i>Acititis hypoleucos</i>	LC	NP
Indian Pond heron	<i>Ardeola grayii</i>	LC	NP
Jungle myna	<i>Acridotheres fuscus</i>	LC	NP
Common house crow	<i>Corvus splendens</i>	LC	NP

Table 2: Seasonal Variation in Avian Diversity Indices

Criteria	Post-Winter Season	Summer Season
Total Pelagic Species	2	1
Total Non-Pelagic Species	5	8
Total Species (P+NP)	7	9
Shannon's Diversity Index (H')	1.0736	1.5722
Shannon's Evenness (E)	0.3221	0.3892

Table 3: Seasonally Dominant Avian Species

Post-Winter Season	Summer Season
Black-headed Gull	Brown-headed Gull
Brahminy Kite	Sandpiper
Sandpiper	Brahminy Kite
Black Kite	Little Egret

The decline in pelagic birds during summer coincides with their migratory patterns, as species like the Black-headed Gull return to breeding grounds in Central Asia. The increase in overall diversity index during summer reflects the greater evenness of non-pelagic species distribution, despite the loss of one pelagic species.

3.3 Dominant Species by Season

The composition of dominant species shifted notably between seasons (Table 3). Pelagic birds featured more prominently in the post-winter period, while non-pelagic species dominated during summer months.

The persistence of Brown-headed Gulls into the summer months suggests either extended wintering patterns or the possibility of a small resident population utilizing the Karwar coastline throughout the year.

4 Discussion

4.1 Limited Pelagic Bird Diversity

The documentation of only two pelagic bird species along the Karwar coastline reflects a significantly impoverished pelagic community compared to the known diversity along the Karnataka coast. This low diversity is particularly noteworthy given that pelagic birds are typically associated with open ocean environments and only come ashore during breeding seasons or when displaced by severe weather conditions [1, 2].

Several factors may explain this limited diversity:

1. **Methodological limitations:** Our study was conducted primarily during daylight hours, missing nocturnal pelagic species. Additionally, the absence of offshore surveys limited observations to coastal species, potentially missing true pelagic birds that remain far from shore.
2. **Seasonal timing:** The study period (January-April) may have missed peak migration periods for certain pelagic species. Many pelagic birds, including shearwaters and petrels, migrate through the Arabian Sea during different seasonal windows [2].
3. **Anthropogenic pressures:** The Karwar coast faces significant human impacts, including port expansion activities, increased fishing pressure, and tourism development [5]. Such disturbances can deter sensitive pelagic birds from utilizing coastal habitats.
4. **Plastic pollution:** The Arabian Sea accumulates substantial marine debris, and pelagic birds are particularly vulnerable to plastic ingestion, which can cause mortality and reduce population viability [4].

4.2 Seasonal Patterns and Migration

The observed seasonal decline in pelagic bird abundance follows expected migration patterns. Both Brown-headed and Black-headed Gulls are known to winter along the Indian coast and return to their breeding grounds in Central and Northeast Asia during summer months. The partial retention of Brown-headed Gulls into the summer months suggests that Karwar may provide sufficient resources for some individuals to extend their stay beyond typical migration windows.

The increase in non-pelagic bird diversity during summer months likely reflects local breeding activities and seasonal movements of resident species rather than long-distance migration. Species such as the Indian Pond Heron and Little Egret may move to coastal areas as inland water sources diminish during summer months.

4.3 Conservation Implications

The low diversity of pelagic birds along the Karwar coastline raises concerns about the health of marine ecosystems in the region. Pelagic birds serve as important indicators of marine ecosystem health, and

their absence may signal broader ecological issues [6]. The significant threats from ongoing port expansion projects [5] and plastic pollution [4] necessitate urgent conservation measures.

We recommend:

1. **Extended monitoring** throughout the year to capture full seasonal variation in pelagic bird diversity.
2. **Offshore surveys** to document true pelagic species beyond coastal waters.
3. **Strict regulation** of port expansion activities to minimize habitat destruction.
4. **Plastic pollution mitigation** through improved waste management systems.
5. **Community engagement** programs to enhance stakeholder participation in coastal conservation

5. Conclusion

The Rabindranath Tagore Beach of Karwar coastline supports a limited diversity of pelagic birds, dominated seasonally by two gull species, alongside a more diverse community of non-pelagic birds. The significant seasonal decline in pelagic species highlights the importance of migration patterns in structuring coastal avian communities. The low pelagic diversity may reflect broader environmental challenges, including habitat degradation, pollution, and anthropogenic disturbances from development projects.

Future research should prioritize extended temporal monitoring incorporating nocturnal surveys and offshore observations to more comprehensively document pelagic bird diversity. Conservation efforts must address the multiple threats facing coastal ecosystems, particularly the impacts of port development and plastic pollution, to protect vulnerable pelagic bird populations along the Karnataka coast.

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