Al-Turath Journal for Biology(ATJB)
Open Access Journal
ISSN Print: 3080-5732
Online : 3080-5740

Diversity and Conservation of the Mesopotamian Marshes of Southern Iraq: A Survey of a World Heritage Site

Wassan Kareem Ahmed[1] , Halah amer abduljabbar[1] , Ayser Imad Abdu-l Aziz[2]
1Department of Biology, College of Education for Pure Sciences, University of Samarra
2Medical laboratories Techniques, Al-Turath University, Baghdad, Iraq
Correspondence email: Ayser.imad@outurath.edu.iq

KEYWORDS
Waterbirds, Mesopotamian Marshes, Biodiversity, Conservation, UNESCO, Iraq, Wetlands

Received: 18/09/2025
Accepted: 05/12/2025
Available online 31/12/2025

ABSTRACT
Mesopotamian Marshes are the most significant wetland ecosystem in Iraq and an internationally significant location of migratory waterbirds in the West Asian- East African Flyway. In this paper, extensive surveys of waterbirds were examined during 12 months long (way, October 20236 September 2024) on three large marsh systems (Central, Hawizeh, Hammar). With the standardized number of counts of 48 sites (576 individual counts), we recorded 127 species (134,682 individuals) that belonged to 18 different families. All systems had species accumulation curves that approached asymptotes, which showed sufficient effort in sampling. There was a significant difference in the diversity of Shannon (H') between marsh systems (ANOVA: $F=8.42$, $p<0.01$): Central Marshes (H'=3.84) > Hawizeh (H'=3.62) > Hammar (H'=3.21). Twelve conservation concern species were listed with three being Vulnerable (Marbled Teal, White-headed Duck, Ferruginous Duck). Peak of Winter was 68,420 people (January). The species richness decreased by about 23 percent and winter populations by about 65; but due to methodological variations, the two cannot be exactly compared to past data in the 1970s (Scott 1995). The marshes maintained [?]1 percent of flyway populations of eight species and so met the qualifications of international status. The threats that are still present are the decrease in the water inflows, illegal hunting, and degradation of habitats. These results compose a very important base line information on conservation management of this UNESCO world heritage site.

DOI: https://doi.org/10.63964/atmj.2025.4.4

1. INTRODUCTION

The Marshes of the south of Iraq are the largest wetland ecosystem of Mesopotamia and of a unique relevance to biodiversity conservation in the world. These marshes are found at the confluence of the Tigris and Euphrates rivers and covered an area of more than 20,000km2 in the past which harbored unusual densities of migratory and breeding waterbirds. It was declared a UNESCO World Heritage Site in 2016 as both a natural and a cultural site, and the recognition of its Outstanding Universal Value (1).

The marshes are critically important in the West Asian-East African Flyway which is one of the main migration paths in the world where birds breed in Siberia and Central Asia and spend the winter in Africa and Middle East. In winter the marshes were traditionally the home of millions of waterbirds and in one day a record of over 400,000 had been recorded during the 1970s alone (Scott 1995; Evans 1994). The BirdLife International has declared it as an Important Bird Area (IBA) (2).

The marshlands have undergone extreme environmental transformations in the past decades. The 1990s deliberately drained down the ecosystem to a level less than 10 percent of its original size. Partial reflooding was commenced in the year 2003, however, recovery has been partial since there were lower inflows of water into the river by the upstream dams, irrigation demands and the drought situation in the region. According to climate change predictions, water stress will persist. The present

day area covered by the marsh is estimated at around 4,500-5,500 km2 throughout the seasonal water levels and yearly fluctuation (3).

Although of global importance, after the 1970s, extensive waterbird surveys have been occasional, even though done only sporadically. This work had the following objectives; (1) record the present waterbird species composition and abundance within the three major marsh systems; (2) quantify the seasonal changes in species richness and abundance; (3) compare the current status with historical where feasible; and (4) offer conservation management suggestions. Such data will be necessary in the efficient management of this internationally significant site (4).

