

Avian Species Diversity and Population Dynamics at Eastern Al Dabasin Bridge, Khartoum, Sudan

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How to cite this paper: Adam, M. E. A., Khalil, M. S. M., & Mohamed, M. A. E. (2024). Avian Species Diversity and Population Dynamics at Eastern Al Dabasin Bridge, Khartoum, Sudan. *Journal of Geoscience and Environment Protection*, 12, 1-27. <https://doi.org/10.4236/gep.2024.1212001>

Received: October 16, 2024

Accepted: December 1, 2024

Published: December 4, 2024

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Abstract

Birds play a vital role in monitoring ecosystem health and biodiversity because they are relatively easy to observe and have been extensively studied. However, ongoing threats such as habitat destruction, fragmentation, and environmental changes have significantly impacted their populations and distribution patterns. This study focuses on assess the variety and relative richness of bird species at Eastern Al Dabasin Bridge in Khartoum, Sudan, as well as evaluating their current conservation status furthermore examines human activities impacting bird populations. Monthly surveys, conducted using the Point Counts method across wet and dry seasons between 7:00 a.m. and 10:00 a.m., documented species counts and locations. Identification utilized visual characteristics such as size, color, and vocalizations. A total of 3708 birds, representing 80 species from 17 orders and 41 families, were recorded. The most frequently observed species were the House Sparrow, Spur-winged Lapwing, Greater Blue-eared Starling, Laughing Dove, and Black Kite. Bird abundance peaked in June and December, with richness affected by seasonal and environmental conditions. All species observed were classified as Least Concern, underscoring the importance of conservation and sustainable management to protect local biodiversity and safeguard the long-term viability of bird populations in the area, it is essential to adopt a holistic approach to environmental management. This should include measures for pollution reduction, habitat rehabilitation, and the promotion of community education on the importance of conservation.

Keywords

Aldabasin Bridge, Abundance and Diversity, Point Count Technique

1. Introduction

Avian species stand out as one of the most noticeable and widespread groups of species across the planet, and their sensitivity to environmental shifts makes them valuable indicators of ecological health. Changes in climate, habitat, and resources are often quickly reflected in bird populations and behaviors, highlighting their role as responsive markers for assessing environmental conditions. Their distinct adaptability, as well as their role in various ecosystems, underscores their importance in understanding the impact of environmental alterations on biodiversity (Pradhan et al., 2023; Jha & Devkota, 2023).

Additionally, these species are pivotal indicators of environmental health and biodiversity due to their visibility and the wealth of information available about their behavior and ecology (Lawal et al., 2020). They contribute significantly to ecosystem functions, such as seed dispersal and pollination, while also providing important benefits to local economies through ecotourism (Girmay, Teshome, and Tesfamichael, 2020).

The richness of avian species is influenced by a variety of factors, including ecological competition and habitat variability, which can be exacerbated by climate change (Liang et al., 2018). With the increasing urgency for biodiversity assessments due to global environmental shifts, understanding bird populations is essential for both conservation efforts and attracting eco-conscious tourists (Bradfer-Lawrence et al., 2020).

This study delves into the diversity and population dynamics of bird species around the Eastern Al Dabasin Bridge wetland and its surrounding vegetation in Khartoum, Sudan. Addressing the notable gaps in knowledge about bird diversity and abundance in this region. This information is crucial for advancing effective biodiversity conservation strategies and offers valuable insights for future avian research and spotlighting bird-watching as a viable ecotourism activity, moreover examining migratory populations and assessing their conservation status, this study lays a foundation for protecting and managing these essential habitats in the future, further contributing to local and global biodiversity efforts.

2. Study Area

2.1. Description and Climate of Eastern Al Dabasin Bridge in Khartoum

This research took place at the Nothern Aldabasin Bridge, Khartoum Sudan it located on the White Nile upstream of the New White Nile Bridge linking Khartoum with Omdurman (Photo 1). The Aldabasin White Nile Bridge is expected a vital transportation link connecting the neighborhoods of Aldabasin and Khartoum North. This bridge will play a crucial role in facilitating travel and commerce across the White Nile, contributing to the region's infrastructure and connectivity.

The research site encompasses a variety of plant species, shrubs, and small trees, surrounded by traditional crop-filled agricultural fields. Scattered palm trees and fruit orchards, each hosting unique bird habitats, complement the diverse landscape.

Bordered on one side by the Nile River, this location is situated amidst alongside primary agricultural irrigation canals, featuring thick clusters of greenery, undergrowth, and various tree species. The study area is regarded as an important habitat for birds due to its surrounding vegetation and wetlands, which provide suitable environments for avian species.

Khartoum is situated at a geographical crossroad, with coordinates ranging from 15°N to 16°N latitude and 31.5°E to 34°E longitude. The city experiences a pronounced climate: summers are typically rainy, while winters are cool and dry. Temperatures in the summer months, particularly from April to June, can soar between 25°C and 40°C. In contrast, from July to October, they generally fluctuate between 20°C and 35°C. This vibrant city lies at the convergence of the Blue and White Nile rivers, with Omdurman to the west and Khartoum North to the north, creating a significant urban area in Sudan (Ali, 2017).

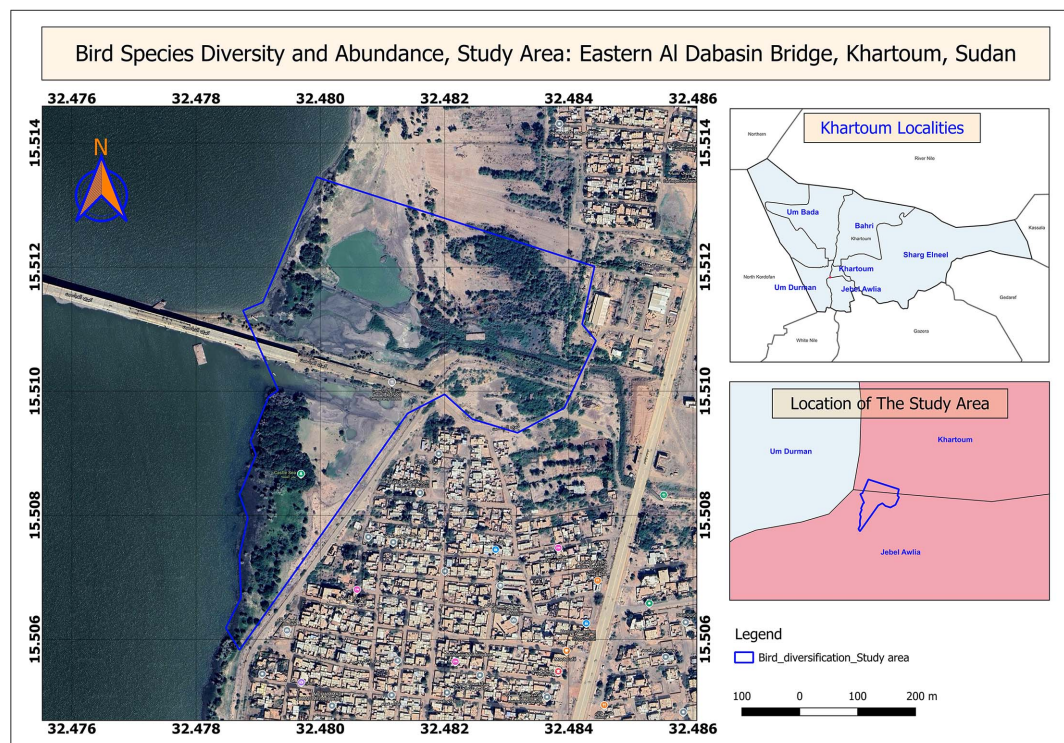


Photo 1. Map indicating the location of the Eastern Al Dabasin Bridge in Khartoum, Created by (Mohamed, 2024).

2.2. Data Collection Procedures

The research was spanned between June and December 2022, encompassing the concluding rainy and warm months. Standard observation data, including avian species, individual counts, climatic conditions, and timing, were documented. Surveys relied on both personal observations and photo documentation, consistently conducted at fixed time each day throughout the study duration, Bird counts and identification surveys were performed once monthly. Field data collection utilized the “point count” technique, which involves counting from a stationary

position, ideal for observing easily visible or vocal bird species across various habitats (Gibbons et al., 1996). For this study, birds were observed from an elevated, fixed point within a 50-meter radius circle for a set period of 10 minutes at each location, following an initial 5-minute adjustment period. Data were collected from 7:00 in the morning to 10:00 during peak bird activity was maximum, to ensure optimal data collection, observations were conducted only during favorable weather conditions (Canterbury et al., 2000). To minimize disturbances while counting, careful measures were implemented, including maintaining a quiet demeanor and keeping a respectful distance from the birds (Bibby et al., 1992). To prevent the issue of double-counting, the study area was segmented according to the birds' distribution patterns and various habitat types (Datiko and Bekele, 2012). Bird species identification was achieved by examining various morphological features, including plumage patterns, size, shape, coloration, and calls, complemented by consulting field guides (Stevenson and Franshawe, 2002; Redman et al., 2009). When identification was challenging, digital photographs were taken to confirm species classification. To minimize the chance of overestimating populations, any bird heard but not seen was logged only once per counting session to prevent duplicate recordings due to repeated calls by the same individual (Stevenson and Franshawe, 2002). Song and call references (Chappuis, 2000; Hammick, 2002) were matched with those of birds heard during the survey. Lastly, a checklist was compiled based on each species' scientific and common names, as well as their IUCN status, in alignment with BirdLife International (BirdLife International, 2017). In this study, we utilized a high-magnification (50 × 50) binocular setup alongside a Swarovski telescope with a calibrated range of 660 - 940, selected specifically for their compatibility with varied field conditions. Each observation was documented visually through a digital camera and systematically logged on data sheets customized for efficient field use, bird identification was assisted by the Birds of Africa South of the Sahara (2nd ed., 2010) by Peter Ryan and Ian Sinclair (Sinclair & Ryan, 2010).

2.3. Data Analysis

Once the field data were collected, the observations were systematically organized in an Excel spreadsheet for further processing. This included species counts, weather conditions, time of observation, and the specific locations of each survey. The data were then categorized by species, month, and survey location, enabling easy identification of patterns in bird distribution and abundance (Sutherland et al., 2004).

