

A review of the avifauna visiting the wetland environments of the Martil plain (Tetouan region, northern Morocco): Preliminary results

Naima Mars¹, Ouafaa Haddad¹, Moussa Jaouani¹, Abdelfattah Maouni¹ and Rabah Saïdi¹

¹Biology, Environment and Sustainable Development Laboratory, ENS Tetouan, Abdelmalek Essaadi University, Morocco; nama.mars@etu.uae.ac.ma (N.M.); ; moussa.jaouani@etu.uae.ac.ma (MJ); ouafaahaddad@gmail.com (OH); maouni@uae.ac.ma (A.M.) r.saidi@uae.ac.ma

Abstract. The wetland environments of the plain of Martil are located in an urban area in the Tetouan region (Northern Morocco); they provide wildlife a place to live and are important for migratory birds as they travel from nesting to wintering sites. The objective of this study is to monitor the avifauna population that frequents these ecosystems. The study duration is from January 2021 to June 2022. The survey methods are the point count and visual identification, using appropriate visual equipment and according to an ornithological guide. The avifauna recorded encompasses a total of 93 bird species and 33 families. A variety of wintering, migratory, and breeding species were identified. The population includes several species of special conservation concern, such as endemic species, heritage species, species in decline, vulnerable species, endangered species and species at risk of extinction, in Morocco, in the Maghreb or in Europe. These ornithological findings underscore the significance of preserving and restoring these urban wetland environments. However, these ecosystems face a range of pressures, including urban development, climate change and anthropogenic activities.

Index Terms—Biodiversity, Birds, Environment, Wetland, Conservation

1 Introduction

Wetland environments are the most biologically diverse ecosystems, playing a crucial role in wildlife conservation (1,3). They also contribute significantly to water retention, soil conservation, carbon storage (1,2,3,4), flood prevention, and groundwater recharge. According to the Ramsar Convention, wetlands are defined as areas of marsh, fen, peatland, or water, whether natural or artificial; permanent or temporary; with water that is static or flowing; fresh, brackish, or salty; including areas of marine water, the depth of which at low tide does not exceed six meters. (2,4,5,7) . Wetland environments provide a wide range of habitats for various plant and animal species including birds. Ornithological monitoring is particularly valuable for assessing biodiversity in wetland environments, given the ecological significance of resident and migratory birds, their movement patterns, their trophic interactions, and their adaptability (1,2,7,8). Moroccan wetlands contain interesting abundance and diversity (5,9,10,11) but their extent is limited in space. There are about 300 sites delimited as natural and artificial wetlands, in an area of 4,000 km² (7). 38 Moroccan

wetlands have been designated as Ramsar sites of international importance (12) , highlighting their significant biodiversity. 4 Ramsar sites are located in the Tangier-Tetouan region: Le Complexe du Bas Tahhadarte (No. 1476) (13) , La lagune et Barrage de Smir (No. 2380) (14), Coastline of Jbel Moussa (No. 2381) (15) and Le Complexe du Bas Loukkos (No. 1475) (16). Moroccan wetlands contain high floristic and faunistic biodiversity (11-20). The avifauna of Morocco contains 421 bird species including 240 breeding species (10). 95 nesting species hold notable heritage value according to IUCN criteria (10,18-25); this encompasses factors such as the rate of decline and the size of population, geographic distribution area, fragmentation of breeding sites, existing threats (endangered, vulnerable, rare, and declining statuses), levels of endemism, unfavourable conservation status at global, national, and regional levels (10-25).

The Tangier-Tetouan region (Northern Morocco) has been the subject of various previous studies, which have unveiled its high urbanization, high tourism activities, high socio-economic and demographic development and its significant biodiversity and ecosystems. Several wetland plants in Oued El Maleh are both rare and endemic to Morocco (4). The wetlands of La Lagune et Barrage de Smir are an important wintering site for a population of 59 wintering and/or migratory waterbirds species, several species with an unfavourable conservation status in Europe and 26 breeding species (11,14,19,24,) . The wetland environments in Le Bas Tahhadarte are the nesting site of many species (4,13,23) , including *Otis tarda*, which is rare and vulnerable according to IUCN (10,22,23,25). The wetlands of Le Bas Loukkos are the habitat and the nesting site of several vulnerable, endangered or near-threatened species (10,16,21). Moreover, these wetland environments are the only environment in Morocco with three types of extremely rare plant formations: *Nymphaea* formation, *Salix* formation, and *Iris pseudacorus* formation (4,7).

Urbanization in cities changes the environment and affects habitats and biodiversity. It causes loss of the surface and quality of the habitats of wetlands (1,5,6,26-38). Birds in wetland environments are important indicators of wetland environment quality and urbanization affects their population and biodiversity (8,26-35). Avifauna and especially migratory birds depend on water and habitats in wetland environments because they spend their entire or an important part of their life cycles in wetlands. Coastal Mediterranean wetlands of Oued Martil and Oued EL Maleh, by their location, are frequented by migratory birds after crossing the Mediterranean Sea and before leaving Africa. They are geographically close to many Ramsar sites (12–17) and important ecosystems. Despite their importance, these wetlands have not yet been the subject of a long-term study or a conservation program. In addition, they undergo anthropogenic, urban and climate change pressures; they are located in urban areas, in Tetouan and Martil. These cities have a high rate of urbanization, a high population growth and very important socio-economic activity.

