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Research Article

Temporal changes in diversity and abundance of wintering birds in the Gavkhuni international wetland, Isfahan Province, Iran

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Abstract

Wetlands serve as critical habitats for migratory birds, providing vital resources for foraging, resting, and breeding. This study assessed the diversity and abundance of wintering aquatic and wader birds in the Zayandeh-Rud–Gavkhuni basin over five years (2020–2024). A total of 12,219 individuals from 57 species and 17 families were recorded. The Anatidae family, particularly *Anas platyrhynchos*, dominated the counts, reflecting its reliance on shallow foraging habitats. Biodiversity indices highlighted significant temporal variations. The Shannon-Wiener diversity index (H') and Simpson diversity index (λ) revealed the highest diversity levels in 2023 (H' = 3.248; λ = 0.953) and 2024, alongside a consistently increasing trend in species evenness, culminating in a Pielou evenness index of 0.946 in 2024. Despite these positive trends, the findings also exposed ecological vulnerabilities. Species like *Phoenicopterus roseus* have shown significant decline due to habitat degradation, reduced water inflow, and declining populations of *Artemia*-their main food source. These are attributed to the changed hydrological regime of the Zayandeh-Rud Dam and the prolonged drought conditions which have reduced wetland water levels and quality. Comparative analysis with previous studies reflected the resilience of Gavkhuni Wetland, with a higher species diversity and abundance than during the previous periods of droughts; however, annual fluctuations in the bird population varied between 352 individuals in 2023 and 6,367 in 2022, which reflected the sensitivity of this wetland to environmental stressors. This study emphasizes the importance of biodiversity monitoring as a tool for understanding ecological dynamics and informing conservation strategies. Reducing human-induced pressures and maintaining environmental flows would allow the wetland to continue as an important refuge for migratory avian species, thus supporting regional and global biodiversity conservation efforts.

Keywords: Ecological study, Species diversity, Biodiversity indices, Wetland conservation, Migratory birds

Introduction

Birds are widely acknowledged as sensitive bioindicators of ecosystem health and biodiversity, reflecting changes in environmental conditions and the balance of ecological processes (Gregory et al., 2003; Gregory & Strein, 2010). Wetlands are particularly valuable among ecosystems due to their support of diverse migratory and resident bird populations. These ecosystems provide critical habitats for breeding, feeding, and resting, hence playing a very important role in maintaining biodiversity by attracting different species of wildlife (Quan et al., 2002; Dehwari et al., 2024). Therefore, monitoring waterbird populations is an important approach in assessing population dynamics, habitat conditions, and migration patterns. It also gives very useful information on the effectiveness of conservation efforts, for example, habitat management practices that increase food availability and reduce predation risk to enhance bird survival (Colwell, 2010; Asgari et al., 2021).

The high dependence of aquatic and wader birds on wetland ecosystems underscores their importance as biological indicators of the health and stability of these sensitive ecosystems (Amat et al., 2010; Sonal et al., 2010). However, wetland ecosystems are increasingly under threat due to anthropogenic pressures and climate change. Climate models predict a rise in the frequency and intensity of droughts, exacerbating water scarcity in these ecosystems (Londe et al., 2023). For instance, studies have projected significant reductions in the maximum areas of key Iranian wetlands, including Bakhtegan, Gavkhuni, Choghakhor, and Parishan, by 2050 relative to their sizes during 1998–2012 (Sanjerehei & Rundel, 2017). Additionally, moisture anomaly analyses using the NDWI index have highlighted the complete desiccation of the Gavkhuni Wetland between 2013 and 2020 (Akbari Azirani, 2022). These changes underscore the urgency of conserving wetland habitats.

Iran's diverse habitats and climatic zones position it as a critical region within the African-Eurasian migratory flyway, providing essential wintering and breeding grounds for millions of aquatic and wader birds (Firouz, 1999). The country supports an estimated 376 migratory bird species (BirdLife International, 2025), playing a vital role in global bird conservation. However, bird populations along this flyway have steadily declined since the 1960s (Ramsar Convention on Wetlands, 2018). Between

1999 and 2006, the proportion of increasing waterbird populations under the African-Eurasian Waterbird Agreement dropped from 25% to 22%, while declining populations remained stable at 41–42% (Delany et al., 2007). Despite these trends, Iran remains a refuge for substantial numbers of migratory waterbirds, as evidenced by the International Waterbird Census (IWC), which recorded approximately 1,473,633 individual aquatic and waterside birds in 2022.

