International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Selected Birds Population at Pulicat Bird Sanctuary: A Statistical Review

Kanchi Siva Prasad

SKR Government Degree College, Department of Zoology, Tilak Nagar, Gudur 524 101, Tirupati District, Andhra Pradesh, India
Email: *kanchi1976[at]gmail.com*

Abstract: ***Pulicat Bird Sanctuary, one of the most significant coastal wetland ecosystems in South India, supports a rich diversity of resident and migratory avifauna. The present study provides a statistical review of the population dynamics of selected bird species at Pulicat Bird Sanctuary, with an emphasis on seasonal variation, species composition and abundance patterns. Systematic field surveys were conducted across representative habitats of the sanctuary during different seasons and bird populations were recorded using standard census techniques. Quantitative data were analyzed using descriptive statistical tools to assess population trends, relative dominance and frequency of occurrence of selected species. The results indicate clear seasonal fluctuations in bird populations, with a marked increase in migratory species during the winter months November to February, particularly among Greater Flamingo, Grey Pelicans, Grey Herons and Night Herons. Resident species exhibited relatively stable population levels throughout the year, reflecting habitat adaptability and resource availability. Statistical analysis revealed significant variations in species abundance across seasons, highlighting the influence of environmental factors such as water levels, food availability and climatic conditions. The study underscores the importance of long-term statistical monitoring to understand avian population dynamics and to evaluate the ecological health of wetland ecosystems. The findings from the years 2019-20 to 2023-24 provide baseline data that can support conservation planning, habitat management and sustainable biodiversity preservation efforts at Pulicat Bird Sanctuary.***

Keywords: Pulicat Bird Sanctuary, migratory birds, Flamingo, ecosystem.

1. Introduction

Wetland ecosystems are among the most productive and ecologically significant habitats, providing essential resources for a wide variety of flora and fauna, particularly avifauna. Birds are widely recognized as sensitive bio-indicators of environmental change and their population dynamics reflect the overall health of ecosystems. Pulicat Bird Sanctuary, located along the Coromandel Coast on the border of Andhra Pradesh and Tamil Nadu, represents one of India's largest brackish water lagoons and is an important wintering ground for migratory birds. The sanctuary supports a rich assemblage of resident, local migrant and long-distance migratory bird species, making it an ideal site for population-based ecological studies.

Pulicat Lake attracts thousands of birds annually, including flamingos, pelicans, storks, herons, egrets, sandpipers and plovers, owing to its favorable climatic conditions, shallow waters and abundant food resources. Seasonal influxes of migratory birds from regions such as Central Asia, Siberia and Europe significantly influence the overall bird population structure of the sanctuary. However, increasing anthropogenic pressures such as habitat degradation, pollution, changes in hydrology and climate variability pose serious threats to avian diversity and population stability in the region.

A statistical review of selected bird populations is crucial for understanding species abundance, seasonal variation and long-term population trends. Quantitative analysis helps in identifying dominant species, population fluctuations and ecological relationships within the wetland system. Such studies provide valuable baseline data for conservation planning and management strategies aimed at sustaining bird populations and maintaining ecological balance. The present study focuses on a statistical evaluation of selected bird species at Pulicat Bird Sanctuary to assess population patterns and seasonal dynamics, thereby contributing to avian ecology research and supporting informed conservation initiatives for this internationally important wetland.

2. Literature Review

Wetlands are globally recognized as critical habitats for avifauna, particularly for water birds that depend on these ecosystems for feeding, breeding and migration stopovers. Numerous studies have emphasized the role of bird population assessments in understanding wetland health and biodiversity conservation. According to Ali [1] and Grimmett *et al*. [2], wetlands in the Indian subcontinent support a high diversity of resident and migratory bird species, with population dynamics largely governed by seasonal and environmental factors.

Pulicat Bird Sanctuary, being one of the largest brackish water lagoons in India, has attracted considerable attention from ornithologists and ecologists. Early descriptive accounts by Ali and Ripley [3] highlighted the importance of Pulicat Lake as a wintering ground for migratory water birds, particularly flamingos, pelicans, storks and shorebirds. Subsequent studies focused on species composition and distribution patterns, reporting a high abundance of migratory species during the winter months, coinciding with favorable hydrological conditions and food availability.

Several researchers have employed quantitative and statistical approaches to analyze bird populations in wetland ecosystems. Bibby *et al*. [4] emphasized the importance of standardized census methods such as point counts, transect counts and total counts for obtaining reliable population data. Studies conducted in Indian wetlands, including Chilika, Kolleru and Vedanthangal, have demonstrated

significant seasonal fluctuations in bird populations, with statistical analyses revealing strong correlations between water levels, prey availability and bird abundance [5], [6].

Specific studies on Pulicat Bird Sanctuary have reported temporal changes in bird populations linked to both natural and anthropogenic factors. Kumar *et al*. [7] observed that alterations in salinity and water depth significantly influenced the distribution of waders and waterfowl in Pulicat Lake. Similarly, Prasad *et al*. [8] highlighted the impact of pollution, fishing activities and habitat modification on wetland avifauna, stressing the need for long-term monitoring. Recent observations have also indicated shifts in migratory patterns, possibly associated with climate change and changing monsoon regimes, which in turn affect bird population statistics.

