

Importance of urbanized wetlands environments in the reproduction of avifauna, city of Martil (Region of Tetouan) in Morocco

Naima MARS , Abdelfattah Maouni and Rabah Saïdi

Biology, Environment and Sustainable Development Laboratory, ENS Tétouan, Abdelmalek Essaadi University, 93000 Tétouan Morocco ; nama.mars@etu.uae.ac.ma; amaouni@uae.ac.ma ; r.saidi@uae.ac.ma

Abstract. This study focused on the significance of urban and peri-urban wetlands in the Martil plain of Tetouan, Morocco, for bird reproduction. Conducted over a two-year period, the research employed fixed-site counting and weekly visits to assess reproductive indicators such as chicks, nests, courtship displays, and territorial defense. The findings demonstrated that these wetland environments play a vital role in the reproduction of 37 bird species from 15 families, including species of national importance, declining Mediterranean species, vulnerable species according to the IUCN, and rare breeding species. These results underscore the critical importance of conserving and sustainably managing these wetland areas. By prioritising the preservation of urban and peri-urban wetlands, Morocco can contribute to global biodiversity conservation efforts while addressing the challenges of urbanization and climate change

Index Terms— Environment, Wetlands, Bird waters, Reproduction, Biodiversity, Conservation

1 Introduction

Wetlands play a crucial role in biodiversity conservation, sediment control (1), water retention, soil conservation, and carbon storage (2), flood prevention, regulation of water flow, and groundwater recharge. Wetland environments provide habitats for birds (1,2), serving as feeding, resting, breeding, and nesting sites (1,3). Despite their significance, wetland habitats are disturbed by anthropogenic activities, resulting in the erosion of biodiversity and a drastic decline in bird populations (2). Recognizing this importance, Morocco has designated 38 Ramsar sites of international importance for biodiversity and migratory birds, 38 continental wetland sites of biological and ecological interest (SIBE), and 38 SIBE coastal wetland sites. Additionally, ten national parks and four biosphere reserves, including the Intercontinental Biosphere of the Mediterranean, have been established to preserve national and global biodiversity. Despite these efforts, several significant wetland environments remain unclassified and unlisted. The Tanger-Tétouan region is located in a transitional zone between Africa and Europe (Strait of Gibraltar) and features both the Atlantic and Mediterranean coasts (a global biodiversity hotspot). It also lies along a major east-Atlantic flyway for bird migration. The wetlands of the Martil Plain (Tanger-Tétouan region) are situated on the country's Mediterranean coast and are geographically close to several Ramsar sites of international importance (Lower Loukkos Complex, Lower

Tahaddart Complex, Smir Marsh and Lagoon, Jbel Moussa Coastal Area), as well as numerous SIBE sites in the coastal (Jbel Moussa, Oued Tahaddart, Larache Marsh, Merja Zerga) and continental domains (Perdicaris, Jbel Bouhachem, Jbel Tizirane). These protected areas host habitats utilised by remarkable national and global avifauna. The wetlands of Oued El Maleh (Martil) harbour coastal dunes and interesting plant species, including several that are rare and endemic to Morocco (4). The Ramsar site "le Complexe du Bas Loukkos" (No. 1475, 2005) is home to vulnerable species such as Marbled Teal and Ferruginous Duck, as well as rare or threatened species. The Ramsar site "Lagune et Barrage de Smir" (2019) is a vital stopover site for migratory birds, attracting 60 species of wintering and/or migratory waterbirds and housing 26 nesting species, 16 of which have conservation status unfavourable in Europe. It is clear that the wetlands of the Tangier-Tetouan region are vital stopover, feeding, resting and breeding sites for migratory, wintering and resident birds. These environments are also home to endemic and rare species. However, as a result of socio-economic and demographic development and high urbanization, many wetlands have become urban and peri-urban, with no clear boundaries within the city. In addition, episodes of drought and flooding, linked to global warming and man-made factors, regularly modify the surface area of water and the extent of these ecosystems. On the other hand, the development of agriculture is important in these wetlands because it is linked to the presence of water and better lands. The Martil plain is subject to a number of socio-economic activities, construction works and development projects. In connection with the economic and industrial development of the city of Tetouan, numerous structures are being built along the Oued Martil. These urban, socio-economic and climatic changes make it necessary to update our knowledge of the region's wetlands in order to guide and better govern the management and/or restoration of these environments. It is therefore necessary to update the importance of these environments for the reproduction of avifauna. With this in mind, we have chosen to record the breeding indices of the avifauna in the wetland environments of Oued El Maleh and Oued Martil, in order to shed light on their ecological and ornithological importance. This objective is motivated by the lack of regular monitoring of the state of avifauna biodiversity in urban and peri-urban wetlands in the region and on the Martil plain. In a Mediterranean and global context, characterized by climate change and episodes of drought/flooding, we are attempting to provide the information needed by researchers, decision-makers, educators and citizens to raise awareness, conserve and restore wetlands and the avifauna that frequent them. This work is being carried out as part of a doctoral thesis on the diversity of wetland fauna in the Tangier-Tetouan region. Ornithological monitoring of avifauna breeding indices in the Oued Martil and Oued El Maleh wetlands was carried out between January 2021 and January 2023. This study presents the results obtained.