Several studies in Iran have examined bird census data to understand species richness and diversity trends across various wetlands. For example, a decade-long analysis (2001–2011) of the Gavkhuni Wetland revealed significant fluctuations in the population, species richness, and diversity of wintering migratory birds (Tabiee et al., 2012). Similarly, research on the Parishan Wetland showed that species richness is influenced by factors such as vegetation cover, water depth, and the extent of shallow areas (Jahanbakhsh et al., 2017). However, long-term trends indicate mixed outcomes: while the abundance of shorebirds in the Miyangaran Wetland has increased, waterfowl populations have declined significantly over the past two decades (Malekian et al., 2022).

Isfahan Province, located along major migratory routes for waterfowl, shorebirds, and landbirds, is a critical aggregation site for birds in Central Iran. The Gavkhuni International Wetland, a key ecological resource in the province, is recognized for its biodiversity, ecotourism potential, and economic significance. However, this wetland is under severe threats, including pollution, reduced water inflow due to the Zayandeh-Rud Dam, and unsustainable water use related to agricultural, industrial, and urban development, including inter-basin water transfer projects. These have accelerated the degradation of the wetland, resulting in loss of biodiversity and a reduced ecological function.

This study provides a comprehensive analysis of the Gavkhuni Wetland at the watershed level, focusing on habitat status and population dynamics of wintering birds over a five-year period. This paper aims at using the results of this research to inform data-driven management strategies and conservation efforts toward protection and restoration of this ecologically important wetland.

Materials and methods

Study Area

This study was conducted in the Zayandeh-Rud-Gavkhuni watershed, comprising the Zayandeh-Rud River and Gavkhuni Wetland (32.1364° N, 52.8605° E) in the Central Plateau of Iran. The Zayandeh-Rud River, originating from the Zardkouh Bakhtiari mountain in Chaharmahal and Bakhtiari Province, flows eastward through the Fereydounshahr and Fereydan counties before terminating at the Gavkhuni

Wetland. Gavkhuni Wetland, recognized for its ecological significance, was designated as a Ramsar site on June 23, 1975, highlighting its status as an international wetland.

The Gavkhuni International Wetland is located southeast of Isfahan, near Siahkouh, approximately 20 km from Varzaneh city (Fig. 1). Covering an area of about 47,000 hectares—extending to over 60,000 hectares when including surrounding lands—this wetland is sustained by the Zayandeh-Rud River, seasonal precipitation, temporary streams, and floods from nearby mountains. Gavkhuni Wetland serves as a critical wintering habitat for diverse migratory bird species.

Climatic conditions of the Gavkhuni Wetland are characterized by an average annual temperature of 17.6°C and annual rainfall of 91 mm, with a prolonged dry period from April to November (Amini et al., 2024). Dominant plant species include representatives of the Amaranthaceae family, with 31 species identified, while *Phragmites australis*, *Tamarix* spp., and *Salicornia europaea* are predominant vegetation in coastal zones. This wetland also supports a complex trophic network essential for migratory birds. A notable crustacean species, *Artemia salina*, forms a critical link in the wetland's food chain, sustaining the ecosystem's overall viability. Additionally, the Zayandeh-Rud basin supports three important fish species: *Petroleuciscus esfahani* and *Aphanius isfahanensis* (both endemic) and *Capoeta damascina* (a native species) (Coad & Bogutskaya, 2010; Asadollah et al., 2011; Keivany, 2013).