Statistical reviews of selected bird populations provide valuable insights into species dominance, diversity indices and population trends. Shannon–Wiener and Simpson diversity indices have been widely used to quantify avian diversity in wetland habitats, allowing comparisons across seasons and regions [9]. Such quantitative measures help identify ecologically sensitive species and periods of vulnerability. In the context of Pulicat Bird Sanctuary, limited studies have systematically applied statistical tools to long-term population datasets, indicating a research gap in comprehensive quantitative evaluations.

Overall, the reviewed literature underscores the ecological significance of Pulicat Bird Sanctuary for avifaunal conservation and highlights the importance of statistical population assessments. Integrating traditional field observations with robust statistical analyses is essential for understanding population dynamics, detecting ecological changes and formulating effective conservation and management strategies. The present study builds upon earlier works by providing a focused statistical review of selected bird populations at Pulicat Bird Sanctuary, contributing to baseline data and supporting evidence-based wetland conservation efforts.

Figure 1: Greater Flamingo

Figure 2: Grey Pelican

Figure 3: Grey Heron

Figure 4: Night Heron

2.1 Statistical treatment of data on Migratory Birds

The data collected on migratory birds were subjected to appropriate statistical treatment to analyze population structure, abundance, diversity and seasonal variation. Field observations were organized species-wise and season-wise and raw count data were tabulated systematically for further analysis.

Descriptive Statistics
Basic descriptive statistics such as total count, mean, range and percentage composition were used to summarize the population size of individual migratory bird species. The mean population size was calculated to understand average abundance, while percentage occurrence helped in identifying dominant and rare species.

Relative Abundance (RA)
Relative abundance of each species was calculated using the formula:

$$RA(\%) = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

This measure helped in assessing the contribution of each species to the total migratory bird population.

Frequency of Occurrence (FO)

Frequency of occurrence was determined to assess how regularly a species appeared during the study period:

$$FO(\%) = \frac{\text{Number of visits in which the species was observed}}{\text{Total number of visits}} \times 100$$

Diversity Indices

To evaluate species diversity, standard ecological indices were applied:

Shannon–Wiener Diversity Index (H′) to measure species diversity.

Simpson's Index (D) to assess dominance.

Evenness Index (E) to understand the distribution of individuals among species.

Seasonal Comparison

Migratory bird population data were compared across seasons (pre-monsoon, monsoon, post-monsoon and winter) using graphical representations such as bar diagrams and line graphs. Percentage variation was calculated to identify seasonal population peaks.

Correlation Analysis

Correlation analysis was used to examine relationships between migratory bird abundance and environmental variables such as water level, temperature and food availability.

The statistical treatment provided a quantitative basis for understanding migratory bird population dynamics, seasonal trends and ecological significance, thereby supporting effective conservation and management strategies.

3. Results

From these results it is clear that Greater Flamingo population highest values recorded in the year 2020-21relative abundance 83.42 and least count recorded in the year 2023-24 is 71.2.

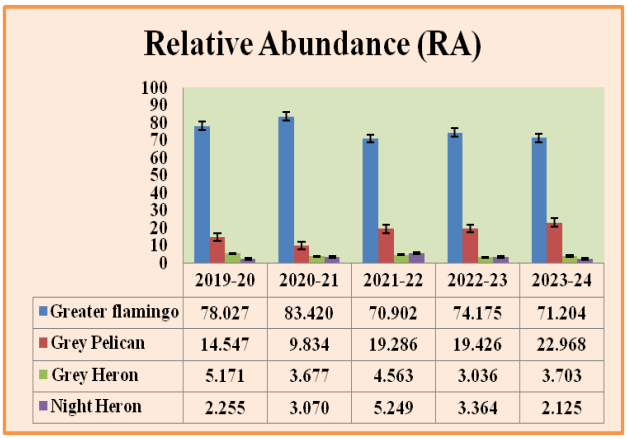
Contrary Grey Pelicans population highest values recorded in the year 2023-24 is 22.96 and lowest count recorded in the year 2020-21, Grey Heron population highest values recorded in the year 2019-20 relative abundance 5.17 and least count recorded in the year 2019-20 is 5.17. Contrary Night Heron population highest values recorded in the year 2021-22 relative abundance 5.24 and least count recorded in the year 2023-24 is 2.12.

Table 1: Selected Birds Population of Pulicat Bird Sanctuary from 2019-20 to 2023-24. (Mean Values) All the values recorded from November 1st to February 28th

Name of the Bird	2019-20	2020-21	2021-22	2022-23	2023-24
Greater Flamingo	15845	28452	16845	18546	16248
Grey Pelican	2954	3354	4582	4857	5241
Grey Heron	1050	1254	1084	759	845
Night Heron	458	1047	1247	841	485
Total	20307	34107	23758	25003	22819

Relative Abundance (RA)

Selected Birds Population of Pulicat Bird Sanctuary from 2019-20 to 2023-24.