Given the limited extent of research conducted on the wetland environments of Oued Martil and Oued El Maleh, in the Plain of Martil, our objective is to contribute to study their avifauna and biodiversity through a doctoral research project. The question of this research is What is the ecological and ornithological value of these urban wetlands? Which ornithological biodiversity do they contain?

We assume that since these wetlands are close to many Ramsar sites, are located in North Morocco and in the Mediterranean coast, they contain remarkable avifauna and biodiversity. High urbanization affects their quality and they must be protected, restored and preserved.

To answer research questions, an ornithological monitoring was carried out within these ecosystems from January 2021 to June 2022. The present paper offers an overview of the preliminary results.

2. Methodology

2. 1. Study area

The wetlands of Oued Martil and Oued El Maleh are located in the plain of Martil, in the Tangier-Tetouan region (Figures 1). The study area is close to two Moroccan cities in Northern Morocco, Tetouan and Martil. The plain of Martil is drained by two wadis. The Oued El Maleh exhibits an intermittent flow pattern, in Mediterranean climate, with an annual rainfall between 600 and 800 mm and the average annual temperature is 18. 7°C. The prevailing winds are frequent in summer and come from the east.

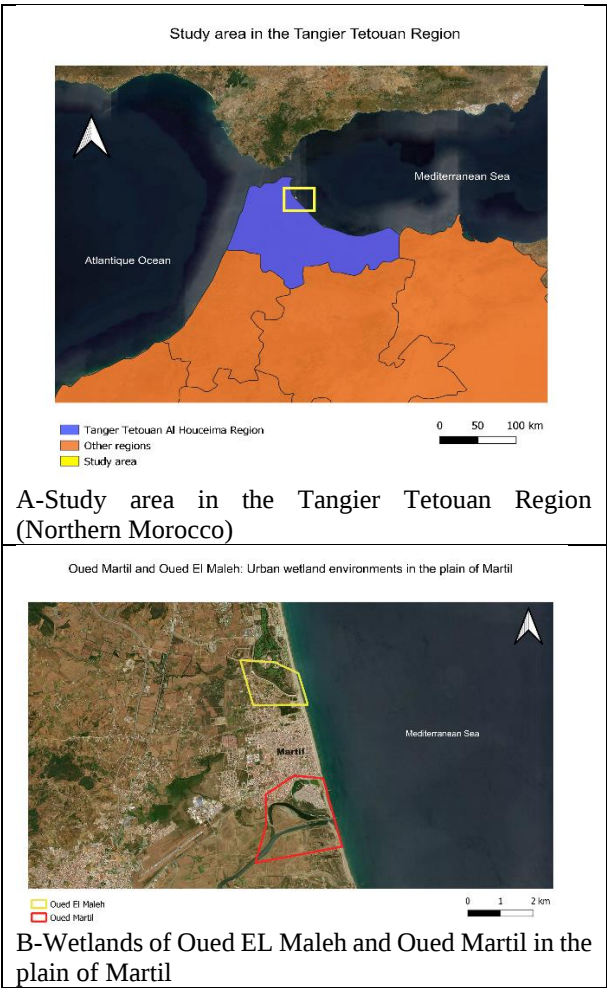


Figure.1 Geographical location of the study area: A- Tanger-Tetouan region in Northern Morocco belongs to Tanger-Tetouan-Al Houceima (Northern Morocco) Region in Morocco - B- Wetlands of Oued El Maleh and Oued Martil are located in Mediterranean Coastal and are close to many Ramsar sites of international importance for birds and biodiversity; These environments are also located in East-Atlantic-Flyway and in urban areas across two Moroccan cities, Tetouan and Martil

Wetland environments of Oued Martil and Oued El Maleh are a part of Tangier-Tetouan region wetlands. They are located in the plain of Martil, on the Mediterranean coast and on the Great East-Atlantic Flyway. These ecosystems contain various habitats provided by plants, sand, soil and water. Hydrophilic and halophilic plants provide habitats for birds for nesting, feeding, hiding, and resting. Many habitats are located in an urban area and are close to human structures, such as buildings, roads, and infrastructure (Figure 2).