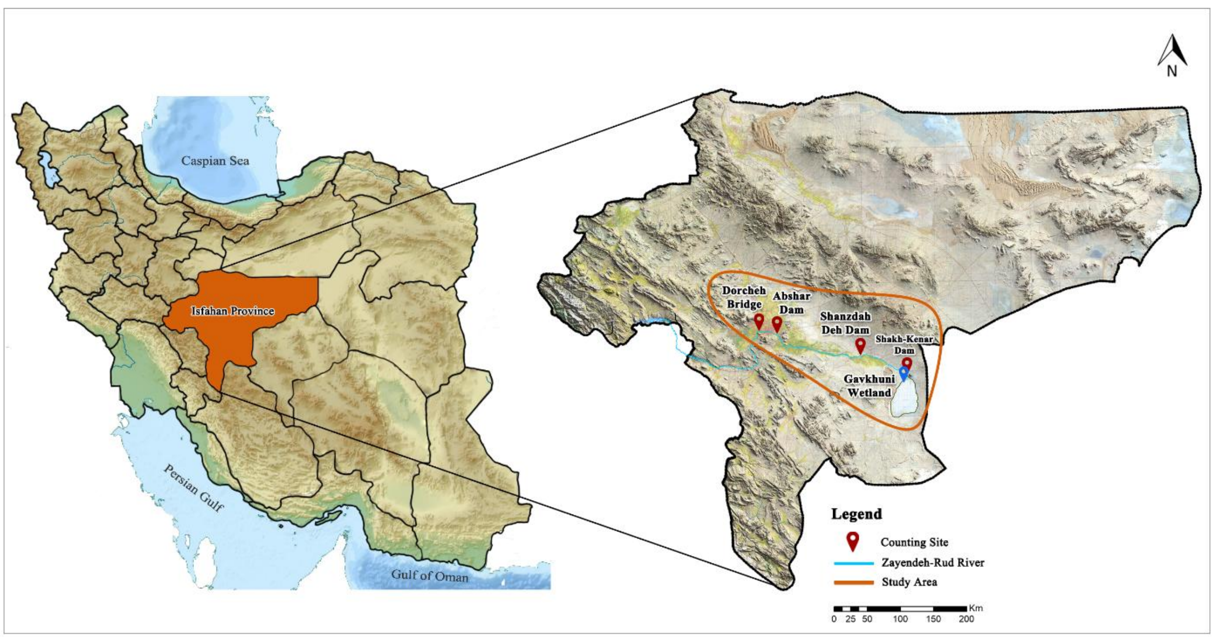

Figure 1. Location of bird census stations in the Zayandeh-Rud-Gavkhouni watershed

Bird Census and Sampling Design

Data for this study were obtained from the Wildlife Conservation and Management Department of Isfahan Province, encompassing bird census records collected between 2020 and 2024 (during the winter season). Bird identification and enumeration were conducted using the direct observation and total count method recommended by Wetlands International (Wetlands International, 2018). Observations were carried out using binoculars, a birdwatching scope, and a bird field guide to ensure accurate species identification. Census data were collected across five stations in the Zayandeh-Rud-Gavkhuni watershed (Fig. 1):

1. Dorcheh Bridge to Abshar Dam,
2. Abshar Dam – River Extension,
3. Abshar Dam to Shakh-Kenar Dam,
4. Gavkhuni – Shanzadah Deh Dam, and
5. Gavkhuni Wetland.

Raw bird data collected over the five-year period were compiled to assess trends in aquatic and wader populations.

Biodiversity Analysis

To evaluate the biodiversity of birds at the Gavkhuni Wetland and upstream stations, the following indices were calculated annually (Table. 1):

- Margalef's Species Richness Index (Rmg): Quantifies species richness.
- Shannon-Wiener Diversity Index (H'): Measures species diversity, incorporating species abundance and evenness.
- Simpson’s Diversity Index (λ): Represents the probability of encountering individuals of the same species.
- Brillouin Index (Ĥ): Accounts for the total population and species composition.
- Pileau Evenness (J'): Assesses species evenness.

The formulas for calculating these indices are provided in Table 1, where *S* represents the number of species, *N* is the total population, n_i is the number of individuals of species i_i, and p_i is the relative abundance of species *i* (Krebs et al., 2024).

Table 1. Diversity indices calculated in the study and their formulas

Index name	Index formula	Index domain
Margalef's species richness index	$Rmg = \frac{S-1}{Ln(N)}$	1-∞

Shannon-Wiener species diversity index	$H' = -\sum_{i-1}^{s}[piLnpi]$	0-5
Pileau evenness	$J' = \frac{H'}{Ln(S)}$	0-1
Simpson species diversity index	$D = \sum_{i-1}^{s} p_i^2$	0-1
Simpson dominance index (λ)	$\lambda = \sum_{i-1}^{s} p_i^2 = \sum \left(\frac{n_i}{N}\right)^2$	0-1

Statistical Analysis

Data were compiled and organized in Microsoft Excel, and statistical analyses were performed using Ecological Methodology software, PAST, and SPSS v19.0. A one-way ANOVA was employed to compare population densities across stations and years, with significance thresholds set at p-value < 0.05. These analyses provided insights into temporal and spatial fluctuations in bird populations, supporting the interpretation of ecological dynamics within the wetland ecosystem.

The Compound Annual Growth Rate (CAGR) was calculated for each of the 57 species to assess population growth trends over the study period. The formula used for this calculation is:

$$CAGR = \left(V_f/V_i\right)^{1/n} - 1$$

Where:

- V_f: Population size of each species in the final year of the study,
- V_i: Population size of each species in the first year of the study,
- n: Duration of the study period (in years).

This method provides a standardized measure of annual population growth, accounting for fluctuations in population dynamics over the study period. The results of the CAGR calculations are presented in Tables 5 and Appendix 1. The populations of each species were further analysed over the five-year period to determine statistical trends. Descriptive statistics, including the mean, median, and standard deviation, were calculated for each species to provide a detailed view of how populations vary and what the central tendencies are. A summary of the total population statistics over the five years is included in Appendix 1.