To understand species richness, the number of different species recorded in each survey was tallied, and these figures were aggregated by month to examine how species diversity changed throughout the study period. The abundance of each species was determined by counting the total number of individuals observed per species during each survey, and these numbers were compiled monthly to track shifts in population dynamics over time (Magurran, 2004).

The analysis also aimed to explore distribution patterns, particularly how

species were spread across various habitats and how these patterns changed seasonally. By reviewing the monthly abundance data, we were able to observe any trends in bird populations that might be linked to the time of the study (Whittingham & Evans, 2006).

Environmental factors such as temperature and humidity were considered alongside the bird counts, these climatic variables were then compared with the bird population data to look for variation in seasons. While no statistical tests were applied, visual inspection and simple comparisons helped us assess how seasons might have influenced bird behavior and population patterns (Davies et al., 2009).

To ensure the data's integrity, the spreadsheet was thoroughly reviewed for any discrepancies or duplicates, and these were corrected or removed. Once the data were cleaned, it was used to create visual representations such as graphs and tables, which helped illustrate the trends in bird abundance and species richness throughout the study. This process provided a clearer understanding of the results and supported the interpretation of the study's findings (Dytham, 2011).

3. Results and Discussion

3.1. Bird Diversity within Orders

Throughout the study, a comprehensive record of 80 bird species was documented, totaling 3708 individuals. These species belonged to 41 families and 17 orders. See (Figure 1) showcasing varied abundances in the North Aldabasin Bridge area. The distribution within orders is as follows: 1 species belongs to the Psittaciformes order, another to Cuculiformes, 1 to Suliformes, 2 species are classified under Anseriformes, and 1 additional species is included in Caprimulgiformes, 1 species in Gruiformes, 1 species in Coliiformes, 1 species in Recurvirostridae, 2 species in Accipitriformes, 10 species in Pelecaniformes, 2 species in Apodiformes, 16 species in Charadriiformes, 3 species in Columbiformes, 2 species in Bucerotiformes, 30 species in Passeriformes, 5 species in Coraciiformes, and 2 species in Ciconiiformes. See (Figure 2) and (Figures 3-20).

The variety of bird orders found in Eastern Al Dabasin Bridge demonstrates a rich tapestry of ecological roles, indicative of the area's capacity to support a wide array of avian niches. Passeriformes, with its large number of species, highlights a typical pattern in which more adaptable and generalist groups dominate diverse landscapes. Furthermore, the presence of Pelecaniformes, which rely on aquatic habitats, underlines the significant influence of the nearby Nile River, supporting niche differentiation and resource partitioning among water-dependent species (Brown, 1984). Specialized orders like Psittaciformes and Caprimulgiformes appear in smaller numbers, suggesting limited or higher dependency on specific resources. The diverse orders observed indicate a balanced ecosystem, where competition is minimized through varying levels of specialization and habitat preferences.

3.2. Bird Diversity within Families

The most abundant family had stood out as the most abundant and species-rich,

indicating its diversity in the Eastern Al Dabasin Bridge, is the “Ardeidae”, Subsequently “Scolopacidae”, “Estrildidae”, “Muscicapidae” and “Columbidae”, all of which were notably well-represented across the study study area, In contrast, families such as “Platystridae”, “Indicataridae”, “Glaredidae”, “Psitadidae”, and “Coraciidae” were observed in lower numbers and contained fewer species; Additionally, families like the “Ciconiidae”, “Caprimulgidae”, and “Recurvirostridae”, Ciconiidae, Coliidae, Coraciidae, Cuculidae, Hirundinidae, Jacanidae, Leiothrichidae, Passeridae, Phalacrocoracidae, Pluvianidae, Psittaculidae, Pycnonotidae, Rallidae, Sturnidae, Sylviidae and Upupidae (**Figure 21**).

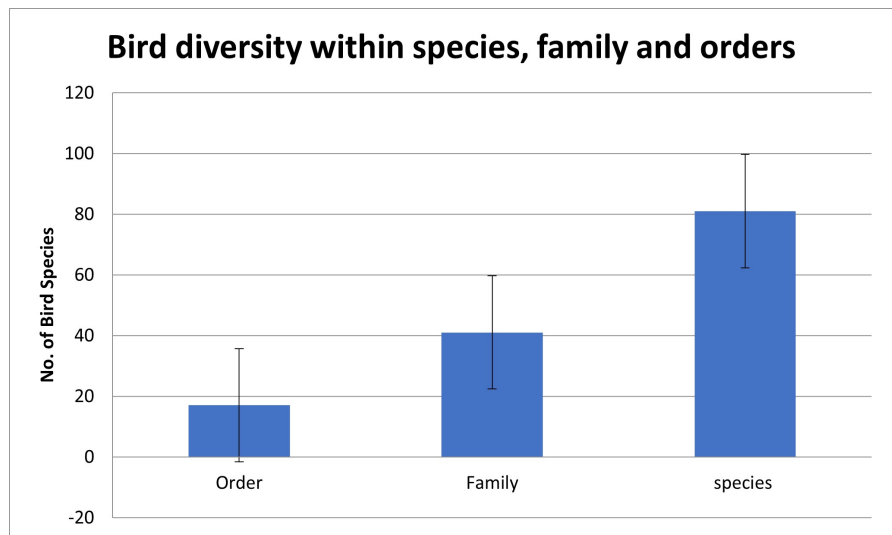


Figure 1. Total number of Bird diversity within species, family and orders observed in Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

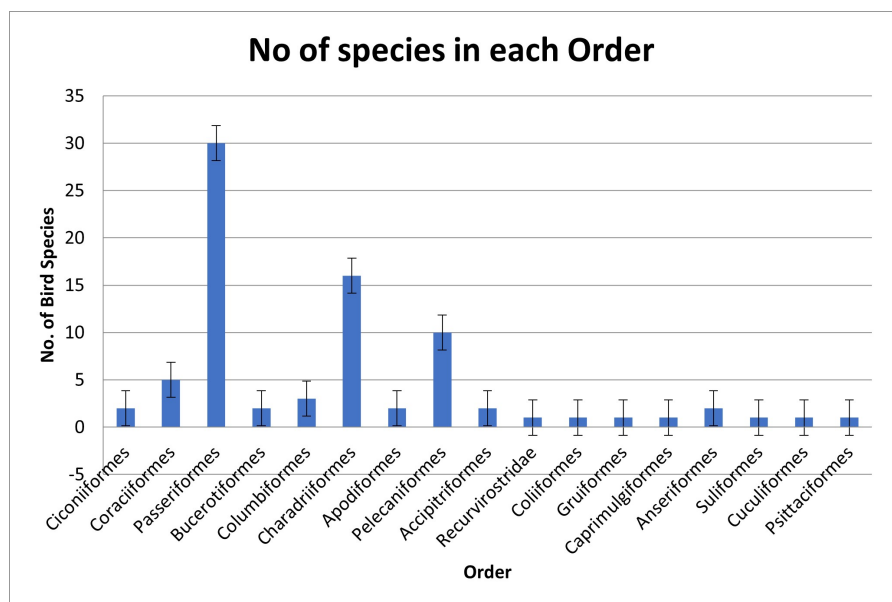


Figure 2. Total bird species within each Order recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

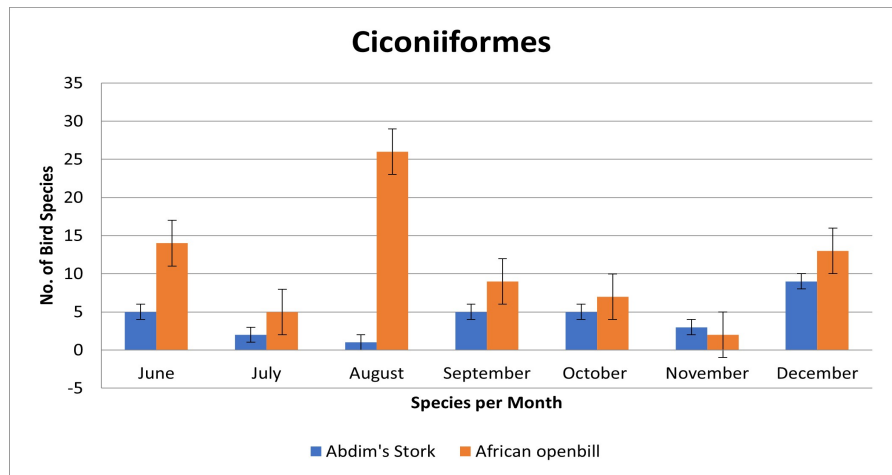


Figure 3. Total bird species within the Order Ciconiiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

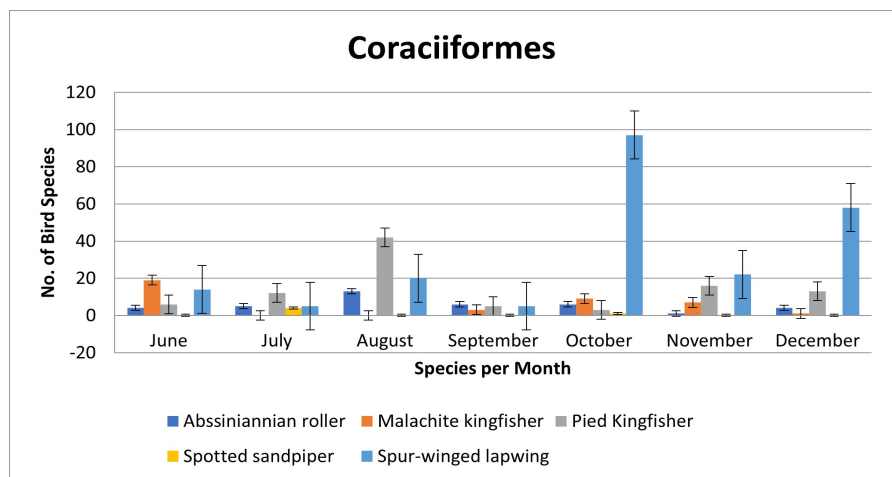


Figure 4. Total bird species within the Order Coraciiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