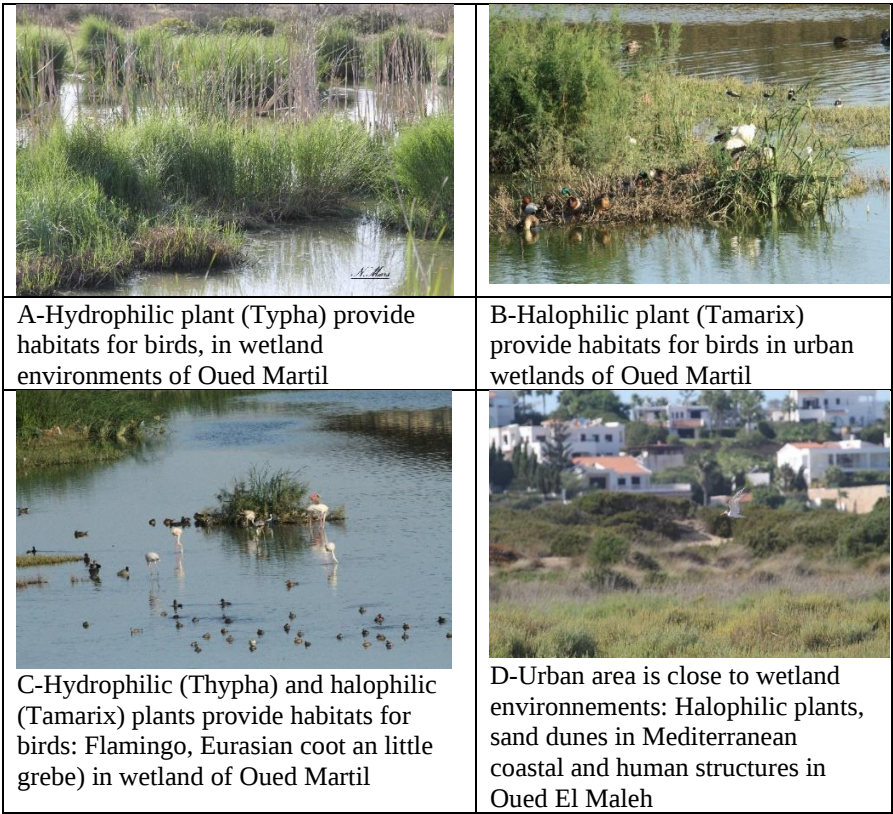


Figure. 2 Some habitats in wetland environments of Oued Martil and Oued El Maleh, in the Plain of Martil, Northern Morocco. These habitats are provided by hydrophilic and halophilic plants, sand dunes, hydric soil and water.

2.2. Monitoring method

To assess the specific biodiversity within the wetlands of Oued Martil and Oued El Maleh, a systematic monitoring of the avian population was conducted, once a week, between January 2021 and June 2022. Observations were carried out during daylight hours from 6:00 am to 6:00 pm, depending on weather conditions and accessibility. A point count method was employed, with observation periods ranging from 30 to 60 minutes. Binoculars were used for field observations, and species identification was facilitated using the Delachaux and Nestlé (2021) ornithological guide. A camera equipped with an appropriate lens was used to capture photographs for later species identification and documentation purposes.

Table 1 The ornithological monitoring sites in the Oued El Maleh and Oued Martil wetlands, some sites are located in urban area in Tetouan and Martil (Morocco). Eleven sites are chosen in urban area.

Study site	Oued Martil	Oued EL Maleh
GPS coordinates	35°36'52"N 5°16'27"W	35°38'21"N 5°16'36"W
	35°36'35"N 5°16'02"W	35°38'12"N 5°16'42"W
	35°36'50"N 5°16'19"W	35°38'12"N 5°16'47"W
	35°36'54"N 5°16'36"W	35°38'12"N 5°16'34"W
	35°36'29"N 5°17'07"W	35°38'43"N 5°17'11"W
	35°33'34"N 5°21'33"W	

3 Results

A total of 93 bird species, belonging to 34 families, were documented in the wetland environments of Oued Martil and Oued El Maleh. The recorded families include Anatidae, Podicipedidae, Ardeidae, Phalacrocoracidae, Ciconiidae, Threskiornithidae, Pandionidae, Accipitridae, Falconidae, Rallidae, Hematopodidae, Recurvirostridae, Buhiridae, Glareolidae, Charadriidae, Scolopacidae, Laridae, Columbidae, Apodidae, Upudidae, Meropidae, Alaudidae, Hirundinidae, Muscicapidae, Turdidae, Sylviidae, Laniidae, Pycnonotidae, Corvidae, Passeridae, Fringillidae and Emberizidae

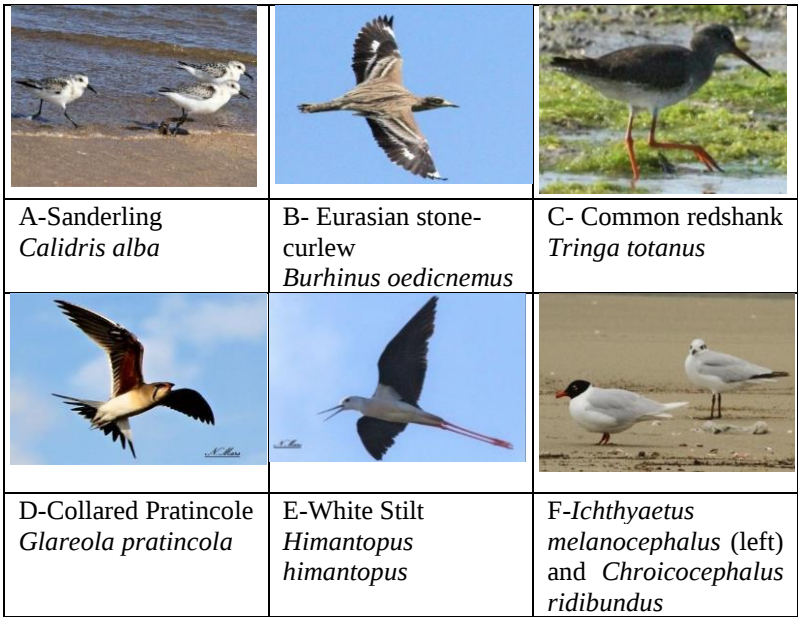


Figure.3 Waders (A, B, C, D and E) and gulls (F Mediterranean gull *Ichthyaetus melanocephalus* (left) and Black-headed gull *Chroicocephalus ridibundus*) in the studied wetland environments. Waders are associated with seashore and inland water habitats. Most waders found in wetland environments are long-distance migrants. Some gulls are seabirds and have high associations with salinity levels, being the main environmental predictor for waterbird assemblage