Results

The number and species of aquatic and shorebirds counted over a five-year period at the Gavkhuni Wetland and its upstream stations are detailed in Appendix 1. During this period, a total of 57 species of aquatic and shorebirds were identified and counted. These species belonged to 17 families, with their abundance and percentage composition summarized in Table 3. Over the study period, 12,219 individual birds were recorded. The most abundant species were the black-headed gull (*Larus ridibundus*) with 5,080 individuals, followed by the common coot (*Fulica atra*) with 2,621 individuals, mallard (*Anas platyrhynchos*) with 836 individuals, common teal (*Anas crecca*) with 647 individuals, and gadwall (*Anas strepera*) with 590 individuals. In contrast, species such as the white-winged tern (*Chlidonias leucopterus*), white-tailed sea eagle (*Haliaeetus albicilla*), and hawk (*Accipiter nisus*) were the least abundant, with only one individual recorded for each (Appendix 1). The annual count of wintering birds varied significantly across the five-year period. The highest number of birds was recorded in 2022, with 6,367 individuals, while the lowest count occurred in 2023, with only 352 individuals (Table 2). These fluctuations highlight notable temporal variability in bird populations in the study area.

Table 2. Statistics related to the census for the period 2020 to 2024

Year	Number of species	Total count
2020	23	3999
2021	17	782
2022	33	6367
2023	15	352
2024	31	719
Total	**57**	**12219**

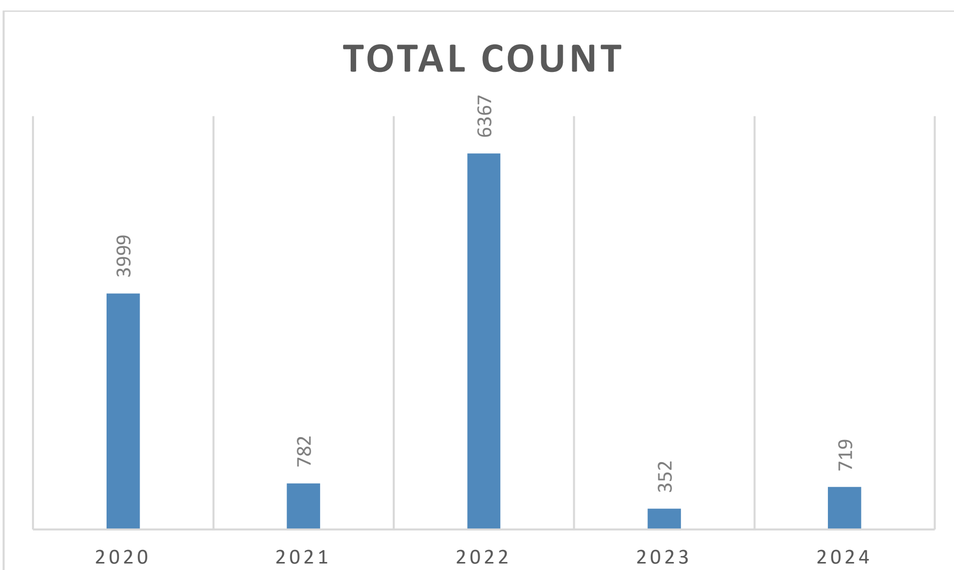

Figure 2. Chart related to the annual census and the number of individuals counted

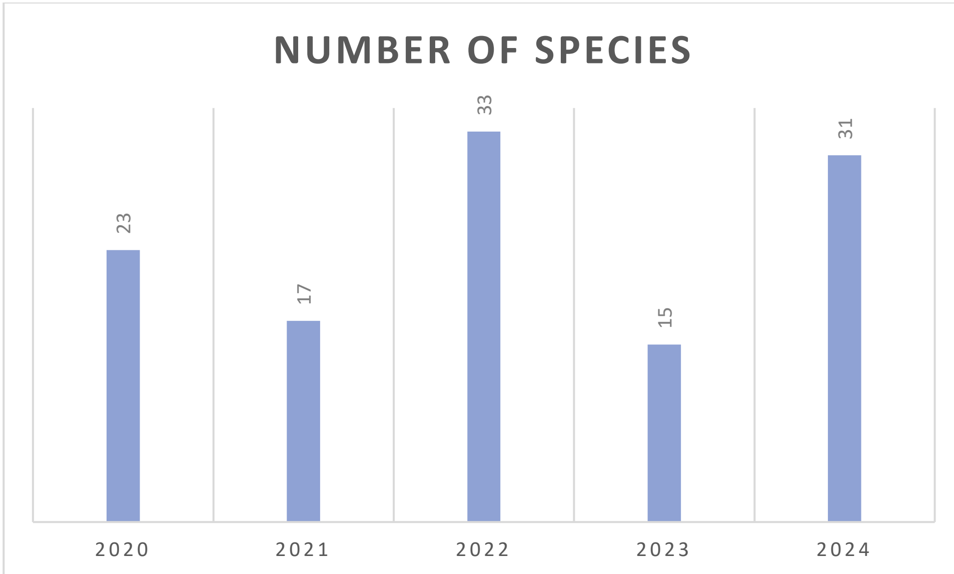

Figure 3. Species richness graph (number of species counted) per year

Table 3. Number of families, species and percentage abundance of each family over the entire five-year period