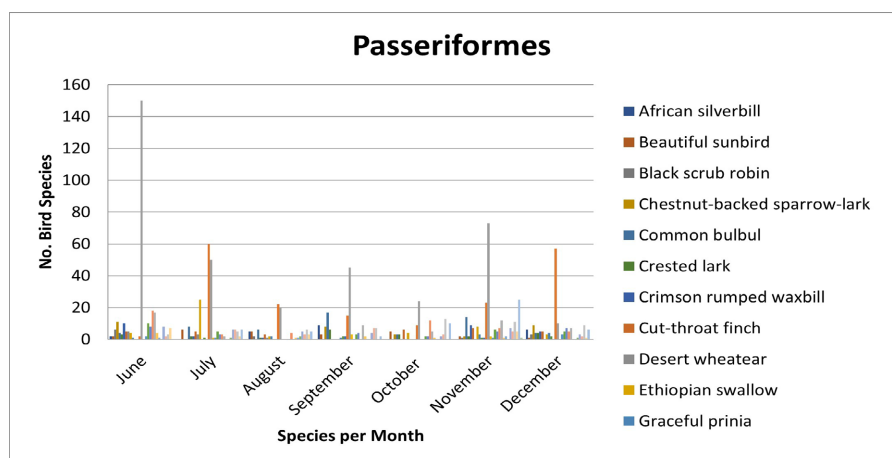


Figure 5. Total bird species within the Order Passeriformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

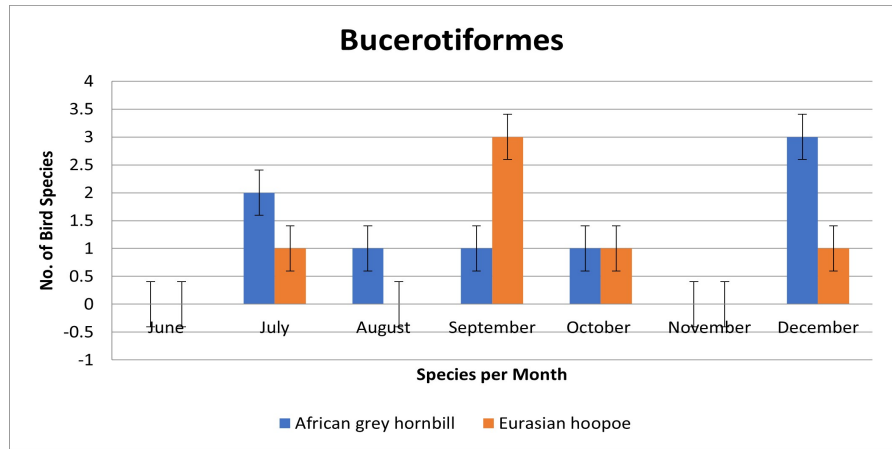


Figure 6. Total bird species within the Order Bucerotiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

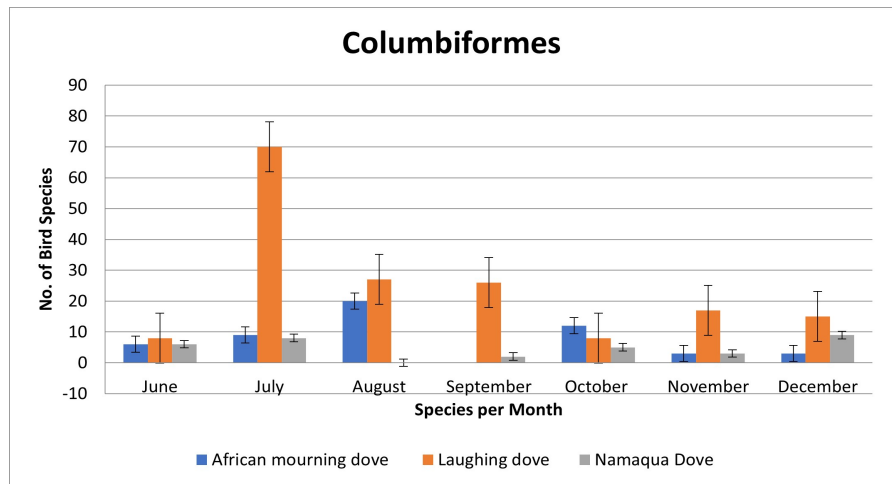


Figure 7. Total bird species within the Order Columbiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

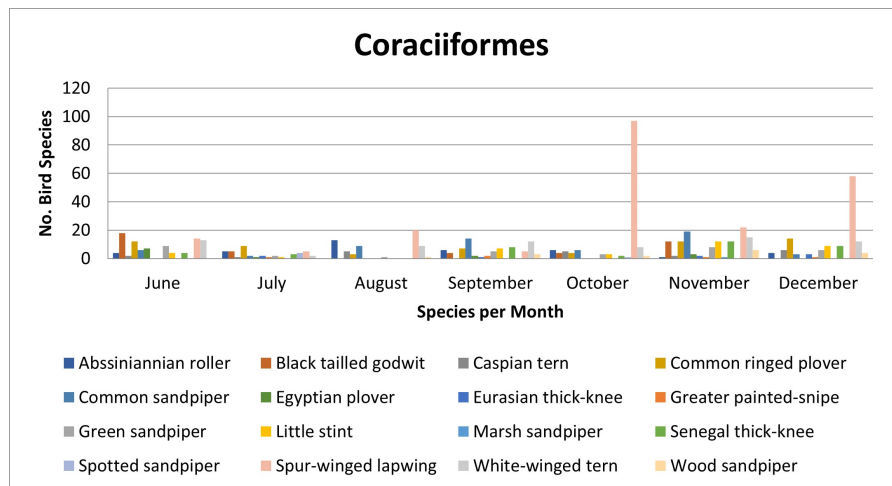


Figure 8. Total bird species within the Order Coraciiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

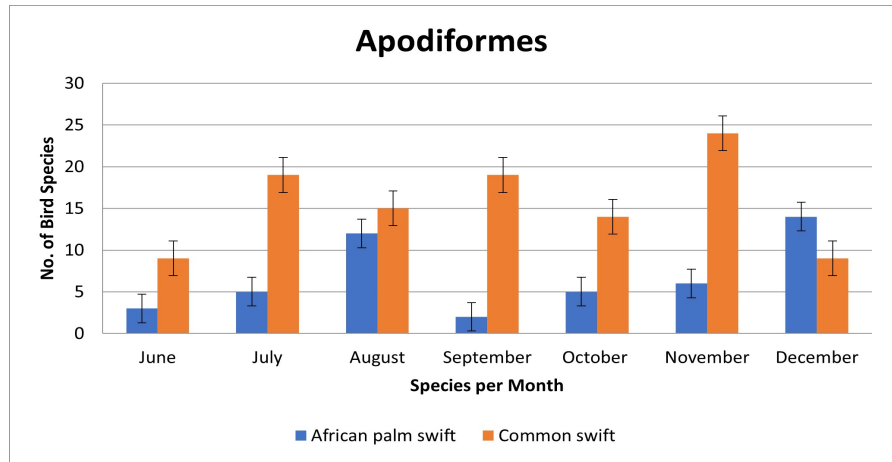


Figure 9. Total bird species within the Order Apodiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

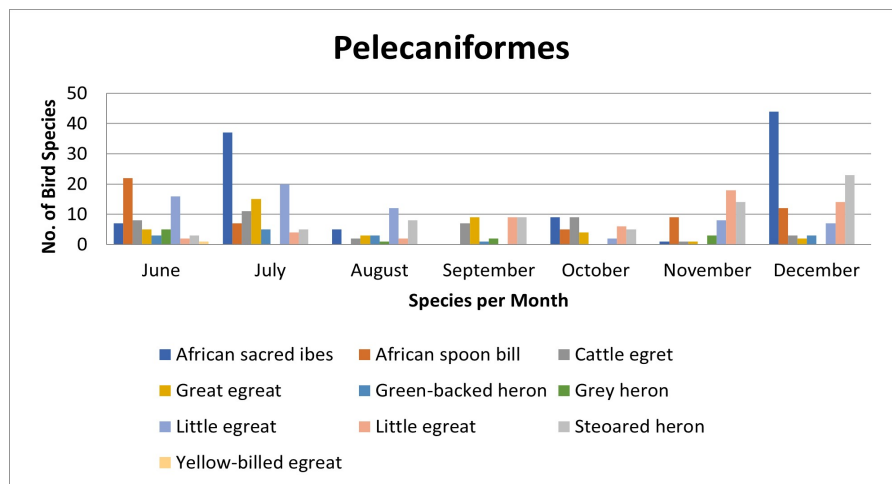


Figure 10. Total bird species within the Order Pelecaniformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

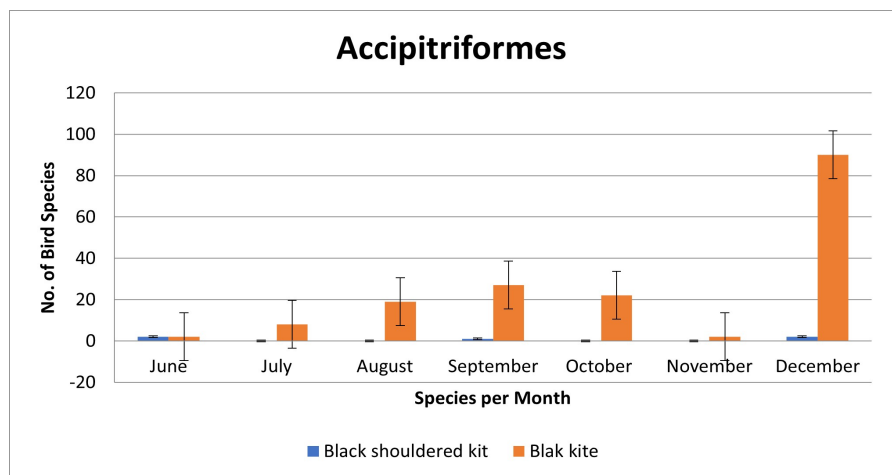


Figure 11. Total bird species within the Order Accipitriformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

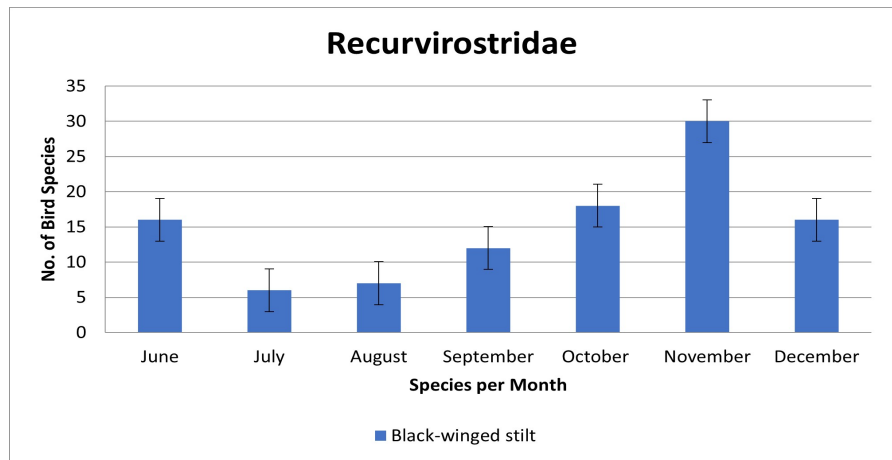


Figure 12. Total bird species within the Order Recurvirostridae recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