2-MATERIALS AND METHODS

Study Area

The three major marsh systems of the south of Iraq covered by the research included (1) Central Marshes (Al-Ahwar al-Wusta) which lies between the Tigris and Euphrates, (2) Hawizeh Marshes which spans across the border of Iraq and Iran, and (3) Hammar Marshes which lie south of the Euphrates which have undergone the worst degradation and fluctuating water levels. The three systems had a total area of marsh land of about 4,500km 2.

Survey Design and Timing

Standardized waterbird surveys were repeated monthly during the period between October 2023 and September 2024 thus covering the whole annual cycle, autumn migration (October-November), wintering (December-February), spring migration (March-April) and breeding season (May-September). A total of 48 count sites / 13 stations were set in each of the three marsh systems consisting of 12, 10 and 8 at the fixed point count location areas (Central: 12, Hawizeh: 10, Hammar: 8; total 48 points 13 sites 12 months = 576 counts). Major habitat types (open water, reedbeds, mudflats and wet meadows) were chosen as points with a minimum separation of 2km to reduce cases of overlap.

Survey Methods

The identification and counting of points were performed by qualified observers with the help of 10x42 binoculars, 20-60x spotting scopes, and long-focal-length cameras (600mm) in order to identify and record them. The surveys were carried out in the morning (0600-1000 h) and in the late afternoon (1500-1800 h) hours when the activity of waterbirds is the most active. Observation of waterbirds was logged at every location in a 30-minute period of time when all the birds could be seen (usually 300-500 m, depending on habitat). The wooden boats (mashhouf) traditionally were used to get to the points in the areas of reeds. Iso (International, 18,000 hand-coded spread species identifications from The World Systematics nuclear gene dataset).

In large congregations (>100 people), the systematic counting techniques were used. Each flock was cut into blocks of known size, and counted by a series of observers, and averaged. Estimates were checked by the use of photographic counts wherever possible. We do admit that an estimate of large flocks must necessarily involve some error of counting; but it is hoped that this error will be reduced by the method of photographic validation and recording, and by the repetition of the scan. Photographic or sound recordings were made of rare and threatened species found worldwide. University of Basrah is the place where voucher photographs are stored.

Data Analysis

The indexes used to compute the level of species diversity were Shannon-Wiener index (H’ = -Sp ln p) and Pielou evenness (J’ = H’/ln S). To determine sampling adequacy, species accumulation curves were created in EstimateS v9.1 (100 randomizations) and curves that approached an asymptote showed that most species present were identified. Tukey post-hoc one-way ANOVA was used to compare the measures of diversity across marsh systems and seasons. Hierarchical cluster analysis (Bray-Curtis similarity) was used in measuring similarity in species composition between systems. The status was compared to the IUCN Red List 2023. The assessment of international thresholds of importance emphasized ([?]1% flyway population) was based on the Wetlands International population estimates. Statistical tests were conducted in SPSS v.26 and PRIMER v.7 and the significance of a=0.05 was used.

3-RESULTS

Richness and Composition of Species.

The total number of individual waterbirds counted during all surveys was 134,682 that represented 127 species belonging to 18 families. The families that had the most number of species were the Anatidae (ducks & geese + swans, 28 species), Scolopacidae (sandpipers, snipes, 24 species), Ardeidae (herons, egrets, 12 species) and Charadriidae (plovers, 10 species). All three marsh systems had species accumulation curves that approached the asymptotes after about 8-9 months of sampling and observed species richness was 89-96 percent of the estimated richness of Chao1 which

suggests that sampling effort was sufficient to describe the waterbird communities.

There was a great difference in species richness of marsh systems (ANOVA: F=12.6, df=2,33, p=0.001). The richest were Central Marshes with 108 species, Hawizeh (94 species) and Hammar (72 species). The post-hoc test by Tukey provided the result that all the pair-wise comparisons were significant ($p<0.05$). High Shannon diversity (H'=3.84+-0.12) was also found in Central Marshes as compared to Hawizeh (H'=3.62+-0.14) and Hammar (H'=3.21+-0.18) (ANOVA: F=8.42, $p<0.01$). Cluster analysis has combined Central and Hawizeh marshes at 68% similarity, and Hammar is having a separate cluster meeting at 42% similarity, or in its deteriorated state.

