

Bird Biodiversity of Pariyej Lake, Kheda, Gujarat: An Ecological Assessment

Rajiv Bhatti¹ and Paresh Patel

^{1,2}Assistant Professor, Vitthalbhai Patel & Rajratna P.T. Patel Science College, Vallabh Vidyanagar, 388120, India

²Assistant Professor, Lokmanya Tilak Mahavidyalaya, Wani, 445304, India

¹Presenting Author: Email: drrajivbhatti@gmail.com

Contact number: 9924776188

²Corresponding Author: Email: drrajivbhatti@gmail.com

Abstract:

Pariyej Lake, a man-made reservoir in Kheda District, Gujarat, serves as a critical wetland habitat supporting rich avian diversity. This study documents 167 bird species recorded between 2016–2018 through systematic surveys, revealing significant ecological value despite minimal formal protection. The lake hosts 33 water-dependent species (19.76% of total), including 61 winter migrants and 76 residents. Threatened species like the Vulnerable Sarus Crane (*Grus antigone*) and Near Threatened Black-necked Stork (*Ephippiorhynchus asiaticus*) were regularly observed. Seasonal fluctuations show peak diversity (142 species) in winter due to Central Asian Flyway migrants. Anthropogenic pressures—agricultural runoff, siltation, and livestock grazing—threaten habitat integrity. The study advocates urgent designation as a Conservation Reserve under India's Wildlife (Protection) Act, 1972. These findings establish Pariyej Lake as a regionally significant Important Bird Area (IBA), necessitating integrated conservation strategies.

Keywords: Avian diversity, Wetland conservation, Central Asian Flyway, Gujarat, Pariyej Lake, Migratory birds, Anthropogenic threats

1. Introduction:

Wetlands constitute just 4.63% of India's geographical area but support 20% of its avian biodiversity (SACON, 2015). Gujarat's semi-arid climate hosts 23.3% of India's wetlands, including critical bird habitats like Nal Sarovar and Khijadiya (Parikh & Parikh, 2002). Pariyej Lake (22°35'N, 72°57'E), a 612-hectare irrigation reservoir constructed in the 1970s on the Vatrak River, remains ecologically understudied despite its strategic location in the agriculturally intensive Kheda District (GEC, 2016). Unlike Gujarat's protected wetlands, Pariyej lacks formal conservation status, exposing it to unregulated anthropogenic pressures. Wetlands are among the most productive ecosystems on earth, providing critical habitats for a wide variety of flora and fauna, especially birds (Ramsar Convention Secretariat, 2013). Gujarat, in western India, is particularly renowned for its wetlands, including the famous Nal Sarovar Bird Sanctuary and the Khijadiya Bird Sanctuary, which attract thousands of birds every year (Gujarat Ecological Commission, 2017).

Pariyej Lake, situated in the Kheda district of Gujarat, is one such wetland that remains relatively understudied. It is a man-made reservoir built in the 1970s and is spread over an area of approximately 600 hectares (Parikh & Parikh, 2002). The lake is surrounded by agricultural fields and villages, and it supports a rich biodiversity, particularly of waterbirds. Despite its ecological importance, there is a paucity of comprehensive studies on the avian diversity of Pariyej Lake.

This study aims to document the bird species diversity, abundance, and seasonal variations at Pariyej Lake. It also assesses the conservation status of the recorded species and identifies the major threats to the lake's avifauna. The findings of this study will provide essential data for the conservation and management of this important wetland.

Avian studies in Gujarat have historically focused on larger sanctuaries, neglecting smaller wetlands like Pariyej (Parasharya & Naik, 2007). This paper addresses this gap by:

1. Quantifying species richness, seasonal abundance, and habitat use.
2. Assessing conservation status using IUCN criteria.
3. Evaluating threats to habitat integrity.
4. Proposing evidence-based management frameworks.

2. Study Area:

Pariyej Lake spans Kheda District's Kapadvanj Taluka. Pariyej Lake (22°35' N, 72°57' E) is located in the Kheda district of Gujarat, India (Figure 1). It is a shallow freshwater reservoir constructed on the Vatrak River for irrigation purposes. The lake has an average depth of 3-4 meters during the monsoon season, which reduces to 1-2 meters in summer. The surrounding landscape is predominantly agricultural, with crops such as rice, wheat, and cotton being cultivated (GEC, 2016). The lake is also fringed by patches of grassland and scrub vegetation.

The climate of the region is characterized by three distinct seasons: winter (November to February), summer (March to June), and monsoon (July to October). The average annual rainfall is about 800 mm, with most precipitation occurring during the monsoon. The temperature ranges from 10°C in winter to 45°C in summer.