Waterbirds Among the recorded bird groups, the waterbirds were prominent, with a notable presence of 21 waders (Figure 3). These species encompass oystercatchers, stilts, Stone-curlews, pratincoles, plovers, snipes, godwits, curlews, sandpipers, turnstones and redshanks. Waterbirds accounted for approximately sixty percent (60%) of the observed bird population, while waders constituted around a quarter (22.60%) of the total population. The Anatidae family was represented by both dabbling ducks (Marbled Duck, Mallard, Gadwall, and Shoveler) and diving ducks (comprising the Greater Scaup, Ferruginous Duck, and Ruddy Duck.)

Conservation status

Species with a declining population in the Mediterranean region 2 species hold heritage value for Morocco and have a declining population in the Mediterranean area, the Gadwall *Mareca strepera* and Northern Shoveler *Spatula clypeata* (Figure3)

Species with Vulnerable status 7 species are vulnerable according to the IUCN criteria, Common pochard *Aythya ferina* (Figure 4; C), Red-crested Pochard *Netta ruffina*, Ferruginous Duck *Aythya nyroca*, Black-crowned Night-Heron *Nycticorax nycticorax*, Crested Coot, Audoin's Gull *Larus audouinii* and Marbled Teal *Marmaronetta angustirostris*

Species endangered in Morocco 6 species are endangered in Morocco, Red-knobbed Coot *Fulica cristata*, Squacco Heron *Ardeola ralloides*, Western Swamphen *Porphyrio porphyrio*, Purple Heron *Ardea purpurea*, Ferruginous Duck *Aythya nyroca* and Glossy Ibis *Plegadis falcinellus*. Glossy Ibis is a heritage specie and is endangered in Morocco.

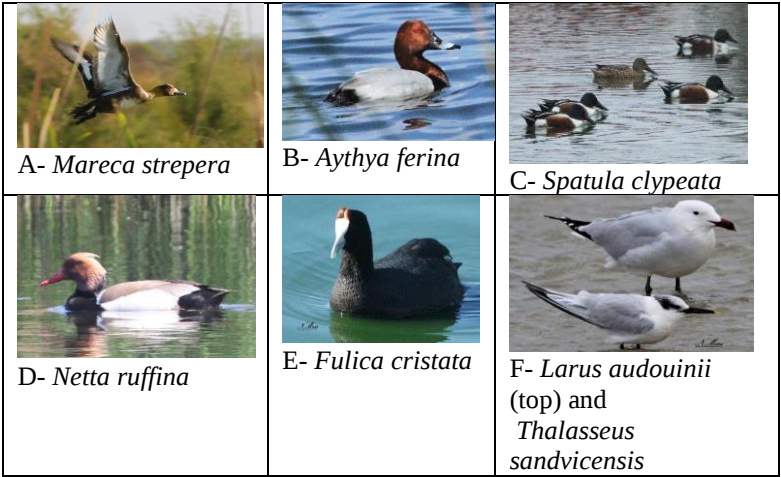


Figure.4 Heritage species for Morocco in Oued Martil and Oued EL Maleh wetland environments: two Anatidae are in decline in the Mediterranean (A and C), Three Anatidae are vulnerable according to the IUCN (B, D and E); E Crested coot (E) is Threatened in Europe and endangered according to IUCN; Audoin’s Gull(F: Audoin's Gull) is vulnerable according to the IUCN and Sandwich tern is unfavorable in Europe (F: *Thalasseus sandvicensis*)

Species declining in Morocco or globally Western Swamphen *Porphyrio porphyrio* is noted in the wetlands of Oued El Maleh. It's a resident and breeder in a few numbers. Western Swamphen is declining because of climate change, high urbanization and anthropogenic

activities in wetlands, especially in the south of the Mediterranean. This specie is declining in the world, in Europe and in Morocco.

Endemism

Endemic subspecies in Morocco 5 species have endemic subspecies in Morocco, Thekla's Lark *Galerida theklae*, Crested Lark *Galerida cristata*, Sardinian Warbler *Curruca melanocephala*, Great Cormorant *Phalacrocorax carbo* and White Wagtail *Motacilla alba*. White Wagtail supersonata (*Motacilla alba sp.supersonata*) is endemic to Morocco (Figure5, B) and is the only African settlement of the species.