2 Methodology

2.1 Study Area

The urban and peri-urban wetlands of Oued Martil and Oued El Maleh are located in the Martil watershed on the Mediterranean coast. The lower area of the watershed corresponds to the Martil plain, which is prone to flooding. Oued El Maleh and Oued Martil drain the Martil plain and run alongside the cities of Tetouan and Martil, eventually flowing into the Mediterranean Sea. The Martil watershed is characterized by a torrential hydraulic regime in a Mediterranean climate, with an average annual temperature of 16°C and 650 mm of precipitation. The climate exhibits two distinct seasons: a wet and cool season from October to April, and a sub-humid and hot season from May to September. Oued El Maleh has

intermittent flow and reaches the coast through an estuary, while Oued Martil has several tributaries and drains a watershed of 1220 km². It has sufficient flow to breach the coastal barrier through an estuary. The flow of both rivers meanders due to the low slope of the plain (8).

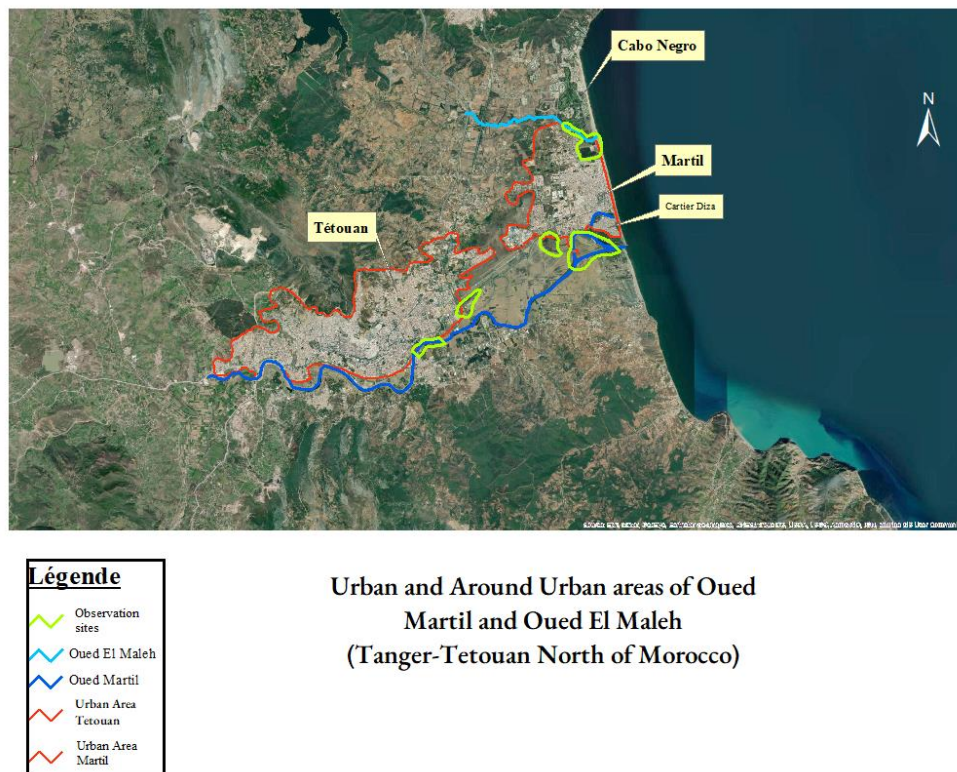


Figure 1: Map showing the study areas and the urban areas next to it (GoogleEarth 2022)

2.2 Ornithological monitoring

Reproductive indicators of avifauna in the wetlands of Oued Martil and Oued El Maleh were recorded on a weekly basis from January 2021 to January 2023. Observations were conducted between 6:00 am and 6:00 pm, taking into account weather conditions and accessibility, using the fixed-site counting method for a duration of 30 to 60 minutes. Binoculars were employed, and field identification was carried out using the ornithological guide by Delachaux and Niestlé (2021). Photographs were taken with a suitable device for subsequent identification purposes. The recorded reproductive indicators included the presence of chicks, nests, courtship displays, territorial defence, and nuptial plumage.



Figure 2: reproduction rates of avifauna in wetland environments of Oued Martil and Oued El Maleh (Tétouan, Morocco)

3 Results

Thirty-seven bird species belonging to 15 families utilize the wetlands of Oued Martil and Oued El Maleh for reproduction 1. Indicators of successful reproduction were collected for several species, including the presence of nests, eggs, chicks, chick rearing, and feeding. This

breeding population comprises resident species nesting in Morocco, species in decline in the Mediterranean, two vulnerable species, and one endangered species.

Through the observation of bird behaviours, several species form pairs and engage in courtship displays necessary for nesting. These indicators pertain to endangered species such as the Sultan Marsh Harrier or vulnerable species like the Tufted Duck, Red-crested Pochard, and Eurasian Coot, as well as species that are no longer nesting in Morocco, like the Greater Flamingo.