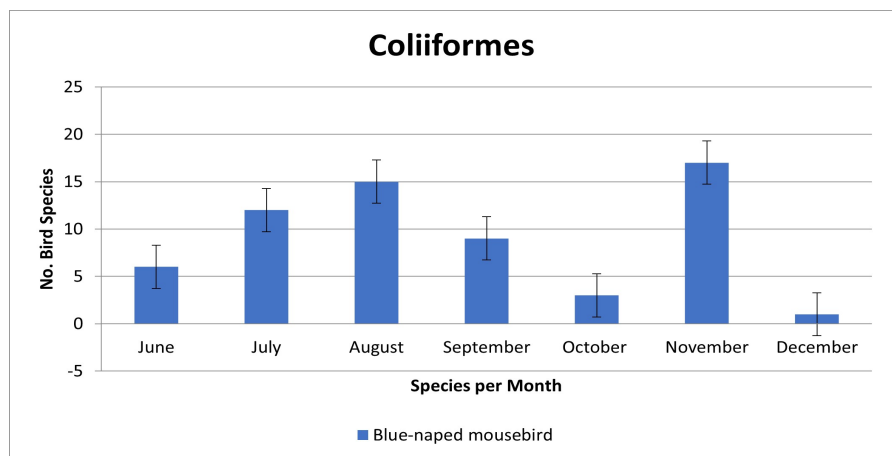


Figure 13. Total bird species within the Order Coliiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

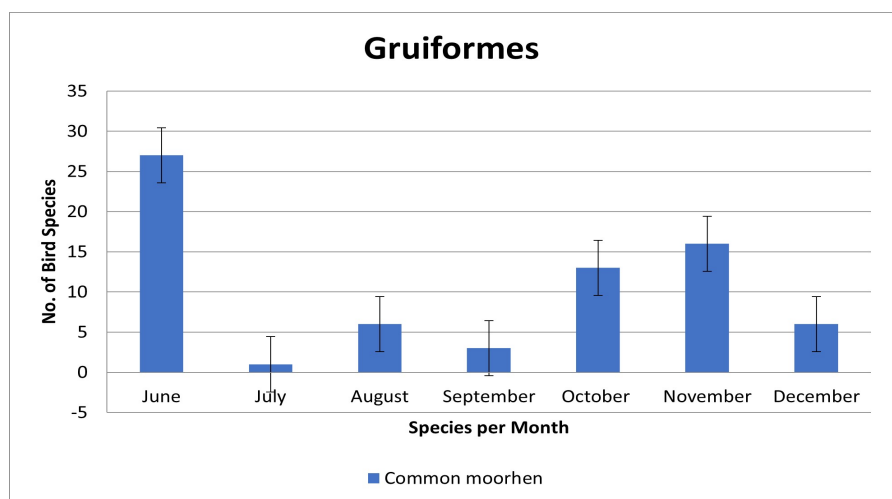


Figure 14. Total bird species within the Order Gruiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan, from June to December 2022.

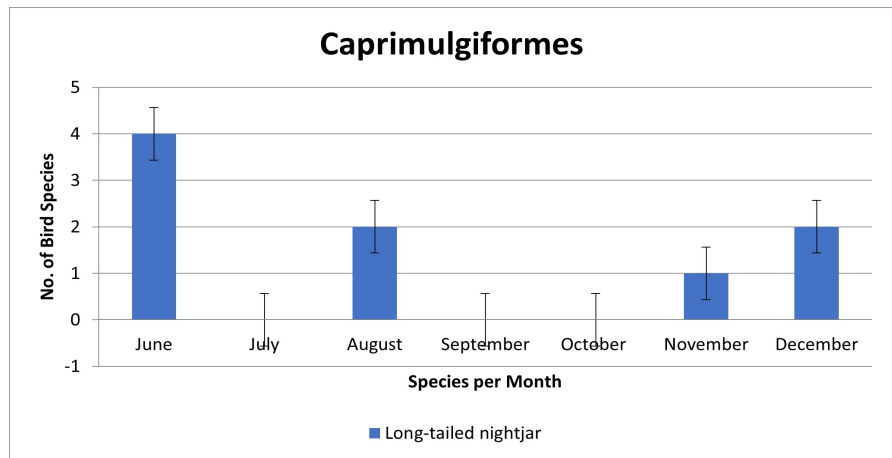


Figure 15. Total bird species within the Order Caprimulgiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

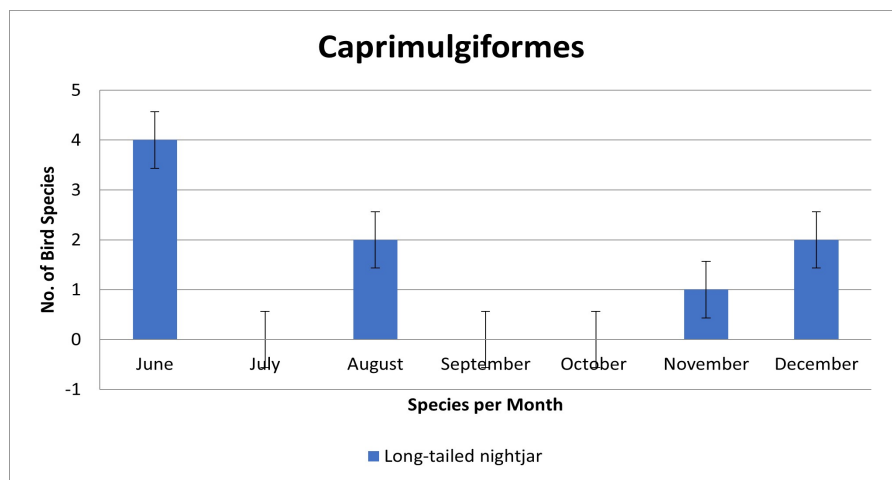


Figure 16. Total bird species within the Order Caprimulgiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

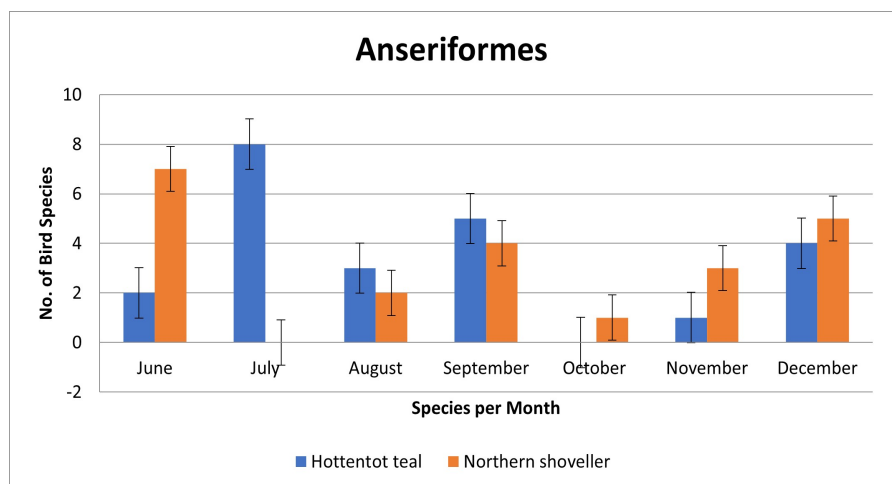


Figure 17. Total bird species within the Order Anseriformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

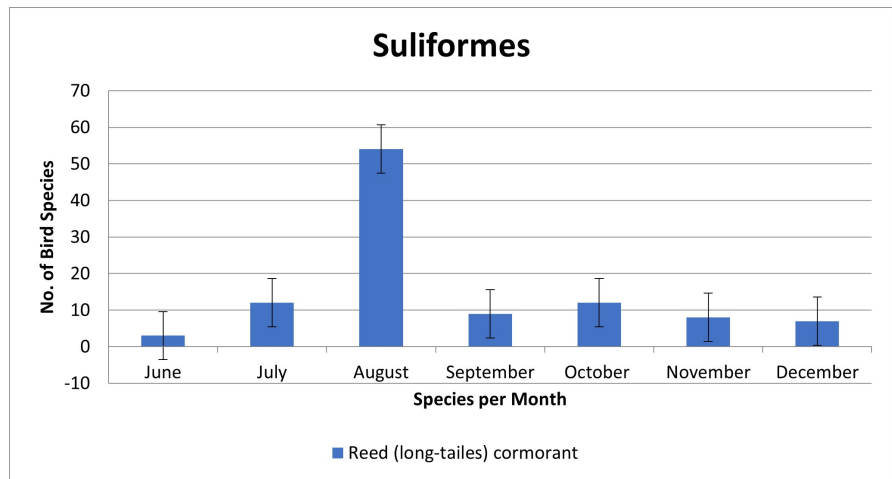


Figure 18. Total bird species within the Order Suliformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

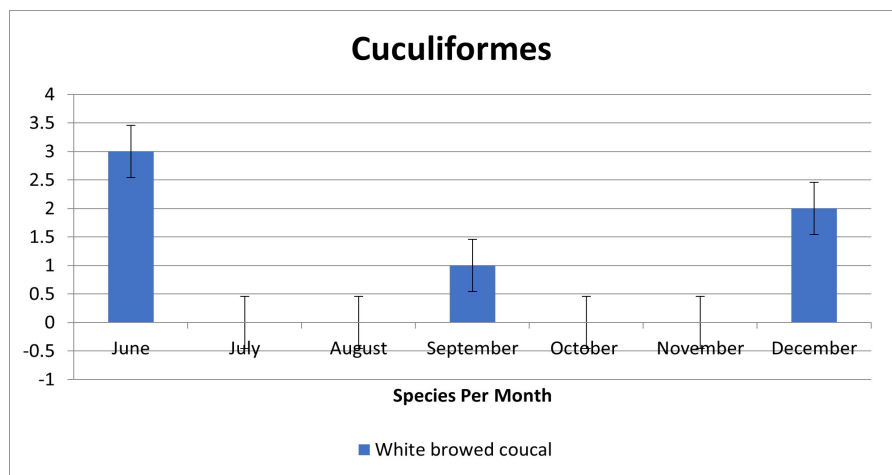


Figure 19. Total bird species within the Order Cuculiformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