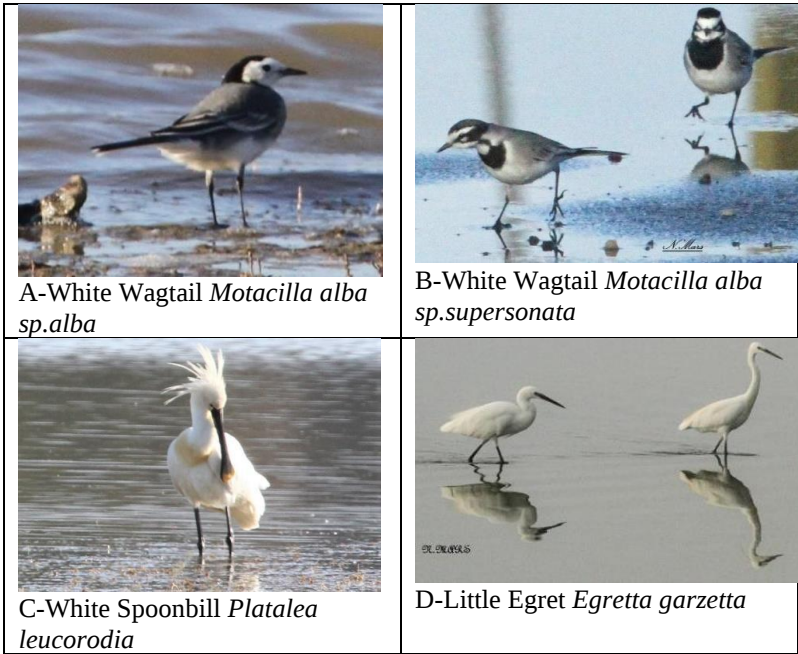


Figure.5 Resident, migratory and wintering breeding species in Morocco and the region (A-B-C and D); White Wagtail (A and B) within an endemic subspecie in Morocco (*Motacilla alba sp.supersonata*) is endemic to Morocco (B) and is the only African settlement of the species.

Endemic subspecies in the Maghreb 7 endemic subspecies in the Maghreb have been noted in the wetland environments, Thekla's Lark *Galerida theklae*, Crested Lark *Galerida cristata*, Common Bulbul *Pycnonotus barbatus*, Eurasian Skylark *Alauda arvensis*, House Sparrow *Passer domesticus*, Common Blackbird *Turdus merula* and Great Grey Shrike *Lanius excubitor*.

Potential endemic taxon in the Maghreb An endemic taxon is represented by one specie Great Grey Shrike *Lanius excubitor*

Endemic subspecies in Morocco and resident breeder 2 resident breeders and endemic subspecies are notified, Sardinian Warbler, *Curruca melanocephala* and White Wagtail. The white wagtail *Motacilla alba sp.supersonata* is the only white wagtail subspecie in Africa.

Phenological status

Palaeartic accidental visitor: One specie was recorded, the Herring Gull *Larus Argentatus*, with a few individuals among other gulls.

Migrants 67 passage migrants are long-distance migrants and 68 winter visitors were counted in the wetland environments. Passage migrants are 24 Scolopacidae, 10 Laridae, 4 Anatidae, 6 Ardeida and 3 Threskiornithidae. The winter visitors are 14 Scolopacidae, 11 Laridaen, 7 Anatidae, 5 Ardeidae and 3 3 Threskiornithidae.Many species from each population have interesting values (vulnerable or endangered species).

Winter visitor and passage migrant

Occasional winterers This study highlighted the presence of 14 occasional winterers from Morocco, Purple Heron, Lesser Kestrel, Spotted Crake, Collared Pratincole, Little Tern, Common Swift, Eurasian Hoopoe, Barn Swallow, Common house martin, Western subalpine warbler, Sedge warbler, Melodious warbler, Woodchat Shrike and Western Jackdaw. including 4 species with a doubt on their status; Common swift, Woodchat shrike, Western Jackdaw and Common house martin.

Breeding species We notified in this study 36 resident breeders known in Morocco, 12 breeding migrants, 6 occasional breeders and 3 former breeders

Former Breeder 3 species are Former breeders in Morocco, Greater Flamingo *Phoenicopterus roseus* (Figure7) , Griffon Vulture *Gyps fulvus* and Black kite *Milvus* migrants

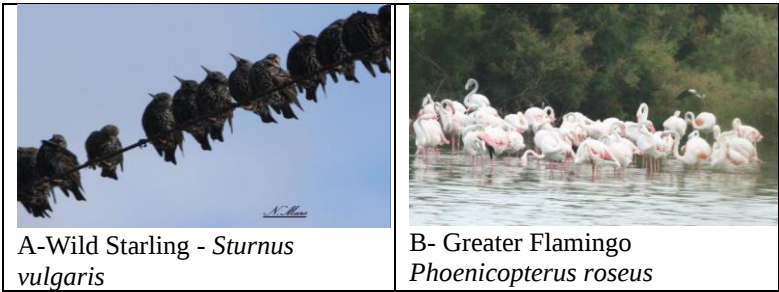


Figure.6 Migrating and wintering birds: A-Common winter visitor, migrant postnuptial arrive since August and can be observed with *Sturnus unicolor*- B-*Phoenicopterus roseus* Common passage migrant, winter visitor and former breeder.

Resident and breeding migrants 7 species with a breeding migrant population and a resident population in Morocco. Resident and breeding migrants are Glossy ibis, White stork, Spanish Sparrow, Western yellow wagtail, Audoin's Gull, Black-winged Stilt and Lesser kestrel

Resident breeders 36 resident breeders in Morocco use wetland environments of Oued Marti and Oued El Maleh in the Plain of Martil, Mallard, Ferruginous Duck, Little Grebe, Cattle Egret, Black-crowned Night Heron, Grey Heron, Crested Coot, Eurasian Stone-curlew, Grey Wagtail, Yellow Wagtail, Spectacled Warbler, Little Ringed Plover, Kentish

Plover, White Stork, Little Egret, Eurasian Spoonbill, Yellow-legged Gull, Woodchat Shrike, Great Grey Shrike, House Sparrow, Spanish Sparrow.