Confirmed reproduction is associated with the presence of nests containing eggs and very young chicks. Highly probable reproduction is linked to the presence of dependent juveniles, courtship displays, pair formation, and nest construction activities involving the collection of various materials. Probable reproduction is indicated when juvenile individuals are observed in the site, along with adults in nuptial plumage, courtship displays, and pair formation.

The wetlands of Oued Martil and Oued El Maleh are important for the reproduction of these species, even if reproduction is not confirmed, as pair formation is crucial for reproductive success.

4 Discussion

The ornithological monitoring during the spring of 2021, focusing on nesting bird populations or potential nesters in urban and peri-urban wetlands of Oued Martil and Oued El Maleh in the urban commune of Martil, Tétouan, Morocco, was significantly influenced by weather constraints and, most importantly, the accessibility to certain flood-prone sites. The lack of previous data for comparison regarding these sites prevents drawing conclusions regarding the improvement or degradation of these ecosystems. A comparison is made with data on nesting bird species, conservation statuses, and phenology of bird species in Morocco. The urban and peri-urban wetlands of Oued Martil and Oued El Maleh undergo changes in water levels depending on the seasons, through flooding and drying, influenced by precipitation and urban development. Several neighbourhoods are in proximity to these ecosystems, some of which are informal settlements (Diza). Their expansion continues at the expense of water surfaces and the population of aquatic avifauna that frequents them.

Twenty-five bird species belonging to ten families use the wetlands of Oued Martil and Oued El Maleh for reproduction. Through the observation of waterbird behaviours, several species form pairs and perform courtship displays necessary for nesting. These phases are crucial for the success of nesting and reproduction, especially for endangered species or vulnerable species, or even species that are no longer nesting in Morocco (Flamingo).

Indicators of successful reproduction were collected for 11 species representing 5 families. These indicators include the presence of nests, eggs, chicks, chick rearing, and feeding. Among this nesting bird population, two species are declining in the Mediterranean (Northern Shoveler and Common Teal), emphasising the need for their protection.