number	Family name	Number of species	Total number	Frequency percentage %
1	Anatidae	15	2416	26.32
2	Scolopacidae	8	475	14.04
3	Ardeidae	6	414	10.53
4	Accipitridae	4	48	7.02
5	Charadriidae	4	57	7.02
6	Rallidae	3	2828	5.26
7	Motacillidae	3	104	5.26
8	Laridae	3	5115	5.26
9	Podicipedidae	2	488	3.51
10	Alcedinidae	2	13	3.51
11	Phalacrocoracidae	1	13	1.75
12	Threskiornithidae	1	9	1.75
13	Phoenicopteridae	1	52	1.75
14	Gruidae	1	84	1.75
15	Recurvirostridae	1	81	1.75
16	Burhinidae	1	14	1.75
17	Emberizidae	1	8	1.75

Biodiversity metrics for the identified bird species, including Margalef's species richness index, Shannon-Wiener diversity index, Simpson's diversity index, Brillouin index, and Pileau evenness, are presented in Table 4. These indices provide insights into species richness, diversity, and evenness across the study area during the five-year monitoring period.

Table 4. Values of biodiversity indices in the Gavkhuni Wetland and upstream areas (Zayandeh-rud) from 2020 to 2024.

year	Margalef's species richness index	Shannon-Wiener species diversity index	Simpson species diversity index	Simpson dominance index	Brillouin index	Pileau evenness	Relative species richness (Jackknife estimate)	Beta diversity (Whitaker)
2020	2.653	0.888	0.348	0.651	0.876	0.283	-	-
2021	2.402	1.702	0.738	0.262	1.663	0.601	-	-
2022	3.653	2.077	0.792	0.207	2.064	0.594	-	-
2023	2.388	2.44	0.899	0.1	2.352	0.901	-	-
2024	4.713	3.248	0.953	0.046	3.148	0.946	-	-
All the years	5.951	2.128	0.768	0.231	2.117	0.526	82.6 (58.9-106.3)	0.93

The results presented in Table 4 and Figure 4 reveal temporal variations in species diversity across the five-year study period, as assessed by various biodiversity indices. The year 2020 exhibited the lowest diversity, with a total of 3,999 individuals representing 23 species, while the year 2024 recorded the highest diversity, with 719 individuals belonging to 31 species.

Notably, the Simpson index demonstrated an increasing trend from low to high diversity over the five-year period, highlighting an improvement in species evenness despite fluctuations in bird abundance. This finding underscores the index's robustness in capturing ecological patterns regardless of annual variations in population size.

Bird abundance exhibited significant year-to-year fluctuations, ranging from 352 individuals in 2023 to 6,367 individuals in 2022. While these fluctuations reflect the influence of annual environmental factors and potential differences in field survey efforts, the consistency of biodiversity indices across years validates the reliability of the data. In particular, the diversity indices appear to mitigate the impact of uneven field effort and environmental stresses, providing an accurate representation of the ecological dynamics in the study area.