4. Discussion

The temporal variation in relative abundance among the four water bird species studied reflects species-specific ecological responses to changing environmental conditions within the wetland ecosystem [10].

4.1 Greater Flamingo (*Phoenicopterus roseus*)

The data showed that the highest relative abundance of Greater Flamingo was recorded in 2020–21 (83.42), with a notable decline by 2023–24 (71.2). Such inter-annual fluctuations are common in flamingo populations and are often linked to wetland hydrology, food availability and climate variations. Flamingos are highly dependent on shallow saline or alkaline waters where filtering of plankton and small invertebrates occurs efficiently. Changes in water levels, salinity and productivity driven by rainfall patterns and wetland condition can concentrate or disperse food resources, resulting in variable counts between years. Research on flamingo abundance demonstrates that droughts and flooding affect wetland salinity and available foraging habitat, leading to marked annual fluctuations in their numbers. Long-term surveys elsewhere e.g., Mediterranean sites also show that flamingo numbers can vary significantly across years in response to habitat protection, water management and climatic influences, supporting the interpretation that environmental drivers are key determinants of relative abundance in Greater Flamingo populations

4.2 Grey Pelican (*Pelecanus philippensis*)

Contrary to flamingos, the highest counts for Grey Pelicans were observed in 2023–24 (22.96) and the lowest in 2020–21. Grey Pelicans are piscivorous and depend on fish abundance, open water expanses and fishable water depths for successful feeding. Increases in relative abundance may be attributed to improved fish productivity, stable water levels or reduced disturbance, which facilitate pelican foraging and perhaps enhanced breeding success. Similar patterns are documented in Indian wetlands where habitat conditions like fish stocks, water level, anthropogenic disturbance were found to significantly influence pelican and other water bird counts over time changes in species occurrence across protected and non-protected wetlands.

Environmental improvement or effective wetland management in recent years, therefore, may have contributed to the upward trend in Grey Pelican abundance by 2023–24.

4.3 Grey Heron (*Ardea cinerea*)

Summary indicates that both the highest and lowest relative abundances for Grey Herons were recorded in 2019–20 (5.17), suggesting relatively stable and low year-to-year variation. Grey Herons are widely resident water birds, adaptable to a range of wetland types and their counts often show less dramatic inter-annual fluctuations compared to highly mobile or migratory species. Research has shown that heron abundance can remain relatively stable over time, provided wetland habitats maintain adequate water and prey resources; minor variations often arise from local habitat changes rather than large climatic shifts

4.4 Night Heron (*Nycticorax spp.*)

The Night Heron displays the highest relative abundance in 2021–22 (5.24) and a steep decline by 2023–24 (2.12). Night Herons typically prefer dense vegetation near shallow water for foraging and shelter. Their abundance can be highly sensitive to disturbance, water quality, vegetation structure and human impacts. Significant declines can result from habitat loss, water level changes that reduce foraging zones, or increased disturbance, which is consistent with patterns seen in various heron populations where habitat alterations lead to reduced detectability and lower counts in successive surveys.

5. Conclusion

The contrasting trends among species illustrate how differential ecological niches and life histories influence annual changes in water bird abundance:

Greater Flamingos responded strongly to changes in wetland hydrology and food conditions, explaining their high counts in 2020–21 and decline thereafter.

Grey Pelicans showed growth in relative abundance by 2023–24, possibly due to improved fish availability or habitat stability.

Grey Herons remained relatively stable, reflecting broad habitat tolerance and less sensitivity to annual conditions.

Night Herons exhibited a sharp decline, likely tied to habitat quality changes and disturbance.

These findings align with water bird ecology research showing that wetland conditions, water availability, prey abundance and anthropogenic factors are key determinants of annual population variations among species with different ecological requirements.

References

[1] Ali, S. (2002). *The Book of Indian Birds*. Bombay Natural History Society, Mumbai.
[2] Grimmett, R., Inskipp, C., & Inskipp, T. (2011). *Birds of the Indian Subcontinent*. Oxford University Press, New Delhi.
[3] Ali, S. and Ripley, S.D. (1987) Compact Edition of the Handbook of the Birds of India and Pakistan. Oxford University Press, New Delhi.
[4] Bibby, C. J., Burgess, N. D., Hill, D. A., & Mustoe, S. (2000). Bird Census Techniques. Academic Press, London.
[5] Vijayan, V. S., & Vijayan, L. (2002). Conservation of wetlands of India – a review. *Tropical Ecology*, 43(1), 173–186.
[6] Rahmani, A. R. (2012). *Important Bird Areas of India*. Bombay Natural History Society, Mumbai.
[7] Kumar, A., Sati, J. P., Tak, P. C., & Alfred, J. R. B. (2005). *Handbook on Indian Wetland Birds and their Conservation*. Zoological Survey of India.
[8] Prasad, S. N., Ramachandra, T. V., Ahalya, N., Sengupta, T., Kumar, A., Tiwari, A. K.,
[9] Magurran, A. E. (2004). Measuring Biological *Diversity*. Blackwell Publishing.
[10] Wetlands International. (2010). *Waterbirds Population Estimates*. Wetlands International, Wageningen.