Table 1: Marsh System (12-month totals) Summary Statistics.

Parameter	Central	Hawizeh	Hammar
Species Richness (S)	108[a]	94[b]	72[c]
Total Abundance	62,840	48,620	23,222
Shannon Index (H')	3.84±0.12[a]	3.62±0.14[ab]	3.21±0.18[b]
Pielou's Evenness (J')	0.82	0.79	0.75
Peak Winter Count	32,450	24,860	11,110
Sampling Adequacy (%)*	96%	93%	89%

*Different superscript letters indicate significant differences ($p<0.05$, Tukey's HSD). *Observed species/Chao1 estimated species*

Seasonal Patterns

The abundance of the waterbirds was highly seasonal (ANOVA: F=24.8, $p<0.001$). The highest abundance was found in winter (December-February), and the highest single-level abundance of 68,420 individuals in January 2024 was found in all the-systems together. Anatidae (42% of individuals) were the dominant winter bird and especially Common Teal (Anas crecca, 12,450 individuals), Mallard (Anas platyrhynchos, 8,620), and Northern Shoveler (Spatula clypeata, 6,840). Migration (March-April) during spring was secondly most abundant with greater shorebird diversity. The lowest abundance was seen during summer (May-August) (12,840-18,420 individuals monthly), but the highest proportion of breeding residents.

Endangered and threatened species.

There were 12 global conservation concern species. There were three IUCN Vulnerable (VU) species: Marbled Teal (Marmaronetta angustirostris, 486 individuals), White-headed Duck (Oxyura leucocephala, 124) and Ferruginous Duck (Aythya nyroca, 842). Four Near Threatened (NT) -species Dalmatian Pelican (Pelecanus crispus, 68), Eurasian Curlew (Numenius arquata, 324), Black-tailed Godwit (Limosa limosa, 892), and Great Snipe (Gallinago media, 28). At least eight species, such as Marbled Teal (1.8% of the estimated population in Southwest Asia), Pygmy Cormorant (2.4%), and Glossy Ibis (1.2%), have their population supported by the marshes. These facts prove the international importance of the site in terms of preserving waterbirds.

Table 2: Extremely endangered and Near Threatened Waterbirds Reported Globally.

Species	IUCN	Count	% Flyway*	Main Season
Marbled Teal (Marmaronetta angustirostris)	**VU**	486	**1.8%**	Breeding/Winter
White-headed Duck (Oxyura leucocephala)	**VU**	124	0.6%	Winter
Ferruginous Duck (Aythya nyroca)	**VU**	842	**1.4%**	Winter
Dalmatian Pelican (Pelecanus crispus)	NT	68	0.4%	Winter
Pygmy Cormorant (Microcarbo pygmaeus)	LC	2,840	**2.4%**	Year-round

*IUCN: VU=Vulnerable, NT=Near Threatened, LC=Least Concern. *Percentage of estimated flyway population (Wetlands International 2024). Bold values indicate ≥1% threshold for international importance.*

Historical Comparison

Comparison to historical surveys indicates that there is a large drop in population but these differences in methodology prevent exact quantification. As part of the Mesopotamian wetlands survey, Scott (1995) summarized surveys made in the 1970s of 165 species of waterbird and wintering populations of more than 400,000 birds in the wetland, then spanning about 20,000km2. We surveyed 127 species (23% decrease) and maximum winter abundance 68,420 individuals (that is, about 65% decrease in winter populations). These comparisons however should be viewed with some caution due to the fact that: (1) historical

surveys were based on a much larger area (20,000 vs 4,500 km2); (2) the methods of survey were different (historical surveys involved aerial counts and larger area); (3) the effort of observers was not comparable between periods. However, the uniformity of declining species richness and decreasing populations, together with the 75 percent loss in the area of marshlands, is strong evidence of a finding of high ecological downgrade. Tighter evaluation would involve re-assessment of same locations through standard procedures.

4-DISCUSSION

This paper presents the most detailed survey of waterbirds in the Mesopotamian Marshes in decades and records 127 species, which substantiates the fact that the site remains relevant to waterbird conservation on a global scale. The conservation significance of these wetlands in their degraded condition is demonstrated by the occurrence of at least eight internationally significant populations ([?]1% flyway threshold) of 3 globally Vulnerable species. The most diverse and abundant habitat was the Central Marshes that did not lose the quality of the habitat and water supply (5).