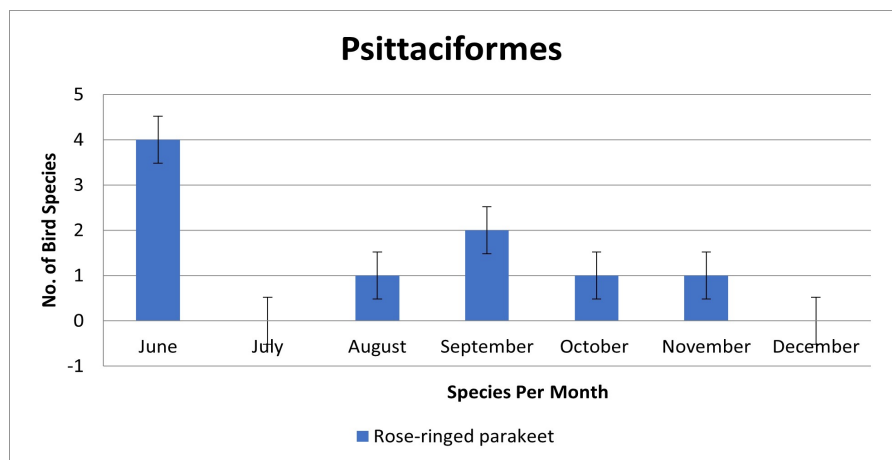


Figure 20. Total bird species within the Order Psittaciformes recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

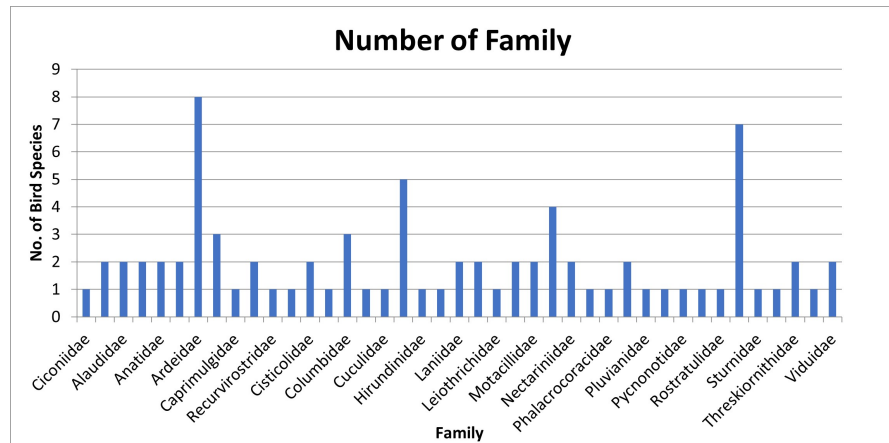


Figure 21. Total number of birds species within each Family recorded at Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

3.3. Bird's Diversity and Richness

The study documented 3708 individual birds belonging to 41 families and 80 species, highlighting the remarkable richness of avian diversity within the region. This diversity is probable attributed to area's abundant food sources, the presence of diverse flora around the North Aldabasin Bridge, and the presence of water. The peak number of birds recorded in July and December and lowest number was during September, the data on monthly bird observations throughout the study period can be found in (Figure 22) and (Appendix 1). The area encompasses various agricultural schemes, offering a diverse array of microhabitats that cater to different bird species. The influential role of vegetation cover on avifauna is well-established (Mills et al., 1989). The agricultural schemes offer ample and suitable habitats for bird feeding and resting. Fluctuations in observed Avian throughout the research could be linked to migration behavior, as some migratory Avian may utilize the area for foraging or as a stopover. The notable high diversity of bird species noted in the study area indicates that the habitat is conducive and suitability habitat to avian life. Nevertheless, the escalating human activities pose significant threat for the survival of these species. The population of birds recorded in the study area indicates that ecological succession may play a role, with variations possibly linked to seasonal rainfall causing inundation surrounding the study area, prompting birds to roost in nearby trees.

The seasonal abundance of bird species, peaking in July and December, reflects migratory patterns influenced by environmental conditions and resource availability. This aligns with the optimal foraging theory, which posits that organisms select habitats that maximize energy efficiency relative to food resources and environmental conditions (Pyke et al., 1977). The abundance of birds during these months suggests that the habitat around Eastern Al Dabasin Bridge serves as a key foraging and resting ground during migration, a crucial function in the broader avian migratory network (Newton, 2008).

Additionally, the migration-linked species diversity supports the resource-tracking hypothesis, which theorizes that birds migrate based on predictable resource patterns, such as those provided by seasonal fluctuations in food availability and climate. This predictable seasonality reinforces the site's ecological importance within larger flyway networks, enable safe migration (Kirby et al., 2008). See **Photos 2-6** for examples of avian diversity observed in North Aldabasin Bridge.

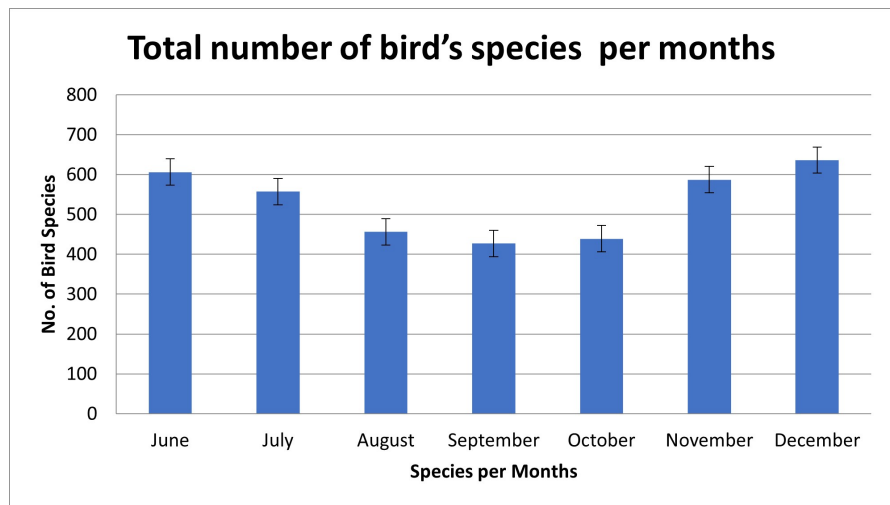


Figure 22. Count of bird's species per months observed in Al Dabasain Bridge, Khartoum, Sudan during June to December 2022.



Photo 2. The image showcases a flock of African Openbill, distinguished by their long, curved bills and dark plumage, as they inhabit their natural environment. The serene landscape of the Al Dabasain Bridge serves as the backdrop, this picture illustrates the birds' adaptation to their habitat and also highlights the ecological significance of the region (Taken by Moner, November 2022).



Photo 3. (a) Reed (Long-tailed) Cormorant, (b) Great Egret, taken by Moner in November 2022 at Al Dabasain Bridge, Khartoum, Sudan.



Photo 4. African jacana, taken by Moner in August 2022 at Al Dabasain Bridge, Khartoum, Sudan.



Photo 5. Black shouldered kite, taken by Moner in November 2022 at Al Dabasain Bridge, Khartoum, Sudan.



Photo 6. Hottentot teal, taken by Moner in November 2022 at Al Dabasain Bridge, Khartoum, Sudan.

3.4. Habitat Use, Preference and Abundance

The diversity of habitat is shaped by the presence of water features, farmlands, and clusters of shrubs and trees, each contributing to the ecological value for bird populations. Agricultural activities, combined with natural vegetation and water availability, create favorable conditions that support bird feeding, nesting, and resting requirements by offering consistent access to essential resources, bird survey results can be significantly affected by various factors, including the season, time of day, and variations in local habitats, such as changes in elevation (Davies, 2002). Additionally, other influencing factors include weather conditions, the presence of humans, the experience level of the observers, the number of observers, and their individual limitations. In Sudan, the avifauna comprises a total of 1013 species, some of which are classified as migratory and move during the year. Therefore, for a more comprehensive understanding and effective monitoring of habitat biodiversity, it is essential that surveys are conducted across different seasons and under varying conditions.

Among the bird species observed, the House Sparrow had the highest frequency, with a recorded count of 372 individuals, making it the most common across the study site. The Spur-winged Lapwing followed with 221 sightings, while the Greater Blue-eared Starling, Laughing Dove, and Black Kite were also notable, with individual counts of 188, 171, and 170, respectively (refer to Appendix 1).

The mixed habitats surrounding Eastern Al Dabasain Bridge provide multiple

resources that support high bird diversity, a concept central to the intermediate disturbance hypothesis. This suggests that moderate disturbances foster biodiversity by creating new ecological niches, leading to greater species richness (Connell, 1978). The mosaic of water bodies, vegetation, and agricultural land supports both specialist and generalist species, providing refuge, food, and nesting opportunities. This heterogeneity also allows niche partitioning, whereby species coexist by exploiting different resources or times, reducing interspecies competition and stabilizing the ecosystem (Schoener, 1974).

3.5. Conservation Status

Taxonomic classification and species identification of the birds documented in this study were carried out following the guidelines of the IUCN Red List of Threatened Species (IUCN, 2015). The conservation status for each species has been detailed in Appendix 2. While all bird species in this study were of Least Concern (LC) per the IUCN, the rapid urbanization around Eastern Al Dabasin Bridge suggests the need for proactive conservation measures to preserve avian diversity. Limiting pollution, and maintaining ecological corridors are essential to support the area's ecological integrity and reduce edge effects that may disrupt species' breeding and feeding patterns. Given its location within a migratory corridor, the bridge area's conservation needs align with the flyway conservation approach, which emphasizes coordinated management across multiple sites for effective protection of migratory species. By maintaining habitat quality and connectivity within this network, regional biodiversity goals can be achieved, ensuring long-term support for both resident and migratory bird populations (Sutherland et al., 2004).