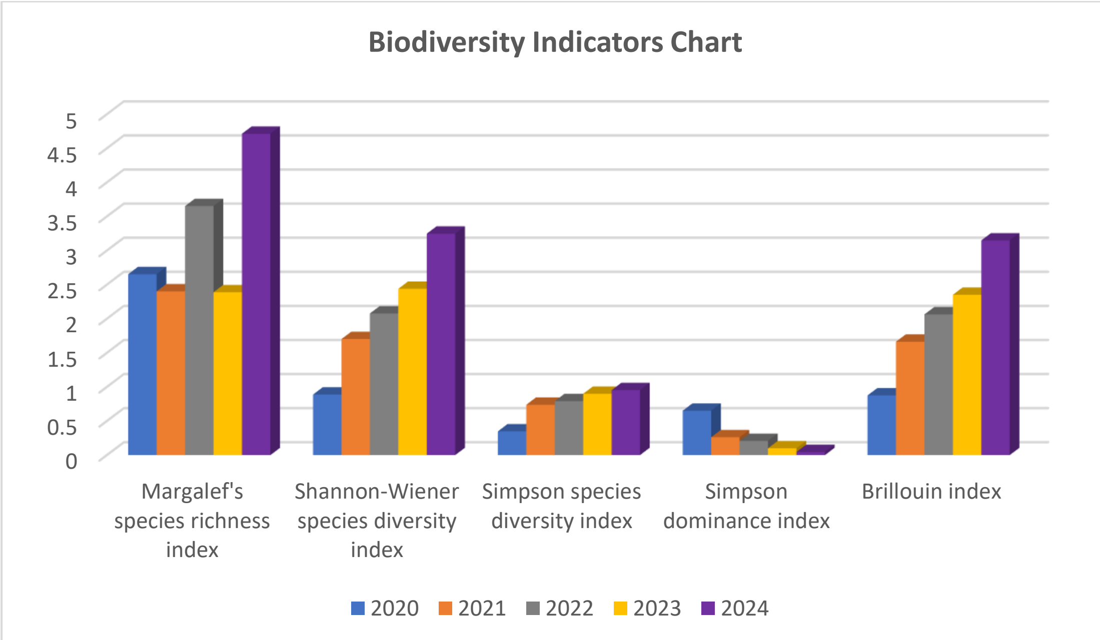

Figure 4. Chart comparing biodiversity indicators in different years

The Pielou evenness index varied across the study period, reflecting changes in species distribution and dominance. In 2020, the index was relatively low (0.283), indicating dominance by only a few species. By 2021, the evenness increased to a moderate level (0.601), suggesting a more equitable distribution of species, though some species remained dominant. In 2022, evenness values remained stable, indicating a relative balance in species distribution with slight dominance by certain species. In 2023, the index showed a marked increase, indicating a highly homogeneous species distribution with no clear dominance by any single species. The highest evenness value (0.946) was recorded in 2024, highlighting a highly balanced species abundance.

The cumulative Pielou evenness index across the five years was 0.526, reflecting moderate evenness in the study area. While some species exhibited a balanced distribution, specific species, such as the black-headed gull, great cormorant, and mallard, were dominant in the community. The increasing trend in evenness over time suggests a gradual shift towards a more balanced species distribution. However, the underlying drivers of this trend, such as ecological, environmental, or anthropogenic factors, remain uncertain. The five-year cumulative evenness value aligns with moderate overall diversity in the region.

The biodiversity indices calculated for each year show that diversity levels were highest in recent years (2023–2024), reflecting a balanced species distribution and high biodiversity during this period. Conversely, in earlier years, biodiversity levels ranged from moderate to low, with significant improvement observed over time.

According to data from the Department of Environment, a total of 106 bird species have been recorded in the study area, including the Gavkhuni International Wetland. Species richness was estimated using the Jackknife resampling method, which provides an estimate of the total number of species in an area, including unobserved species. The Jackknife estimate yielded a value of 83 species (95% confidence interval: 59–106 species). This value aligns closely with the actual number of 105 species recorded during the study period. The decimal precision of 82.6 in the estimate reflects the variability and uncertainty inherent in the resampling method. These results suggest the potential presence of additional species that may not have been identified during sampling efforts.

Beta diversity index (β), calculated as the ratio of regional to local species diversity, was 0.93, indicating a relatively high variation in species composition across habitats. This value suggests that differences in species structure may be attributed to habitat fragmentation or environmental gradients. Low Beta diversity would indicate a homogeneous species structure and uniform habitat conditions, whereas the observed high beta diversity reflects the heterogeneous and fragmented nature of the environment.

Annual growth rates for species populations are presented in Table 5 and Figure 5, illustrating notable fluctuations in abundance across the study period.

Table 5. Annual growth rates of populations and the entire study period.

Growth rate in percent	2020-2021	2021-2022	2022-2023	2023-2024	All five years
	-80.42	+729.37	-93.51	+84.08	-90.94