The Martil Plain is experiencing increasing urbanization and coastal development at the expense of the environment and the wetlands of Oued Martil and Oued El Maleh. The impact of anthropogenic activities on wetland habitats results in the erosion of biodiversity and a drastic decline in bird populations (S. Hugues, W. Azonningbo, J. Boco Adjakpa, and E. Codjo Agbangba, 2020). To preserve habitats and biodiversity, appropriate conservation and management measures must be implemented. While urbanization is a necessity, developing management policies that consider this need along with biodiversity conservation is now a priority.

The proximity of urban and peri-urban wetlands of Oued Martil and Oued El Maleh to Ramsar sites of international importance (Lower Loukkos Complex, Lower Tahaddart Complex, Smir Marsh and Lagoon, Jbel Moussa Coast) and their location within the

Intercontinental Biosphere of the Mediterranean highlight their role as wintering, feeding, resting, and nesting habitats for resident and migratory bird species.

5 Conclusion

These ornithological data highlight the importance of urban and peri-urban wetlands of Oued Martil and Oued El Maleh in the reproduction of heritage species that require conservation efforts. Urbanization, coastal development, and the growth of tourism activities pose threats to these ecosystems, which are located in a region of national and international significance for biodiversity conservation. Protecting and managing these wetland areas is crucial for the long-term survival of bird populations and the preservation of their habitats. Conservation measures should be implemented to mitigate the negative impacts of urbanization and tourism, including the enforcement of regulations, the establishment of protected areas, and the Furthermore, raising awareness among local communities, stakeholders, and decision-makers about the ecological value of these wetlands is essential. Engaging in collaborative efforts involving government agencies, environmental organisations, and the public can lead to effective conservation strategies and ensure the sustainable coexistence of urban development and biodiversity conservation. By recognizing the significance of urban and peri-urban wetlands as vital breeding grounds for bird species, steps can be taken to conserve these ecosystems, safeguard the rich biodiversity they harbour, and contribute to the overall protection of nature in the region.

Table 1: The avifauna recorded in two wetlands of the Martil plain (Tetouan, Northern Morocco) and the status of the species: + present - absent; RB Resident Breeder; BM Breeding migrant; FB Former Breeder; PM Passage Migrant; WV Winter Visitor OW Occasional Winter Occurrence of regular migrant species Occasional Breeder Nicheur occasionnel; PAV Palearctic Accidental Visitor; VUL Vulnerable; Endang Endangered in Morocco or the Mediterranean; Endec Declining in Morocco or globally; ? indicates a doubt about the status 1 =chicks 2=couples 3=courtship 4=ests 5=eggs 6=juveniles 7=breeding plumage

Families	Species	Reproduction Rates	Status
Common Name	Scientific Name		
Anatidae			
Mallard Duck	<i>Anas platyrhynchos</i>	1, 2, 3	RB WV
Gadwal Duck	<i>Mareca strepera</i>	1, 2, 3	WV PM OB
Northern Shoveler	<i>Spatula clypeata</i>	1, 2, 3	WV PM OB
Marbled Teal	<i>Marmaronetta angustirostris</i>	1, 2, 3	RB WV PM VUL
Common Pochard	<i>Aythya ferina</i>	1, 2, 3	WV PM OB
Red-crested pochard	<i>Netta rufina</i>	1, 2, 3	RB WV
Ferruginous duck	<i>Aythya nyroca</i>	1, 2, 3	RB WV
Podicipedidae			