3.6. Impacts of Human Activities on Bird Populations in the Eastern Al Dabasin Bridge

The Eastern Al Dabasin Bridge is home to various bird species whose populations and habitats face challenges due to human activities. These disturbances have disrupted bird diversity and threaten the sustainability of their habitats. During this study, several key human-induced impacts were identified, each of these human-induced factors presents significant, often lasting, consequences for the bird populations and habitat health in the Al Dabasin Bridge. Addressing these issues through comprehensive environmental management and conservation initiatives is essential to safeguard the region's biodiversity and the survival of its avian species.

1) **Nile River Pollution from Sewage and Industrial Waste:** Pollution in the Nile River, caused by the release of untreated sewage and industrial waste, poses a major threat near the **Al Dabasin Bridge**. Chemical and biological contaminants, including heavy metals like lead and mercury, along with organic pollutants such as phosphates and nitrates, degrade water quality and reduce oxygen levels. This contamination harms fish and other aquatic life, which are primary food

sources for many bird species. The deteriorating conditions may force birds to migrate to find safer feeding grounds, decreasing local populations. If pollution persists, the long-term biodiversity of the region may be at risk, particularly for species sensitive to water quality (HCENR Report, 2021).

2) **Tree Removal and Soil Disruption from Bridge Construction:** The construction of the bridge has led to the removal of vegetation and soil displacement, which decreases the availability of nesting sites and feeding areas. This reduction in habitat can force some birds to relocate in search of suitable environments.

3) **Tree Burning by Visitors:** Some visitors burn trees for cooking or warmth, leading to the destruction of critical vegetation. This practice diminishes natural habitats essential for birds, including nesting sites and food sources, as observed through visual documentation (Photo 7(a)).

4) **Improper Waste Management:** Waste accumulation disrupts the ecological balance, attracting certain bird species like crows but negatively impacting others. Images taken during the study illustrate how waste build-up contributes to soil and water pollution, undermining the habitat quality for various local bird populations (Photo 7(b)).

5) **Noise Disturbance from Visitor Activity:** Human presence and activity generate noise levels that disrupt the area's bird populations, which are highly sensitive to changes in sound. This noise disturbance drives birds away from nearby areas and can hinder breeding success by interfering with communication and natural behavior patterns.

6) **Anticipated Impact of Vehicle Noise After Construction:** Once the bridge is completed, regular vehicle traffic is expected to add ongoing noise pollution, which may particularly disturb noise-sensitive bird species. This will likely disrupt their behavior and regular activities within the region.

7) **Grazing by Livestock:** Grazing activities in the region impact plant life that birds rely on for food and shelter. Documented observations reveal that the reduction of plant cover from cattle grazing exerts pressure on bird species, sometimes causing them to abandon the area (Photo 8).

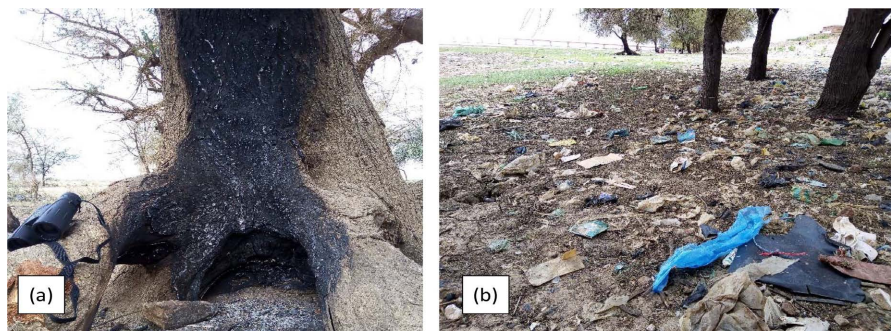


Photo 7. (a): Destruction of Bird Habitats Due to Tree Burning by Visitors—Eastern Al Dabasin Bridge. (b): Improper Waste Disposal on Local Bird Habitats—Disruption of Ecosystem and Pollution, Eastern Al Dabasin Bridge (Adam, 2022).



Photo 8. Effects of Livestock Grazing on Bird Habitats—Depletion of Plant Life and Habitat Loss, Eastern Al Dabasin Bridge (Adam, 2022).

4. Conclusion

The Eastern Al Dabasin Bridge area serves as an essential habitat that sustains a variety of bird species, reinforcing the importance of this region in preserving local biodiversity. This study emphasizes the need for effective conservation measures that prioritize the connectivity of landscapes, encourage sustainable land use, and control environmental pollution, thereby safeguarding the ecological stability of this region for both resident and migratory bird populations.

Our research highlights how differences in resource availability—such as shelter, food, and water—play a crucial role in determining the distribution and abundance of specific bird species across distinct ecological niches. Areas with limited human disturbances, like farmland and secluded settlements, were observed to support a greater diversity of bird species, suggesting that these habitats contribute to greater ecological resilience.

The study documented a total of 3708 individual birds from 80 distinct species, spread across 17 orders and 41 families. The five most common species observed were the House Sparrow, Spur-winged Lapwing, Greater Blue-eared Starling, Laughing Dove, and Black Kite, which exhibited a widespread presence throughout the study area. Seasonal variations in bird populations were also noted, with peak sightings occurring in June and December, indicating the influence of seasonal cycles, microhabitat diversity, and environmental factors—such as climatic conditions, and human activity levels—on avian population dynamics.

Overall, this study provides a baseline for understanding the richness and structure of bird communities in the Eastern Al Dabasin Bridge area, underscoring the resilience of avian populations under current conditions. Conservation efforts that protect natural habitats and address anthropogenic impacts are critical to ensuring that this region continues to be a supportive environment for diverse bird species, ultimately contributing to broader biodiversity conservation initiatives.

5. Recommendations

- Establish long-term monitoring programs to track seasonal variations in bird

abundance, considering the influence of factors such as weather conditions, time of day, and local habitat characteristics.

- Develop ecotourism initiatives in study area to promote appreciation and understanding of avian ecosystems, appealing to birdwatchers, nature enthusiasts, and researchers in ornithology alike.
- Continue observing bird communities to ensure the effectiveness of conservation measures and adapt strategies based on changing ecological dynamics.
- Engage local communities in bird conservation initiatives, providing them with information on the vital role settlements and farmlands play in supporting bird populations, encouraging practices that harmonize with bird-friendly habitat management.
- Continued classification and monitoring to maintain the classification of avian diversity within the “Least Concern” classification but continue periodic assessments to ensure the status remains accurate.
- future research could examine variations in bird populations across both the dry and rainy seasons, this will enhance birds watching and ecotourism and also help to identify the best seasons for observing bird species.
- Efforts to restore habitats should prioritize the replanting of native vegetation and the establishment of protected zones, accompanied by consistent monitoring to ensure the recovery of these areas.
- Raising public awareness is key to addressing issues like tree burning and littering. Informative campaigns and community engagement activities should encourage environmentally responsible behaviors.
- Improved waste management practices, including more accessible disposal facilities and coordinated clean-up initiatives, are necessary to reduce pollution and enhance the environment for wildlife.
- To preserve vital vegetation and bird habitats, it is important to implement controlled grazing areas and promote sustainable grazing practices that minimize the negative impacts of livestock on the ecosystem.

Acknowledgements

The researchers would like to extend heartfelt thanks to their colleagues, particularly the enthusiastic young Sudanese birders: Hind, Islam, and Samah, whose enthusiasm and support greatly enriched the final survey of this study. A special acknowledgment is extended to Moneer KhaliL, the Director of Winji Tour Company, for facilitating the provision of equipment and aiding in data collection.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendixes

Appendix 1. Enumeration of avian species and their observed counts at Eastern Al Dabasin Bridge, Khartoum, Sudan, from June to December 2022.