Breeding migrants 15 species have been recorded as summer breeders in Morocco, Black-crowned Night Heron, Purple Heron, Sedge Warbler, Black Kite, Lesser Kestrel, Collared Pratincole, Eurasian Collared Dove, Common Swift, Eurasian Hoopoe, European Bee-eater, Melodious Warbler, Subalpine Warbler, Barn Swallow, House Martin, Glossy Ibis.

Rare, localised or occasional breeding species The population includes 6 occasional breeders from Morocco: Laughing Gull, Spotted Redshank, Grey Heron, Common Pochard, Northern Shoveler, and Northern Pintail. The rare or localized nesting species are Northern Pintail, Marbled Teal, Osprey, Purple Swamphen, Little Tern, Audouin's Gull, and Black-headed Gull.

4 Conclusion and discussion

This study highlights the ecological and ornithological importance of two Mediterranean coastal wetlands in the plain of Martil (Tangier-Tetouan Region, Northern Morocco). These ecosystems are geographically close to 4 Moroccan Ramsar sites of international importance for birds and biodiversity (14–18,32,33). The Plain of Martil has been undergoing high urbanization, tourism, demographic and socio-economic growth. These anthropogenic activities have modified the general landscape as well as the structure and dynamics of the wetlands (1,4,6,9,12,30,31,34,35). Wetland environments of Oued Martil and Oued El Maleh are located in urban areas of Tetouan and Martil. They are close to habitations and roads. Our research focuses on their ecological importance for migratory and resident birds, despite their location and urban pressures. Our results show the bird population of the wetlands of Oued Martil and Oued El Maleh contains 93 species belonging to 33 families. The most abundant species are waterbirds, waders and seashores. This result is related to conditions in these environments in which water is the predominant factor, and water in these environments comes from rivers and the sea. 72% of the population are passage migrants, 62 species, 24 Scolopacidae and 10 Laridae. Winter visitors include 14 Scolopacidae and 11 Laridae and 14 winter visitor species are Occasional Winters. This result highlights the crucial role of coastal Mediterranean wetlands in Morocco for migrants, because they are resting and feeding sites for several birds. This study underlines that it is necessary to improve the quality of these wetland habitats in order to preserve this interesting biodiversity. In the other hand, this research shows that 3 species in the population are former breeders and used to be breeders in Morocco, Flamingo, Griffon vulture and Black kite. Habitat degradation and anthropogenic activities have affected their life cycle. Many reproduction attempts are recorded in Southern Morocco for Flamingo and in Northern Morocco for Griffon vulture (Coastline of Jbel Moussa) (16). These observations highlight the possible role of wetlands in the Plain of Martil in breeding of former breeders. We also noticed that 40% of the population is resident breeders (36 species) in Morocco. It is necessary to develop this result by more observation in order to confirm effective nesting species and nesting sites in these wetlands.

In concern of conservation status of the population, 2 species have a declining population in the Mediterranean region, 7 species are vulnerable according to IUCN criteria and 6 species are endangered in Morocco (36). Western swamphen is resident and breeder in the wetland of Oued El Maleh in a few numbers and is declining in Morocco and Globally. By

this observation, it is important to improve the quality of the studied wetlands and the quality of management policy in order to preserve this important biodiversity (1,4,8,19,31,35,) .

An important endemism is notified in this research, in wetland environments of Oued Martil and Oued El Maleh, 5 endemic subspecies in Morocco, 7 endemic subspecies in the Maghreb, one potential endemic taxon is represented by one specie and two endemic species are also resident breeders in Morocco. In order to protect this local and regional endemism, it is necessary to initiate conservation and management plans in the Plain of Martil.

Several parameters influence the diversity of the avifauna frequenting studied wetlands, the quantity (11,14,16,17,24,27)proximity of the Mediterranean coastline. Moreover, their location makes them stopover sites for migrants and winterers. The proximity to Ramsar sites of international importance for birds and biodiversity in the region (Coastline of Jbel Moussa (16), Complexe du Bas Loukkos (17) , Lagune de Smir (15) Complexe du Bas Tahaddarte (14) , and the mobility of the birds may mean that the avifauna recorded is almost the same in these sites. Several species have an important ecological and patrimonial value (27)

With regard to the conservation status and phenological status, the population includes species of national importance for Morocco, species in decline in the Mediterranean, vulnerable species according to the IUCN and species in danger of extinction(13). These ornithological data highlight the importance of the urbanised areas of Oued Martil and Oued El Maleh for the conservation and reproduction of heritage, vulnerable and endangered species. Urbanization and coastal development, as well as the growth of tourism activities, threaten these ecosystems, which are located in a region of national and international importance for biodiversity conservation (1,2,4,6,8,30,31,). More observations are necessary to confirm breeder and migrant species. It is important to examine the effects of high urbanization in Northern Morocco in wetland environments and biodiversity. Moroccan wetlands are the richest ecosystems and the most endangered because of climate change, high urbanization, earthworks, drainage, water extraction and agricultural practices. In order to have healthy wetlands with all roles, research, conservation and management policy are important.