Little grebe	<i>Tachybaptus ruficollis</i>	1, 2, 3	RB WV
Phalacrocoracidae			
Great cormoran	<i>Phalacrocorax carbo</i>	6,7	RB , WV
Ardeidae			
Black-crowned night heron	<i>Nycticorax nycticorax</i>	6,7	PM BM WV
Cattle egret	<i>Bubulcus ibis</i>	6,7	RB PM WV
Squacco heron	<i>Ardeola ralloides</i>	6,7	BM RB? PM WV
Little egret	<i>Egretta garzetta</i>	6,7	RB PM WV
Gray heron	<i>Ardea cinerea</i>	6,7	PM WV OB
Purple heron	<i>Ardea purpurea</i>	6,7	PM BM OW
Ciconiidae			
White stork	<i>Ciconia ciconia</i>	7	PM,BM/RB, WV
Threskiornithidae			
Glossy ibis	<i>Plegadis falcinellus</i>	6,7	PM, WV BM/RB
Spoonbill	<i>Platalea leucorodia</i>	6,7	PM WV RB
Flamingo	<i>Phoenicopterus roseus</i>	2,3,6,7	PM WV FB
Rallidae			
Common Moorhen	<i>Gallinula chloropus</i>	1,2	RB WV PM
Eurasian Coot	<i>Fulica atra</i>	1,2,3	RB WV PM
Wattled coot	<i>Fulica cristata</i>	1,2,3	RB Endang
Western swamphen	<i>Porphyrio porphyrio</i>	1,2,3	RB Endec
Recurvirostridae			
Black-winged Stilt	<i>Himantopus himantopus</i>	1,2,3,4,5,7	BM/RB PM WV
Charadriidae			
Kentish plover	<i>Charadrius alexandrinus</i>	1,3,6	RB PM WV
Scolopacidae			
Dunlin	<i>Calidris alpina</i>	6	PM WV
Laridae			
Black-headed gull	<i>Chroicocephalus ridibundus</i>	6,7	WV PM RB
Mediterranean Gull	<i>Ichthyaetus melanocephalus</i>	6,7	PM WV
Yellow-legged Gull	<i>Larus michahellis</i>	6,7	RB WV

Audoin's Gull	<i>Larus audouinii</i>	6,7	BM/RB PM WV - VUL
Lesser crested tern	<i>Thalasseus bengalensis</i>	6,7	PM WV
Hirundinidae			
Barn Swallow	<i>Hirundo rustica</i>	4,6,7	PM BM OW
Common House Martin	<i>Delichon urbicum</i>	4,6,7	PM BM OW
Motacillidae			
Western yellow wagtail	<i>Motacilla flava</i>	6,7	PM BM/RB WV
Muscicapidae			
Zitting Cisticola	<i>Cisticola juncidis</i>	6,7	RB WV
Spotless Starling	<i>Sturnus unicolor</i>	4,6,7	RB WV
Passeridae			
House Sparrow	<i>Passer domesticus</i>	6,7	RB WV
Strigidae			
Little Owl	<i>Athene noctua</i>	6	RB

References

- 1) A.Veeramani. S.Usha (2018). Diversity, Abundance and Activity Pattern of Wetland Birds Along Cauvery Basin at Kumbakonam, Tamil Nadu, India. Global Journal of Science Frontier Research: C Biological Science Volume 18 Issue 4 Version 1.0 Year 2018. Type: Double Blind Peer Reviewed International Research Journal Publisher: Global Journals. Online ISSN: 2249-4626 & Print ISSN: 0975-5896
- (2) S.Hugues, W.Azonningbo, J.Boco Adjakpa et E.Codjo Agbangba (2020): Organisation spatio-temporelle des peuplements d'oiseaux de la zone humide d'importance internationale du Sud-Ouest du Bénin (Site Ramsar 1017), International Journal of Environmental Studies, DOI: 10.1080/00207233.2020.1778259
- (3) S. Hammada, L.Linares et J.Cortes(2011) Biodiversité floristique des dunes littorales de l'Oued El Maleh (Martil) et du bas Tahaddart: résultats préliminaires (Bayed A.(ed.). Sandy beaches and coastal zone management-Proceedings of the Fifth International Symposium on Sandy Beaches,19th-23rd October 2009, Rabat, Morocco. Travaux de l'Institut Scientifique, Rabat, série générale, 2011, n°6, 45-50.)
- (4) Morocco Biodiversity Information Exchange Center. Convention on Biological Diversity. <https://ma.chm-cbd.net/>
- (5) Ramsar Sites Information Service / <https://rsis.ramsar.org/ris>
- (6) M.A.EL Agbani, A.Qninba, M.Amezian, F.Cuzin et M.Dakki (2009) Le peuplement