No	Species English Name	Species scientific Name	Order	Family	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1	Abdim's Stork	<i>Ciconia abdimii</i>	<i>Ciconiiformes</i>	<i>Ciconiidae</i>	5	2	1	5	5	3	9	30
2	Abssiniannian roller	<i>Coracias abyssinicus</i>	<i>Coraciiformes</i>	<i>Coraciidae</i>	4	5	13	6	6	1	4	39
3	African grey hornbill	<i>Lophoceros nasutus</i>	<i>Bucerotiiformes</i>	<i>Bucerotidae</i>	0	2	1	1	1	0	3	8
4	African Mourning Dove	<i>Streptopelia decipiens</i>	<i>Columbiformes</i>	<i>Columbidae</i>	6	9	20		12	3	3	53
5	African jacana	<i>Actophilornis africanus</i>	<i>Charadriiformes</i>	<i>Jacanidae</i>	4	23	4	9	3	5	4	52
6	African openbill	<i>Anastomus lamelligerus</i>	<i>Ciconiiformes</i>	<i>Ciconiidae</i>	14	5	26	9	7	2	13	76
7	African palm swift	<i>Cypsiurus parvus</i>	<i>Apodiformes</i>	<i>Apodidae</i>	3	5	12	2	5	6	14	47
8	African sacred ibes	<i>Threskiornis aethiopicus</i>	<i>Pelecaniformes</i>	<i>Threskiornithidae</i>	7	37	5	0	9	1	44	103
9	African Silverbill	<i>Euodice cantans</i>	<i>Passeriformes</i>	<i>Estrildidae</i>	2	0	5	9	0	0	6	22
10	African spoon bill	<i>Platalea alba</i>	<i>Pelecaniformes</i>	<i>Threskiornithidae</i>	22	7	0	0	5	9	12	55
11	Beautiful sunbird	<i>Cinnyris pulchella</i>	<i>Passeriformes</i>	<i>Nectariniidae</i>	2	6	5	3	5	2	1	24
12	Black scrub robin	<i>Cercotrichas podobe</i>	<i>Passeriformes</i>	<i>Muscicapidae</i>	6	0	2	0	0	1	3	12
13	Black shouldered kit	<i>Elanus axillaris</i>	<i>Accipitriformes</i>	<i>Accipitridae</i>	2	0	0	1	0	0	2	5
14	Black tailed godwit	<i>Limosa limosa</i>	<i>Charadriiformes</i>	<i>Scolopacidae</i>	18	5	0	4	4	12	0	43
15	Black backed sparw	<i>Eremopterix leucotis</i>	<i>Passeriformes</i>	<i>Alaudidae</i>	11	0	0	8	3	2	9	33
16	Black-winged stilt	<i>Himantopus himantopus</i>	<i>Recurvirostridae</i>	<i>Recurvirostridae</i>	16	6	7	12	18	30	16	105
17	Blak kite	<i>Milvus migrans</i>	<i>Accipitriformes</i>	<i>Accipitridae</i>	2	8	19	27	22	2	90	170
18	Blue-naped mousebird	<i>Urocolius macrourus</i>	<i>Coliiformes</i>	<i>Coliidae</i>	6	12	15	9	3	17	1	63
19	Caspian tern	<i>Hydroprogne caspia</i>	<i>Charadriiformes</i>	<i>Laridae</i>	2	1	5	0	5	2	6	21
20	Cattle egret	<i>Bubulcus ibis</i>	<i>Pelecaniformes</i>	<i>Ardeidae</i>	8	11	2	7	9	1	3	41
21	Common bulbul	<i>Pycnonotus barbatus</i>	<i>Passeriformes</i>	<i>Pycnonotidae</i>	4	8	6	17	3	14	4	56
22	Common moorhen	<i>Gallinula chloropus</i>	<i>Gruiformes</i>	<i>Rallidae</i>	27	1	6	3	13	16	6	72
23	Common ringed plover	<i>Charadrius hiaticula</i>	<i>Charadriiformes</i>	<i>Charadriidae</i>	12	9	3	7	4	12	14	61
24	Common sandpiper	<i>Actitis hypoleucos</i>	<i>Charadriiformes</i>	<i>Scolopacidae</i>	6	2	9	14	6	19	3	59
25	Common swift	<i>Apus apus</i>	<i>Apodiformes</i>	<i>Apodidae</i>	9	19	15	19	14	24	9	109
26	Crested Lark	<i>Galerida cristata</i>	<i>Passeriformes</i>	<i>Alaudidae</i>	3	2	1	6	3	2	4	21
27	Crimson rumped waxbill	<i>Estrilda rhodopyga</i>	<i>Passeriformes</i>	<i>Estrildidae</i>	10	2	1	0	0	9	5	27
28	Cut-throat finch	<i>Amadina fasciata</i>	<i>Passeriformes</i>	<i>Estrildidae</i>	5	5	3	0	6	7	5	31
29	Desert wheatear	<i>Oenanthe deserti</i>	<i>Passeriformes</i>	<i>Muscicapidae</i>	5	3	1	0	0	0	0	9
30	Egyptian Plover	<i>Pluvianus aegyptius</i>	<i>Charadriiformes</i>	<i>Pluvianidae</i>	7	1	0	2	0	3	0	13
31	Ethiopian Swallow	<i>Hirundo aethiopica</i>	<i>Passeriformes</i>	<i>Hirundinidae</i>	4	25	2	0	4	8	3	46
32	Eurasian hoopoe	<i>Upupa epops</i>	<i>Bucerotiiformes</i>	<i>Upupidae</i>	0	1	0	3	1	0	1	6
33	Long-tailed nightjar	<i>Caprimulgus macrurus</i>	<i>Caprimulgiformes</i>	<i>Caprimulgidae</i>	4	0	2	0	0	1	2	9
34	Eurasian thick-knee	<i>Burhinus oediconemus</i>	<i>Charadriiformes</i>	<i>Burhinidae</i>	0	2	0	1	0	2	3	8

Continued

35	Graceful Prinia	<i>Prinia gracilis</i>	Passeriformes	Cisticolidae	1	0	2	1	0	3	4	11
36	Garden wallbler	<i>Sylvia borin</i>	Passeriformes	Sylviidae	0	1	0	2	0	1	2	6
37	Great grey shrike	<i>Lanius excubitor</i>	Passeriformes	Laniidae	0	0	0	2	0	1	0	3
38	Great egret	<i>Ardea alba</i>	Pelecaniformes	Ardeidae	5	15	3	9	4	1	2	39
39	Greater painted-snipe	<i>Rostratula benghalensis</i>	Charadriiformes	Rostratulidae	0	1	0	2	0	1	1	5
40	Greater blue-eared starling	<i>Lamprotornis chalybaeus</i>	Passeriformes	Sturnidae	2	60	22	15	9	23	57	188
41	Green sandpiper	<i>Tringa ochropus</i>	Charadriiformes	Scolopacidae	9	2	1	5	3	8	6	34
42	Green-backed heron	<i>Butorides striata</i>	Pelecaniformes	Ardeidae	3	5	3	1	0	0	3	15
43	Grey heron	<i>Ardea cinerea</i>	Pelecaniformes	Ardeidae	5	0	1	2	0	3	0	11
44	Hottentot teal	<i>Spatula hottentota</i>	Anseriformes	Anatidae	2	8	3	5	0	1	4	23
45	House sparrow	<i>Passer domesticus</i>	Passeriformes	Passeridae	150	50	20	45	24	73	10	372
46	Laughing dove	<i>Spilopelia senegalensis</i>	Columbiformes	Columbidae	8	70	27	26	8	17	15	171
47	Little bee-eater	<i>Merops pusillus</i>	Coraciiformes	Meropidae	2	2	3	7	5	4	4	27
48	Little grebe	<i>Egretta garzetta</i>	Pelecaniformes	Ardeidae	16	20	12	0	2	8	7	65
49	Little egret	<i>Egretta garzetta</i>	Pelecaniformes	Ardeidae	2	4	2	9	6	18	14	55
50	Little stint	<i>Calidris minuta</i>	Charadriiformes	Scolopacidae	4	1	0	7	3	12	9	36
51	Malachite Kingfisher	<i>Corythornis cristatus</i>	Coraciiformes	Alcedinidae	19	0	0	3	9	7	1	39
52	March sandpiper	<i>Tringa stagnatilis</i>	Charadriiformes	Scolopacidae	0	0	0	0	0	1	0	1
53	Masked shrik	<i>Lanius nubicus</i>	Passeriformes	Laniidae	0	1	0	3	0	2	0	6
54	Namaqua Dove	<i>Oena capensis</i>	Columbiformes	Columbidae	6	8	0	2	5	3	9	33
55	Nile Valley sunbird	<i>Hedydipna metallica</i>	Passeriformes	Nectariniidae	2	1	0	0	0	1	3	7
56	Eastern red bishop	<i>Euplectes franciscanus</i>	Passeriformes	Ploceidae	10	5	0	3	2	6	5	31
57	Eastern Shoveller	<i>Spatula clypeata</i>	Anseriformes	Anatidae	7	0	2	4	1	3	5	22
58	Pied Kingfisher	<i>Ceryle rudis</i>	Coraciiformes	Alcedinidae	6	12	42	5	3	16	13	97
59	Pin-tailed Whydah	<i>Vidua macroura</i>	Passeriformes	Viduidae	8	3	0	4	2	5	7	29
60	Red-billed Firefinch	<i>Lagonosticta senegala</i>	Passeriformes	Estrildidae	18	3	4	0	12	7	5	49
61	Red-cheeked cordonbleu	<i>Uraeginthus bengalus</i>	Passeriformes	Estrildidae	17	2	0	9	5	12	7	52
62	Reed (long-tailed) cormorant	<i>Microcarbo africanus</i>	Suliformes	Phalacrocoracidae	3	12	54	9	12	8	7	105
63	Rose-ringed parakeet	<i>Psittacula krameri</i>	Psittaciformes	Psittaculidae	4	0	1	2	1	1	0	9
64	Rufous-tailed scrub-robin	<i>Cercotrichas galactotes</i>	Passeriformes	Muscicapidae	1	0	1	0	0	2	0	4
65	Senegal Thick-knee	<i>Burhinus senegalensis</i>	Charadriiformes	Burhinidae	4	3	0	8	2	12	9	38
66	spotted flycatcher	<i>Muscicapa striata</i>	Passeriformes	Muscicapidae	0	1	2	0	0	0	1	4
67	Spotted Sandpiper	<i>Actitis macularius</i>	Charadriiformes	Scolopacidae	0	4	0	0	1	0	0	5
68	Spur-winged lapwing	<i>Vanellus spinosus</i>	Charadriiformes	Charadriidae	14	5	20	5	97	22	58	221
69	Stoared heron	<i>Butorides striata</i>	Pelecaniformes	Ardeidae	3	5	8	9	5	14	23	67
70	Village indigobird	<i>Vidua chalybeata</i>	Passeriformes	Viduidae	8	6	5	4	2	7	3	35
71	Village Weaver	<i>Ploceus cucullatus</i>	Passeriformes	Ploceidae	2	6	3	7	3	5	2	28

Continued

72	White browed coucal	<i>Centropus superciliosus</i>	Cuculiformes	Cuculidae	3	0	0	1	0	0	2	6
73	White wagtail	<i>Motacilla alba</i>	Passeriformes	Motacillidae	3	5	6	7	13	11	9	54
74	White-headed Babbler	<i>Turdoides leucocephala</i>	Passeriformes	Leiothrichidae	7	2	3	0	0	5	1	18
75	White-winged tern	<i>Chlidonias leucopterus</i>	Charadriiformes	Laridae	13	2	9	12	8	15	12	71
76	White-throated bee-eater	<i>Merops albicollis</i>	Coraciiformes	Meropidae	2	2	0	3	4	0	4	15
77	Wood Sandpiper	<i>Tringa glareola</i>	Charadriiformes	Scolopacidae	0	0	1	3	2	6	4	16
78	Yellow wagtail	<i>Motacilla flava</i>	Passeriformes	Motacillidae	0	6	5	2	10	25	6	54
79	Yellow-billed egret	<i>Ardea brachyrhyncha</i>	Pelecaniformes	Ardeidae	1	0	0	0	0	0	0	1
80	Zitting cisticola	<i>Cisticola juncidis</i>	Passeriformes	Cisticolidae	0	0	0	0	0	1	0	1
	Total				606	557	456	427	439	587	636	3708

Appendix 2. List of avian and general IUCN status recorded Eastern Al Dabasin Bridge, Khartoum, Sudan during June to December 2022.