Table.2 : 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

Families	Species	Oued		Status
		Oued Martil	El Maleh	
Common name	Scientific name			
Anatidae				
Mallard Duck	<i>Anas platyrhynchos</i>	+	+	RB WV
Gadwal Duck	<i>Mareca strepera</i>	+	+	WV PM OB
Northern Shoveler	<i>Spatula clypeata</i>	+	+	WV PM OB
Marbled Teal	<i>Marmaronetta angustirostris</i>	+	-	RB WV PM VUL
Common Pochard	<i>Aythya ferina</i>	+	+	WV PM OB
Red-crested pochard	<i>Netta rufina</i>	+	+	RB WV
Ferruginous duck	<i>Aythya nyroca</i>	+	+	RB WV

Podicipedidae				
Little grebe	<i>Tachybaptus ruficollis</i>	+	+	RB WV
Phalacrocoracidae				
Great cormoran	<i>Phalacrocorax carbo</i>	+	+	RB , WV
Ardeidae				
Black-crowned night hero	<i>Nycticorax nycticorax</i>	+	+	PM BM WV
Cattle egret	<i>Bubulcus ibis</i>	+	+	RB PM WV
Squacco heron	<i>Ardeola ralloides</i>	+	-	BM RB? PM W
Little egret	<i>Egretta garzetta</i>	+	+	RB PM WV
Gray heron	<i>Ardea cinerea</i>	+	+	PM WV OB
Purple heron	<i>Ardea purpurea</i>	+	+	PM BM OW
Ciconiidae				
White stork	<i>Ciconia ciconia</i>	+	+	PM, BM/RB, W
Threskiornithidae				
Glossy ibis	<i>Plegadis falcinellus</i>	+	+	PM, WV BM/RB
Spoonbill	<i>Platalea leucorodia</i>	+	+	PM WV RB
Flamingo	<i>Phoenicopterus roseus</i>	+	+	PM WV FB
Pandionidae				
Western Osprey	<i>Pandion haliaetus</i>	+	+	PM WV RB
Accipitridae				
Griffon Vulture	<i>Gyps fulvus</i>	+	+	PM FB
Black kite	<i>Milvus migrans</i>	+	+	WV FB/ RB ?
Western Marsh Harrier	<i>Circus aeruginosus</i>	+	+	RB WV PM
Falconidae				
Lesser kestrel	<i>Falco naumanni</i>	+	+	PM BM/RB OW
Common kestrel	<i>Falco tinnunculus</i>	+	+	RB PM WV
Rallidae				
Spotted crake	<i>Porzana porzana</i>	+	-	PM OW
Common Moorhen	<i>Gallinula chloropus</i>	+	+	RB WV PM
Eurasian Coot	<i>Fulica atra</i>	+	+	RB WV PM
Wattled coot	<i>Fulica cristata</i>	+	-	RB Endang
Western swamphen	<i>Porphyrio porphyrio</i>	-	+	RB Endec
Haematopodidae				
Oystercatcher	<i>Haematopus ostralegus</i>	-	+	PM WV
Recurvirostridae				
Black-winged Stilt	<i>Himantopus himantopus</i>	+	+	BM/RB PM WV
Buhiriniidae				
Stone Curlew	<i>Burhinus oedicnemus</i>	+	+	RB WV PM
Glareolidae				
Collared Pratincole	<i>Glareola pratincola</i>	+	+	PM BM OW
Charadriidae				
little ringed plover	<i>Charadrius dubius</i>	+	+	RB PM WV
Great Ringed Plover	<i>Charadrius hiaticula</i>	+	+	PM WV
Kentish plover	<i>Charadrius alexadrinus</i>	+	+	RB PM WV
Scolopacidae				
Red knot	<i>Calidris canutus</i>	+	+	PM WV
Sanderling	<i>Calidris alba</i>	-	+	PM WV
Ruddy Turnstone	<i>Arenaria interpres</i>	-	+	PM WV