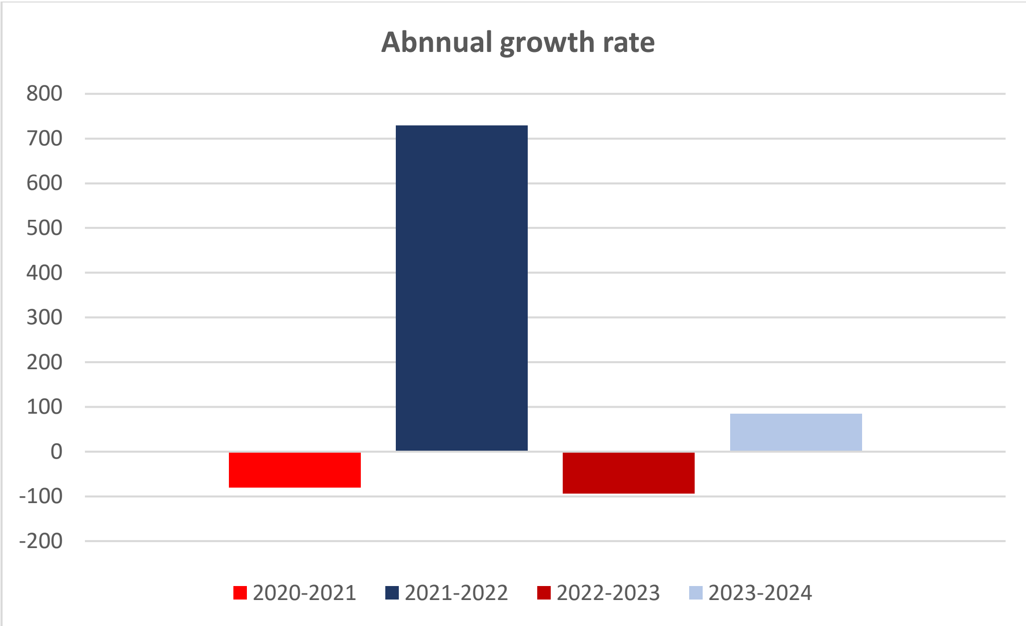

Figure 5. Bird population growth rate per year

The data reveal significant fluctuations in bird counts across years, some of which can be explained by variation in field survey efforts, for example, time available or energy for census attempts. These fluctuations, when considered independently of environmental factors such as drought, temperature variability, and environmental stresses, determine considerable increases and decreases in individual counts between years.

A decline in growth rate in many species may indicate deteriorating environmental conditions in wetland and river ecosystems, mainly due to the decrease in water flow and the drying of the Zayandeh-Rud River. These observations underline the adverse impacts of hydrological stress on bird populations, emphasizing the need for immediate conservation interventions to mitigate habitat degradation.

Discussion

The ecological health and biodiversity of wetlands can be effectively assessed through the monitoring of waterbird populations, which serve as bioindicators of environmental conditions (Owen & Black, 1990; Amat & Green, 2010). This study recorded 12,219 individuals from 57 aquatic and shorebird species along the Zayandeh-Rud River and the Gavkhuni Wetland during 2020–2024. The Anatidae family, particularly *Anas platyrhynchos*, was the most abundant, consistent with earlier regional studies (Tabiee et al., 2012). In contrast, families like Phoenicopteridae and Rallidae experienced population declines compared to earlier studies (Tabiee et al., 2012), likely due to reduced water inflow and

hydrological changes caused by the Zayandeh-Rud Dam, which has negatively impacted Artemia reproduction—an essential food source for flamingos (Savage, 1964; Zolfagharpour et al., 2022).
Biodiversity indices demonstrated increasing diversity over the five-year period, with 2024 exhibiting the highest diversity (Simpson's index λ = 0.953; Shannon-Wiener index H' = 3.248). Improved evenness in these years reflects more balanced species distribution, likely driven by favorable habitat conditions, including sufficient water levels and vegetation (Behrouzi-Rad, 2019; Tu et al., 2020). These results highlight the importance of maintaining environmental security and habitat quality to support migratory bird populations.
Comparisons with other wetlands in Iran underscore the Gavkhuni Wetland's notable biodiversity despite environmental stresses. For example, 57 species were observed in this study, surpassing earlier records of 18 species during drought-affected periods (2001–2011) (Tabiee et al., 2012). While the Shannon-Wiener index in the Gavkhuni Wetland (H′ = 2.128) is comparable to values from other Iranian wetlands, fluctuations in diversity reflect the challenges posed by chronic droughts and hydrological alterations.
The Gavkhuni Wetland is under great ecological pressure due to flow reductions upstream for various reasons. Droughts have been so severe, with changed flow regimes resulting in habitat shrinkage and threatening waterbird populations and biodiversity. Sustainable management strategies, including regulated water consumption, improved agricultural practices, and redirecting stored water for environmental purposes, are essential for restoring wetland health (Madani & Mariño, 2009; Haddad et al., 2022). Ensuring natural streamflow is crucial to maintaining the ecological integrity of this terminal wetland and mitigating the impacts of hydrological droughts (Zolfagharpour et al., 2022).
In conclusion, the Gavkhuni Wetland has shown the ability to maintain species diversity under environmental stressors. However, adequate water resource management and conservation measures should be implemented to ensure the wetland's ecological functions and support migratory bird populations in the long term.

Conclusion

This five-year study highlights the Zayandeh-Rud–Gavkhuni watershed as a critical habitat for migratory birds, showing remarkable biodiversity despite increasing droughts and environmental pressures. The identification of 57 species and an overall count of 12,219 wintering birds underscore the ecological importance of Gavkhuni Wetland. However, the wetland still falls short of meeting the

Ramsar Convention's bird criteria, highlighting an urgent need for conservation and restoration measures to be taken in view of the declining water levels and deteriorating habitat quality.