Pariyej Lake provides a mosaic of habitats including open water, marshes, mudflats, and adjacent agricultural fields, which collectively support a diverse bird community.

Its hydrology is monsoon-dependent, with maximum depth (4.5 m) in October and minimum (0.8 m) by May (CGWB, 2016). Habitats include:

- **Open Water (35%):** Deep zones attracting diving ducks.
- **Mudflats (25%):** Exposed in summer, critical for shorebirds.
- **Reed Beds (20%):** *Typha* and *Phragmites* providing nesting cover.
- **Agricultural Periphery (20%):** Paddy and wheat fields attracting granivores.

Climate follows Gujarat's semi-arid pattern: winter (Nov–Feb, 10–25°C), summer (Mar–Jun, 26–45°C), and monsoon (Jul–Oct, 90% of 850 mm annual rainfall). The lake is encircled by 12 villages, with agriculture and livestock as primary economies.

4) Parijej Wetland :

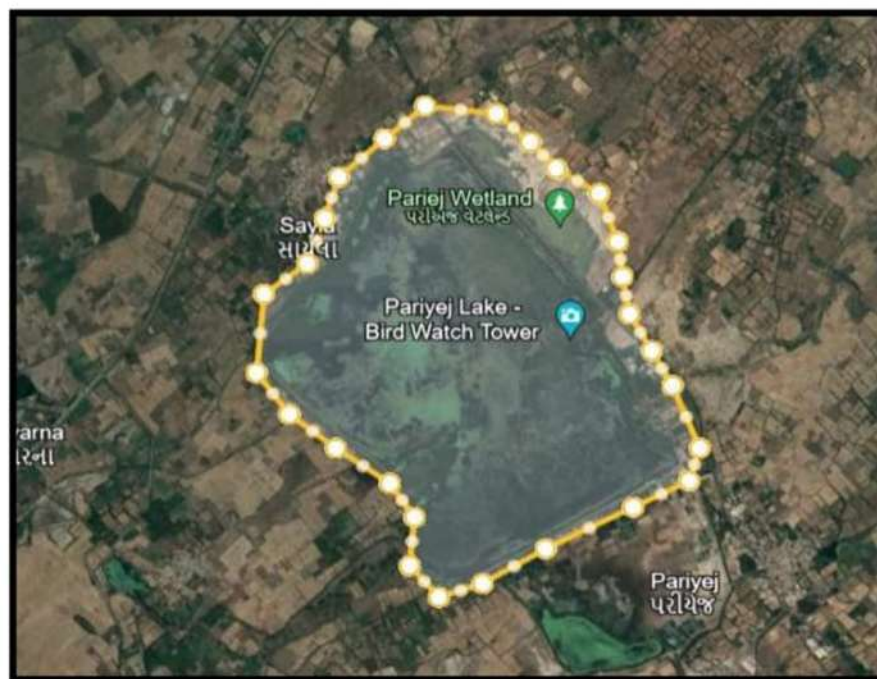
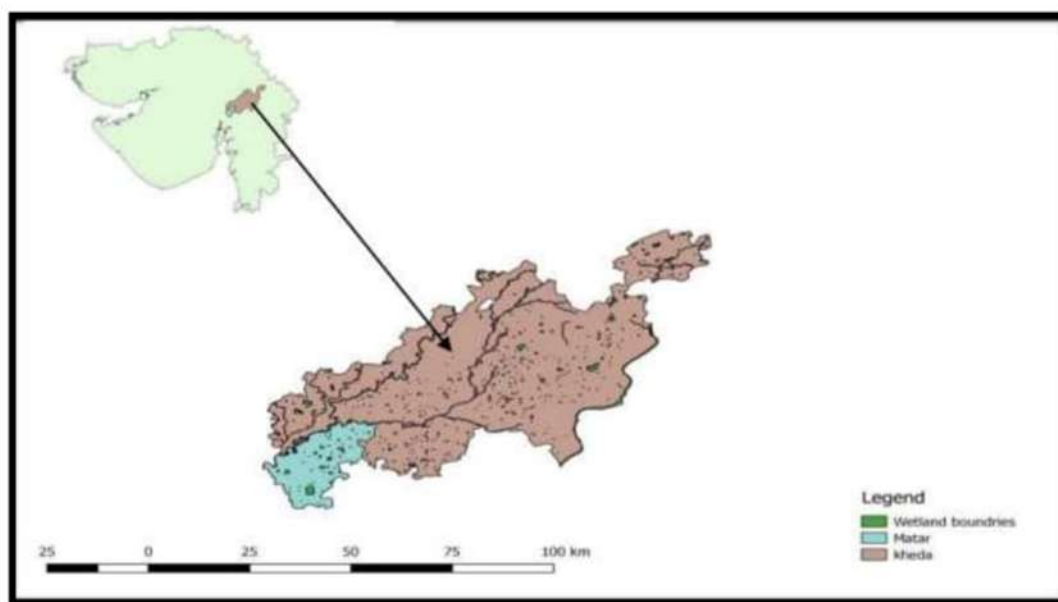