- d'oiseaux d'eau du complexe des zones humides de Smir (Nord du Maroc) : état actuel, intérêt patrimonial et évolution depuis les quatre dernières décennies. Bulletin de l'Institut scientifique, Rabat, Section Sciences de la Vie, 2009, N°31(2), 103-110
- (7) P.Bergier, M.Thévenot, A.Qninba et J.R Houllier (2022) Oiseaux du Maroc. Société d'Etudes Ornithologiques de France (SEOF). Muséum National d'Histoires Naturelles, Bibliothèque, Paris, France. IS BN 2-916802-06-1. (648 pages).
- (8) B.Comentale, L.Ménanteau, D.Nachite. Géomorphologie et remblaiement récent de la plaine de Martil (Région de Tétouan, Maroc Septentrional). 2007Colloque Géomorphologie et Quaternaire du Maroc, Juin2007, France. Halshs-00283894 H..Khabali, K. Targuisti, F.Ezzouak et L.M.Valenzuela Montes. Diagnostic environnemental et urbanistique de la ville de Martil entre 1966 et 2003. 2011
- (9) Echeverry-Galvis, M. A., Lozano Ramírez, P., & Amaya-Espinel, J. D. (2023). Long-term Christmas Bird Counts describe neotropical urban bird diversity. *Plos one*, 18(2), e0272754.
- (10) Fraissinet, M., Ancillotto, L., Migliozi, A., Capasso, S., Bosso, L., Chamberlain, D. E., & Russo, D. (2023). Responses of avian assemblages to spatiotemporal landscape dynamics in urban ecosystems. *Landscape Ecology*, 38(1), 293-305.
- (11) Studholme, K. R., Fiorino, G. E., Grabas, G. P., & Tozer, D. C. (2023). Influence of surrounding land cover on marsh-breeding birds: Implications for wetland restoration and conservation planning. *Journal of Great Lakes Research*, 49(1), 318-331.
- (12) Xie, S., Marzluff, J. M., Su, Y., Wang, Y., Meng, N., Wu, T., ... & Ouyang, Z. (2022). The role of urban waterbodies in maintaining bird species diversity within built area of Beijing. *Science of The Total Environment*, 806, 150430.
- (13) Douini, I., Squalli, W., Mansouri, I., Mounir, M., Benka, E. M., Dakki, M., & Hammada, S. (2023). Diversity and Abundance of Breeding Birds, Habitat, and Nesting Substrate Selection in Urban Areas: A Relevant Case from the Southern Slope of the Mediterranean. *International Journal of Zoology*, 2023.
- (14) Heywood, J. J. N., Massimino, D., Balmer, D. E., Kelly, L., Noble, D. G., Pearce-Higgins, J. W., ... & Harris, S. J. (2023). The Breeding Bird Survey 2022. BTO Research Report, 756.
- (15) Gueye, M. T., Bop, D., Sorlini, S., Ndoye, A., & Gueye, O. (2023). Impacts de la qualité des ressources en eau sur la biodiversité de l'écosystème aquatique du lac de Technopole et sur les produits agricoles dans cette zone humide de Pikine (Dakar, Sénégal). *International Journal of Biological and Chemical Sciences*, 17(1), 173-191.
- (16) Svensson, L et al. (2021) . Le guide ornitho d'oiseaux d'Europe, d'Afrique du Nord et du Moyen-Orient - 448 page- Edition Delachaux et Niestlé.
- (17) Quatrième rapport national sur la biodiversité (Mars 2009) Secrétariat d'état auprès du ministère de l'énergie, des mines, de l'eau et de l'environnement, chargé de l'eau et de l'environnement, département de l'environnement.
- (18) Ringim, A. S. and Shafi'u, A. (2019). Composition and Diversity of Birds: A Comparative Study between Two Wetlands . *FUTY Journal of the Environment* Vol. 13 No. 1 March, 2019 © 2019 by the authors. License FUTY Journal of the Environment, Yola, Nigeria. This article is an open access distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).