Targeted actions such as pollution control, sustainable agricultural practices, and habitat restoration are essential to reverse ecological degradation and improve the wetland's capacity to support biodiversity. Ecological monitoring and bird censuses will be an important component in tracking trends, addressing emerging challenges, and guiding adaptive management strategies.

By prioritizing sustainable water use and ecosystem restoration, Gavkhuni Wetland can continue to function as a vital refuge for migratory birds and a cornerstone for biodiversity conservation in this ecologically fragile region.

Appendix 1. Percentage growth rate and average number of individuals counted for each species over the entire five-year period.

row	Species name	Growth rate (%)	Total number counted	mean	median	Standard deviation
1	*Tachybaptus ruficollis*	49.594	480	96	26	102.899
2	*Podiceps nigricollis*	-78.52	8	4	4	2
3	*Phalacrocorax carbo*	0	13	13	13	0
4	*Ardea cinerea*	764.19	166	33.2	42	23.878
5	*Ardea purpurea*	-100	1	1	1	0
6	*Casmerodius albus*	596.44	93	18.6	18	13.994
7	*Egretta garzetta*	177.19	86	21.5	21.5	5.59
8	*Bubulcus ibis*	-100	15	15	15	0
9	*Nycticorax nycticorax*	45.582	53	17.66	17	4.109
10	*Plegadis falcinellus*	477.69	9	4.5	4.5	2.5
11	*Phoenicopterus roseus*	304.685	52	13	13	5.522
12	*Anser anser*	-100	44	44	44	0
13	*Tadorna ferruginea*	-100	19	19	19	0
14	*Anas strepera*	11594.179	590	147.5	39	210.535
15	*Anas crecca*	-95.538	647	161.75	160	127.332
16	*Anas platyrhynchos*	-82.491	836	167.2	149	129.937
17	*Anas acuta*	-100	26	26	26	0
18	*Anas querquedula*	-100	20	20	20	0
19	*Anas clypeata*	-100	12	12	12	0
20	*Aythya ferina*	-100	55	55	55	0
21	*Aythya fuligula*	-100	27	27	27	0
22	*Aythya marila*	-100	33	33	33	0
23	*Anas penelope*	-100	38	38	38	0
24	*Aythya nyroca*	0	28	28	28	0
25	*Mergus merganser*	0	5	5	5	0
26	Anatinae	-100	36	36	36	0
27	*Grus grus*	459.53	84	42	42	23
28	Rallidae	0	16	16	16	0
29	*Fulica atra*	-7.386	2621	524.2	75	790.617
30	*Gallinula chloropus*	-68.414	191	47.75	44	24.076
31	*Himantopus himantopus*	22.782	81	20.25	20.5	3.699
32	*Burhinus oedicnemus*	0	14	14	14	0
33	*Vanellus vanellus*	88.283	25	8.333	7	1.885

34	*Vanellus spinosus*	0	18	18	18	0
35	*Vanellus indicus*	0	2	2	2	0
36	*Charadrius spp.*	0	12	12	12	0
37	*Tringa erythropus*	-100	6	6	6	0
38	*Tringa totanus*	2589.459	303	101	21	126.8
39	*Tringa stagnatilis*	-90.477	70	35	35	24
40	*Tringa nebularia*	-100	6	6	6	0
41	*Tringa ochropus*	260.674	23	7.66	6	5.436
42	*Tringa* spp.	0	20	20	20	0
43	*Phalaropus lobatus*	0	32	32	32	0
44	*Gallinago gallinago*	312.159	15	7.5	7.5	3.5
45	*Larus ridibundus*	-99.894	5080	1270	925.5	1339.05
46	*Chlidonias leucoptera*	-100	1	1	1	0
47	Unidentified Terns	26.348	34	11.33	11	1.247
48	*Haliaeetus albicilla*	-100	1	1	1	0
49	*Buteo rufinus*	-100	1	1	1	0
50	*Circus aeruginosus*	-51.088	45	9	10	4.381
51	*Accipiter nisus*	-100	1	1	1	0
52	*Alcedo atthis*	-100	4	4	4	0
53	*Ceryle rudis*	260.674	9	3	2	1.414
54	*Motacilla alba*	-92.662	97	48.5	48.5	35.5
55	*Motacilla citreola*	-100	2	2	2	0
56	*Anthus spinoletta*	-100	5	5	5	0
57	*Emberiza schoeniclus*	-100	8	8	8	0
total	**57 Species**	**-90.949**	**12219**	**2443.8**	**782**	**2363.145**

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