The observed losses relative to previous levels, about 23 percent decrease in species richness and 65 percent in winter populations, are also in line with the enormous decrease in the extent of the marsh (>75 percent of the maximum number observed historically). Nevertheless, as it is observed, methodological variations between past and present surveys restrict the accuracy of such comparisons. What can be said with certainty is that: (1) the present-day extent of the marshland has significantly decreased as compared to in the past; (2) a number of species that could be found in the past (e.g. Sociable Lapwing, Basra Reed Warbler) could not be found at all or were very few in our surveys; and (3) the population is significantly lower in winter than at its highest levels in the 1970s. The standardized techniques of monitoring in the future should be implemented in a long-term monitoring program (6).

Hammar Marshes were less diverse and abundant than Central and Hawizeh systems due to its degraded state, and water levels fluctuated, and large areas were dry. Cluster analysis made it clear that Hammar has a specific poor waterbird community as compared to the other systems. This heterogeneity in conservation value in space must be used to prioritize management intervention. The Central Marshes should be given priority protection since it is in a fairly good condition and the marsh has the greatest value of biodiversity (7).

Study Limitations

There are a number of limitations that should be noted. To begin with, we did not systematically gather concurrent quantitative data of water levels, water quality, and vegetation; thus, restricting our degrees of modeling the species-environment relations. Further research ought to incorporate both the hydrological and habitat surveillance and bird surveys. Second, large flock estimates have uncertainty in them although we have used photographic validation and photographic validation of multiple observers. Third, cryptic species (rails, bitterns) can be not represented enough because these species are secretive. Fourth, the one-year period of survey is not in a position to record the inter-annual change associated with the water supply and the climate in the regions. Fifth, no careful breeding success data were obtained and this would help in generating essential information about viability of the population. It requires long-term monitoring which incorporates several biological and physical parameters.

CONCLUSION

The Mesopotamian Marshes are one of the most important conservation sites of waterbirds in the world despite the extreme degradation they experienced in the course of the past decades. The 12-month survey of the entire assessed area revealed 127 species of which three of the Vulnerable and four Near Threatened species were documented, and at least eight species of international importance. Areas with the most diversity and should be given priority conservation options are the Central Marshes. It compares historical data with the present, indicating that there have been massive losses in species richness and population, but there are methodological caveats. Some of the conservation measures suggested as urgent include: (1) the negotiation of regional agreements to provide minimum environmental flow of upstream dams; (2) the creation and enforcement of no-hunting areas, especially in key areas of concentration; (3) the formalization of protected areas under the law of Iraq in addition to the UNESCO status; (4) the community-based conservation programs through involvement of the Marsh Arab communities; (5) the creation and enforcement of conservation programs through the involvement of the communities; and (6) the creation and enforcement of a long-term monitoring program with the addition In the absence of these interventions, more deteriorations of this ecosystem that is of global significance are expected.

REFERENCES

1. UNESCO. Ahwar of Southern Iraq: Refuge of Biodiversity and the Relict Landscape of the Mesopotamian Cities. World Heritage Nomination; 2016.
2. BirdLife International. Important Bird Areas factsheet: Mesopotamian Marshlands. http://www.birdlife.org; 2024.
3. Richardson CJ, Hussain NA. Restoring the Garden of Eden: An ecological assessment of the marshes of Iraq. BioScience. 2006;56:477-489.
4. Scott DA. A Directory of Wetlands in the Middle East. IUCN/IWRB; 1995.
5. Evans MI. Important Bird Areas in the Middle East. BirdLife Conservation Series No. 2; 1994.
6. Wetlands International. Waterbird Population Estimates, 5th ed. Wageningen; 2024.
7. Gill F, et al. IOC World Bird List (v13.2). doi: 10.14344/IOC.ML.13.2; 2023.
8. Al-Sheikhly OF, et al. Current status of waterbirds in the marshes of Iraq. Sandgrouse. 2019;41:44-65.