

Determining Abundance, diversity and trend of Water-birds in selected dam of Zoba Maekel, Eritrea, with a 10-Year Comparative Analysis

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1. Introduction

This report presents the findings of a senior research project conducted by fourth-year students in Zone Maekel, Eritrea. Waterbirds play a vital role in aquatic ecosystems, serving as indicators of environmental health and biodiversity. The study aimed to assess the current diversity and abundance of waterbird species in four selected dams, which serve as crucial habitats for both resident and migratory avian populations. Building upon a baseline study conducted in 2014, this project's central objective was to identify changes in the waterbird community over the last decade and to provide an updated ecological snapshot of these vital ecosystems.

The primary research question was: How have the diversity and abundance of waterbird species in the selected dams of Zone Maekel changed between 2014 and the present?

To address this, the project set out to achieve the following specific objectives:

- To identify and compile a comprehensive checklist of all waterbird species currently present at the study sites.
- To quantify the relative abundance of each identified species.
- To compare current species richness and diversity indices with those recorded in the 2014 baseline study.
- To provide actionable recommendations for the conservation and sustainable management of these habitats based on observed long-term trends.

Eritrea's diverse geography, including its numerous artificial wetlands, provides essential stopover and wintering grounds for a wide variety of migratory birds traversing the Great Rift

Valley flyway. These dams have become integral to the local ecosystems, supporting significant biodiversity. The 2014 study provided the first systematic baseline data on waterbird populations in this specific region, offering a crucial reference point for long-term ecological monitoring. Ecological metrics such as species richness (the number of different species) and the Shannon-Wiener diversity index (H') are standard tools used to evaluate the health and stability of an ecosystem over time.

2. Study Area, Sampling and Data Collection

The study was conducted at the same four dams analyzed in the 2014 study: Mai nefhi dam, Radar dam, Sembel dam, and Adi-nfas dam. These sites were chosen for their differing sizes, surrounding land use, and their role as representative samples of the region's aquatic habitats.



Figure 1: Topography of Mai-nefhi Dam

A systematic point-count survey method was replicated from the 2014 study to ensure direct comparability of data. Over a eight-month period, from September 2024 to April 2025, students conducted surveys during the wet and dry seasons at dawn and dusk—periods of peak waterbird activity— at pre-determined observation points around each dam. All

observed waterbird species were identified, and the number of individuals for each species was meticulously recorded using binoculars and field guides.



Figure 2: Associated Agricultural fields around the Dams

The collected data was compiled into a master spreadsheet. Species abundance was calculated by averaging the number of individuals of each species across all survey seasons. Species richness was determined by simply counting the total number of unique species. The Shannon-Wiener diversity index (H') was calculated. This analysis provided a quantitative measure of diversity that accounted for both the number of species and their relative abundance, allowing for a robust comparison to the 2014 baseline.

3. Results and Findings

A total of 40 waterbird species were identified across the four study sites in all seasons, representing a slight increase from the 38 species recorded in 2014. The data shows a clear increase in species richness across all three dams over the past decade. The diversity index (H') also increased for all sites, indicating not only more species but also a more balanced distribution of abundance. Notably, the population of the Egyptian Goose has more than tripled at all three dams compared to the 2014 figures, becoming the most abundant species observed.

4. Discussion

The observed increases in both waterbird diversity and abundance are significant and suggest a positive ecological trend in the region's wetlands. This could be attributed to several factors, including improved habitat conditions, changes in migratory patterns, or enhanced protection of these sites. The general increase in diversity indicates a healthier and more resilient ecosystem overall. However, the dramatic increase in the Egyptian Goose population warrants further investigation. While its presence contributes to the overall species count, a disproportionate increase in one species can sometimes signal an imbalance. This could be due to a lack of natural predators, increased food availability, or the species outcompeting others for resources. The long-term implications of this population shift on the broader waterbird community, including native residents and rarer migrants, must be monitored.

5. Conclusion and Recommendations

In conclusion, this project provides a crucial update to the 2014 baseline, demonstrating a positive trend in waterbird diversity and abundance in Zone Maekel's dams over the last ten years. The findings underscore the importance of these ecosystems for regional biodiversity and validate their role as a vital stopover on the flyway. These man-made habitats are indispensable for the conservation of waterbird populations in Eritrea and strongly recommend the implementation of long-term monitoring programs, targeted habitat protection measures, and strategic community engagement initiatives to ensure the continued sustainability of these ecosystems and their avifauna.

Based on our findings, the following recommendations were offered:

- Implement a permanent, long-term monitoring program to continue tracking population trends and to better understand the factors driving the observed changes.
- Conduct further research to investigate the ecological reasons behind the explosive growth of the Egyptian Goose population and its potential impact on other species.
- Develop conservation measures to protect these sites from excessive development and disturbance, which could reverse the positive trends observed.