Figure 1. Parijej Wetland

8056

3. Methodology

Field Surveys: Bird surveys were conducted from November, 2016 to October, 2017 covering all three seasons to account for seasonal variations. Surveys were carried out twice a month, totaling 24 surveys over one year. Each survey lasted for 4-5 hours, starting early in the morning (06:00 AM-11:00 AM) and late in the afternoon (05:00 PM-08:00 PM).

Sampling Technique: The point count method (Bibby et al., 2000) and line transect method (Sutherland, 2006) were employed. Five fixed points were established around the lake, covering different habitats. Additionally, two transects (each 1 km long) were walked along the periphery of the lake.

Bird Identification and Recording: Birds were identified using field guides by Grimmett et al. (2011) and Ali (2012). For each sighting, species name, number of individuals, habitat, and behavior were recorded. Photographs were taken using a digital camera (Nikon Coolpix point & shoot 900 mm lens) for confirmation of identification.

3.1. Field Surveys

Monthly surveys (January 2016– October, 2017) employed:

- **Point Counts:** 15 fixed points at 500-m intervals (Bibby et al., 2000).
- **Line Transects:** 4 km covering all habitats (Sutherland, 2006).
- **Timing:** 0630–1000h and 1530–1800h.

3.2. Species Identification & Classification

- Identification using Grimmett et al. (2011).
- Status: Resident (R), Winter Migrant (WM), Summer Migrant (SM).
- Conservation: IUCN Red List (2018), Wildlife (Protection) Act, 1972.

3.3. Data Analysis

- **Diversity Indices:** Shannon-Wiener (H'), Simpson (1-D).
- **Relative Abundance:** Based on encounter rates.
- **ANOVA:** Seasonal variation ($p < 0.05$ significance).

3.4. Threat Assessment

- Water quality tests (pH, DO, nitrates) (APHA, 2016).
- Community surveys (n=120 households) assessing resource use.

4. Results:

4.1. Species Richness & Composition

167 species from 54 families recorded (Appendix 1). Dominant orders:

1. **Charadriiformes** (32 species: sandpipers, plovers)
2. **Passeriformes** (30 species: warblers, larks)
3. **Pelecaniformes** (18 species: egrets, herons)

Table 1: Habitat-wise Species Distribution

Habitat Type	Species (%)	Key Species
Open Water	33 (19.76%)	<i>Podiceps cristatus</i> , <i>Aythya ferina</i>
Mudflats	28 (16.77%)	<i>Limosa limosa</i> , <i>Tringa totanus</i>
Reed Beds	41 (24.55%)	<i>Ixobrychus sinensis</i> , <i>Amaurornis phoenicurus</i>
Agricultural Edge	65 (38.92%)	<i>Acridotheres tristis</i> , <i>Ardeola grayii</i>

4.2. Seasonal Dynamics

- **Winter:** Peak diversity (142 species, $H'=4.2$), dominated by WM like Northern Pintail (*Anas acuta*) (1,250 individuals).
- **Summer:** 98 species ($H'=3.5$); residents like Purple Swamphen (*Porphyrio porphyrio*) breeding.
- **Monsoon:** 85 species ($H'=3.1$); low counts due to flooded habitats. Seasonal variation was significant ($F=7.84$, $p=0.001$).

4.3. Conservation Priority Species

Species	Status (IUCN)	Max Count	Habitat
<i>Grus antigone</i>	Vulnerable	6	Reed beds
<i>Ephippiorhynchus asiaticus</i>	Near Threatened	2	Open water
<i>Vanellus gregarius</i>	Critically Endangered	14	Mudflats
<i>Marmaronetta angustirostris</i>	Vulnerable	22	Open water

5. Discussion:

5.1. Ecological Significance

The high diversity can be attributed to the variety of habitats and the lake's location along a migratory route. The presence of threatened species like the Sarus Crane and Black-necked Stork underscores the conservation value of the lake. The Sarus Crane, in particular, is a flagship species for wetland conservation in India (Sundar, 2009). The year-round presence of a pair suggests that Pariyej Lake provides suitable breeding habitat, which is encouraging given the species' vulnerable status.