No	Species English name	Binomial name	Migratory status	IUCN Status	Order	Family
1	Abdim's Stork	<i>Ciconia abdimii</i>	AM	LC	Ciconiiformes	Ciconiidae
2	Abssiniannian roller	<i>Coracias abyssinicus</i>	LM/AM	LC	Coraciiformes	Coraciidae
3	African grey hornbill	<i>Lophoceros nasutus</i>		LC	Bucerotiformes	Bucerotidae
4	African mourning dove	<i>Streptopelia decipiens</i>	R	LC	Columbiformes	Columbidae
5	African jacana	<i>Actophilornis africanus</i>		LC	Charadriiformes	Jacanidae
6	African openbill	<i>Anastomus lamelligerus</i>		LC	Ciconiiformes	Ciconiidae
7	African palm swift	<i>Cypsiurus parvus</i>	R/LM	LC	Apodiformes	Apodidae
8	African sacred ibes	<i>Threskiornis aethiopicus</i>	LM/AM	LC	Pelecaniformes	Threskiornithidae
9	African silverbill	<i>Euodice cantans</i>	LM/R	LC	Passeriformes	Estrildidae
10	African spoon bill	<i>Platalea alba</i>	LM/AM	LC	Pelecaniformes	Threskiornithidae
11	Beautiful sunbird	<i>Cinnyris pulchella</i>	R	LC	Passeriformes	Nectariniidae
12	Black scrub robin	<i>Cercotrichas podobe</i>	R	LC	Passeriformes	Muscicapidae
13	Black shouldered kit	<i>Elanus axillaris</i>		LC	Accipitriformes	Accipitridae
14	Black tailed godwit	<i>Limosa limosa</i>	PM	LC	Charadriiformes	Scolopacidae
15	Chestnut-backed sparrow-lark	<i>Eremopterix leucotis</i>		LC	Passeriformes	Alaudidae
16	Black-winged stilt	<i>Himantopus himantopus</i>		LC	Recurvirostridae	Recurvirostridae
17	Blak kite	<i>Milvus migrans</i>	PM	LC	Accipitriformes	Accipitridae
18	Blue-naped mousebird	<i>Urocolius macrourus</i>	R	LC	Coliiformes	Coliidae
19	Caspian tern	<i>Hydroprogne caspia</i>	LM R/PM	LC	Charadriiformes	Laridae
20	Cattle egret	<i>Bubulcus ibis</i>	LM/AM/PM	LC	Pelecaniformes	Ardeidae
21	Common bulbul	<i>Pycnonotus barbatus</i>	R	LC	Passeriformes	Pycnonotidae
22	Common moorhen	<i>Gallinula chloropus</i>		LC	Gruiformes	Rallidae

Continued

23	Common ringed plover	<i>Charadrius hiaticula</i>	PM	LC	<i>Charadriiformes</i>	<i>Charadriidae</i>
24	Common sandpiper	<i>Actitis hypoleucos</i>	PM	LC	<i>Charadriiformes</i>	<i>Scolopacidae</i>
25	Common swift	<i>Apus apus</i>	LM/R	LC	<i>Apodiformes</i>	<i>Apodidae</i>
26	Crested lark	<i>Galerida cristata</i>	R	LC	<i>Passeriformes</i>	<i>Alaudidae</i>
27	Crimson rumped waxbill	<i>Estrilda rhodopyga</i>	R	LC	<i>Passeriformes</i>	<i>Estrildidae</i>
28	Cut-throat finch	<i>Amadina fasciata</i>	LM/R	LC	<i>Passeriformes</i>	<i>Estrildidae</i>
29	Desert wheatear	<i>Oenanthe deserti</i>	PM	LC	<i>Passeriformes</i>	<i>Muscicapidae</i>
30	Egyptian plover	<i>Pluvianus aegyptius</i>	R/LM	LC	<i>Charadriiformes</i>	<i>Pluvianidae</i>
31	Ethiopian swallow	<i>Hirundo aethiopica</i>	R/AM	LC	<i>Passeriformes</i>	<i>Hirundinidae</i>
32	Eurasian hoopoe	<i>Upupa epops</i>	LM/R/AM	LC	<i>Bucerotiformes</i>	<i>Upupidae</i>
33	Long-tailed nightjar	<i>Caprimulgus macrurus</i>		LC	<i>Caprimulgiformes</i>	<i>Caprimulgidae</i>
34	Eurasian thick-knee	<i>Burhinus oediconemus</i>	PM	LC	<i>Charadriiformes</i>	<i>Burhinidae</i>
35	Graceful prinia	<i>Prinia gracilis</i>	R	LC	<i>Passeriformes</i>	<i>Cisticolidae</i>
36	Garden wallbler	<i>Sylvia borin</i>		LC	<i>Passeriformes</i>	<i>Sylviidae</i>
37	Great grey shrike	<i>Lanius excubitor</i>		LC	<i>Passeriformes</i>	<i>Laniidae</i>
38	Great egret	<i>Ardea alba</i>	LM/PM/AM	LC	<i>Pelecaniformes</i>	<i>Ardeidae</i>
39	Greater painted-snipe	<i>Rostratula benghalensis</i>		LC	<i>Charadriiformes</i>	<i>Rostratulidae</i>
40	Greater blue-eared starling	<i>Lamprotornis chalybaeus</i>	LM/R	LC	<i>Passeriformes</i>	<i>Sturnidae</i>
41	Green sandpiper	<i>Tringa ochropus</i>	PM	LC	<i>Charadriiformes</i>	<i>Scolopacidae</i>
42	Green-backed heron	<i>Butorides striata</i>		LC	<i>Pelecaniformes</i>	<i>Ardeidae</i>
43	Grey heron	<i>Ardea cinerea</i>	PM/LM	LC	<i>Pelecaniformes</i>	<i>Ardeidae</i>
44	Hottentot teal	<i>Spatula hottentota</i>		LC	<i>Anseriformes</i>	<i>Anatidae</i>
45	House sparrow	<i>Passer domesticus</i>	R	LC	<i>Passeriformes</i>	<i>Passeridae</i>
46	Laughing dove	<i>Spilopelia senegalensis</i>	PM/LM/R	LC	<i>Columbiformes</i>	<i>Columbidae</i>
47	Little Bee eater	<i>Merops pusillus</i>	R/LM	LC	<i>Coraciiformes</i>	<i>Meropidae</i>
48	Little egret	<i>Egretta garzetta</i>	PM/LM	LC	<i>Pelecaniformes</i>	<i>Ardeidae</i>
49	Little egret	<i>Egretta garzetta</i>		LC	<i>Pelecaniformes</i>	<i>Ardeidae</i>
50	Little stint	<i>Calidris minuta</i>	PM	LC	<i>Charadriiformes</i>	<i>Scolopacidae</i>
51	Malachite kingfisher	<i>Corythornis cristatus</i>	LM/R	LC	<i>Coraciiformes</i>	<i>Alcedinidae</i>
52	Marsh sandpiper	<i>Tringa stagnatilis</i>	PM	LC	<i>Charadriiformes</i>	<i>Scolopacidae</i>
53	Masked shrike	<i>Lanius nubicus</i>	PM	LC	<i>Passeriformes</i>	<i>Laniidae</i>
54	Namaqua Dove	<i>Oena capensis</i>	AM/R/LM/PM	LC	<i>Columbiformes</i>	<i>Columbidae</i>
55	Nile valy sunbirds	<i>Hedydipna metallica</i>	R/LM	LC	<i>Passeriformes</i>	<i>Nectariniidae</i>
56	Eastern red bishop	<i>Euplectes franciscanus</i>	R/LM	LC	<i>Passeriformes</i>	<i>Ploceidae</i>
57	Eastern shoveller	<i>Spatula clypeata</i>		LC	<i>Anseriformes</i>	<i>Anatidae</i>
58	Pied Kingfisher	<i>Ceryle rudis</i>	AM R/LM	LC	<i>Coraciiformes</i>	<i>Alcedinidae</i>
59	Pin-tailed whydah	<i>Vidua macroura</i>	R	LC	<i>Passeriformes</i>	<i>Viduidae</i>

Continued

60	Red-billed firefinch	<i>Lagonosticta senegala</i>	R	LC	Passeriformes	Estrildidae
61	Red-cheeked cordonbleu	<i>Uraeginthus bengalus</i>	R	LC	Passeriformes	Estrildidae
62	Reed (long-tailed) cormorant	<i>Microcarbo africanus</i>	R	LC	Suliformes	Phalacrocoracidae
63	Rose-ringed parakeet	<i>Psittacula krameri</i>		LC	Psittaciformes	Psittaculidae
64	Rufous-tailed scrub-robin	<i>Cercotrichas galactotes</i>	R/LM	LC	Passeriformes	Muscicapidae
65	Senegal thick-knee	<i>Burhinus senegalensis</i>	LM/R	LC	Charadriiformes	Burhinidae
66	Spotted flycatcher	<i>Muscicapa striata</i>	PM	LC	Passeriformes	Muscicapidae
67	Spotted sandpiper	<i>Actitis macularius</i>		LC	Charadriiformes	Scolopacidae
68	Spur-winged lapwing	<i>Vanellus spinosus</i>	PM/LM	LC	Charadriiformes	Charadriidae
69	Stoared heron	<i>Butorides striata</i>		LC	Pelecaniformes	Ardeidae
70	Village indigobird	<i>Vidua chalybeata</i>	R	LC	Passeriformes	Viduidae
71	Village Weaver	<i>Ploceus cucullatus</i>	LM/AM	LC	Passeriformes	Ploceidae
72	White browed coucal	<i>Centropus superciliosus</i>	R	LC	Cuculiformes	Cuculidae
73	White Wagtail	<i>Motacilla alba</i>	PM	LC	Passeriformes	Motacillidae
74	White-headed Babbler	<i>Turdoides leucocephala</i>	R	LC	Passeriformes	Leiothrichidae
75	White-winged tern	<i>Chlidonias leucopterus</i>		LC	Charadriiformes	Laridae
76	White-throated Bee-eater	<i>Merops albicollis</i>	LM/AM	LC	Coraciiformes	Meropidae
77	Wood sandpiper	<i>Tringa glareola</i>	PM	LC	Charadriiformes	Scolopacidae
78	Yellow wagtail	<i>Motacilla flava</i>	PM	LC	Passeriformes	Motacillidae
79	Yellow-billed egret	<i>Ardea brachyrhyncha</i>	LM/AM	LC	Pelecaniformes	Ardeidae
80	Zitting cisticola	<i>Cisticola juncidis</i>	R/LM	LC	Passeriformes	Cisticolidae

The following designations are used to indicate the conservation and breeding status of bird species: **B** denotes confirmed breeding records; **M** refers to migrants that pass through Sudan; **P** indicates species that breed in the Palearctic; **R** signifies resident species; **W** denotes those that winter in Sudan but do not breed; **RB** indicates residents confirmed by breeding records; **PW** refers to species that breed in the Palearctic and winter in Sudan; **AM** signifies intra-African migrants; and **RB/PW** indicates both a resident breeding population and a wintering population. Lastly, **LC** represents species classified as Least Concer.