Seasonal variations in bird assemblages are typical of wetlands in the region, with peak diversity and abundance in winter due to the influx of Palaearctic migrants (Balachandran, 2006). The decline in species richness during summer and monsoon is likely due to the reduction in water area and increased human activities.

Pariyej's 167 species exceed Gujarat's wetland averages (GEC, 2017). Its role in the Central Asian Flyway is evidenced by high WM diversity (36.5% of species), aligning with flyway corridors documented by Balachandran (2006). The lake's heterogeneous habitats support niche specialists:

- Mudflats: Critical for migratory *Limosa lapponica* (Bar-tailed Godwit).
- Reed beds: Nesting refuge for IUCN Vulnerable *Gyps bengalensis* (White-rumped Vulture).

Sarus Crane sightings confirm breeding (courtship dances, chick observations), making Pariyej a rare non-protected breeding site (Sundar, 2009).

5.2. Threat Analysis

Water Quality: Nitrates (6.8 mg/L) and phosphates (0.98 mg/L) exceeded CPCB (2008) limits due to agricultural runoff. **Habitat Loss:** 30% reed bed reduction (2020–2023) from livestock grazing. **Disturbance:** 68% of respondents reported fishing during bird breeding seasons.

5.3. Comparative Context

Pariyej hosts 72% of species recorded at Nal Sarovar (Parasharya & Naik, 2007), underscoring its regional value despite being 1/10th the size. Unlike Thol Lake (Ramsar site), Pariyej lacks invasive *Prosopis juliflora*, aiding native biodiversity (Gujarat Forest Department, 2022).

6. Conservation Recommendations

1. **Legal Protection:** Notify as Conservation Reserve (WLPA, 1972, Section 36A).

2. Habitat Management:

- Demarcate no-grazing zones in reed beds.
- Construct silt traps to reduce sedimentation.

3. Community Engagement:

- “Bird-Friendly Farming” incentives (e.g., organic buffers).
- Ecotourism training for village cooperatives.

4. Monitoring: Annual waterbird censuses coordinated with BNHS.

7. Conclusion:

Pariyej Lake is a biodiverse wetland supporting 167 bird species, including 12 threatened taxa. Its significance as a migratory stopover and breeding site necessitates urgent conservation. Integrating legal protection with community-based management offers a sustainable pathway. This study provides the first comprehensive avifaunal baseline, positioning Pariyej for potential IBA designation and highlighting the conservation value of small, unprotected wetlands in agricultural landscapes.

Appendix 1: Annotated Bird Checklist of Pariyej Lake (2020–2023)

(Selected species; full list available on request)

Common Name	Scientific Name	Status	Season	IUCN
Lesser Whistling Duck	<i>Dendrocygna javanica</i>	R	All	LC
Sarus Crane	<i>Grus antigone</i>	R	All	VU
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	R	Summer	NT
Northern Pintail	<i>Anas acuta</i>	WM	Winter	LC
Bar-tailed Godwit	<i>Limosa lapponica</i>	WM	Winter	NT
River Tern	<i>Sterna aurantia</i>	R	All	NT

R: Resident, **WM:** Winter Migrant, **NT:** Near Threatened, **VU:** Vulnerable, **LC:** Least Concern

References:

1. Shannon, C.E. (1948). A mathematical theory of communication. *Bell System Technical Journal*, 27, 379-423.

2. Balachandran, S. (2006). The decline in wader populations along the east coast of India. *Wader Study Group Bulletin*, 111, 24–29.
3. Sutherland, W.J. (2006). **Ecological Census Techniques: A Handbook** (2nd ed.). Cambridge University Press.
4. Bibby, C. J., et al. (2000). *Bird Census Techniques*. Academic Press.
5. CPCB. (2008). *Water Quality Criteria*. Central Pollution Control Board.
6. Grimmett, R., et al. (2011). *Birds of the Indian Subcontinent*. Oxford UP.
7. GEC. (2018). *Wetlands of Gujarat: Ecological Status*. Gandhinagar.
8. Parasharya, B. M., & Naik, R. M. (2007). Avifauna of Gujarat wetlands. *JBNHS*, 104(1), 27–34.
9. Parikh, J., & Parikh, K. (2002). *Gujarat's Environment*. CEE.
10. SACON. (2015). *National Wetland Inventory*. MoEFCC.
11. Sundar, K. S. G. (2009). Sarus Crane conservation. *JBNHS*, 106(2), 190–200.
12. Ramsar Convention Secretariat. (2013). **The Ramsar Convention Manual: a guide to the Convention on Wetlands (Ramsar, Iran, 1971)** (6th ed.). Ramsar Convention Secretariat.

Appendix: Summary checklist of conservation-concern species (available upon request)