Dunlin	<i>Calidris alpina</i>	-	+	PM WV
Curlew sandpiper	<i>Calidris ferruginea</i>	-	+	PM WV
Wood Sandpiper	<i>Tringa glareola</i>	+	+	PM WV
Least Sandpiper	<i>Calidris minuta</i>	+	+	PM WV
Green Sandpiper	<i>Tringa ochropus</i>	+	+	PM WV
Common sandpiper	<i>Actitis hypoleucos</i>	+	+	PM WV
Common redshank	<i>Tringa totanus</i>	+	+	PM WV OB
Black-tailed godwit	<i>Limosa limosa</i>	+	+	PM WV
Eurasian whimbrel	<i>Numenius phaeopus</i>	-	+	PM WV
Common snipe	<i>Gallinago gallinago</i>	+	+	PM WV
Jack snipe	<i>Lymnocyptes minimus</i>	+	+	PM WV
Laridae				
Black-headed gull	<i>Chroicocephalus ridibundus</i>	+	+	WV PM RB
Slender-billed gull	<i>Chroicocephalus genei</i>	+	+	PM WV OB
Common gull	<i>Larus canus</i>	+	+	WV
Mediterranean Gull	<i>Ichthyaeetus melanocephalus</i>	-	+	PM WV
European herring G	<i>Larus argentatus</i>	-	+	PAV
Yellow-legged Gull	<i>Larus michahellis</i>	+	+	RB WV
Audoin's Gull	<i>Larus audouinii</i>	+	+	BM/RB PM WV VUL
Lesser black-backed	<i>Larus fuscus</i>	-	+	PM WV
Little tern	<i>Sternula albifrons</i>	+	+	BM, PM, OW
Sandwich tern	<i>Thalasseus sandvicensis</i>	+	+	PM WV
Caspian tern	<i>Hydroprogne caspia</i>	+	+	PM WV
Lesser crested tern	<i>Thalasseus bengalensis</i>	+	+	PM WV
Sterne voyageuse				
Whiskered tern	<i>Chlidonias hybrida</i>	+	+	PM, WV,OB
Columbidae				
Eurasian Collared Dove	<i>Streptopelia decaocto</i>	+	+	RB
Apodidae				
Common swift	<i>Apus apus</i>	+	+	PM BM OW?
Upupidae				
Eurasian hoopoe	<i>Upupa epops</i>	+	+	PM BM OW
Meropidae				
European Bee-eater	<i>Merops apiaster</i>	+	+	PM BM
Alaudidae				
Eurasian Skylark	<i>Alauda arvensis</i>	+	+	WV
Crested lark	<i>Galerida cristata</i>	+	+	RB
Thekla's lark	<i>Galerida theklae</i>	+	+	RB
Hirundinidae				
Barn Swallow	<i>Hirundo rustica</i>	+	+	PM BM OW
Common House	<i>Delichon urbicum</i>	+	+	PM BM OW?
Martin				
Motacillidae				
White Wagtail alba	<i>Motacilla alba ssp.alba</i>	+	+	WV RB PM
White Wagtail supersonat	<i>M. alba ssp.supersonata</i>	+	+	
Western yellow wagtail	<i>Motacilla flava</i>	+	+	PM BM/RB WV
Muscicapidae				
Northern Wheatear	<i>Oenanthe oenanthe</i>	+	+	PM WV
European Stonechat	<i>Saxicola rubicola</i>	+	+	RB WV PM

Turdidae				
Common blackbird	<i>Turdus merula</i>	+	+	RB WV?
Sylviidae				
Sardinian Warbler	<i>Curruca melanocephala</i>	+	+	RB PM WV
Western Subalpine Warbler	<i>Curruca iberiae</i>	+	-	PM BM OW
Sedge Warbler	<i>Acrocephalus schoenobaenus</i>	+	+	PM OW
Zitting Cisticola	<i>Cisticola juncidis</i>	+	+	RB WV
Melodious warbler	<i>Hippolais polyglotta</i>	+	+	BM PM OW
Laniidae				
Great Grey Shrike	<i>Lanius excubitor</i>	-	+	RB
Woodchat Shrike	<i>Lanius senator</i>	+	+	BM PM OW ?
Pycnonotidae				
Common Bulbul	<i>Pycnonotus barbatus</i>	+	+	RB
Corvidae				
Western Jackdaw	<i>Coloeus monedula</i>	+	+	RB OW ?
Common Starling	<i>Sturnus vulgaris</i>	+	+	WV
Spotless Starling	<i>Sturnus unicolor</i>	+	+	RB WV
Passeridae				
House Sparrow	<i>Passer domesticus</i>	+	+	RB WV
Spanish Sparrow	<i>Passer hispaniolensis</i>	+	+	BM/RB WV
Fringillidae				
Common Linnet	<i>Linaria cannabina</i>	+	+	RB WV
Emberizidae				
Corn Bunting	<i>Emberiza calandra</i>	+	-	RB WV
33 Families / 93 species and subspecies		O .Martil : 82 species	O. El Maleh 87 species	

References

1. McKinney, Richard A., Kenneth B. Raposa, and Rose M. Cournoyer. Wetlands as habitat in urbanizing landscapes: patterns of bird abundance and occupancy. *Landscape and Urban Planning* 100, no. 1-2 (2011): 144-152

2. Sheta Et Al, Basma M. Wetland Habitat Suitability and Diversity for Migratory and Resident Birds in the Ramsar Site Lake Burllus, Egypt. *Egyptian Journal of Aquatic Biology and Fisheries* 27, no. 1 (2023): 253-274.

3. Novoa, Vanessa, Octavio Rojas, Ramón Ahumada-Rudolph, Katia Sáez, Pablo Fierro, and Carolina Rojas. "Coastal wetlands: ecosystems affected by urbanization? *Water* 12, no. 3 (2020): 698.

4. HAMMADA, Soumaya, Leslie LINARES, and John CORTES. Biodiversité floristique des dunes littorales de l'Oued El Maleh (Martil) et du bas Tahaddart: résultats préliminaires. *Trav. Instit. Scient. Rabat* 6 (2009): 45-50.

5. Xu, Qingru, Lizhi Zhou, Shanshan Xia, and Jian Zhou. "Impact of Urbanization Intensity on Bird Diversity in River Wetlands around Chaohu Lake, China." *Animals* 12, no. 4 (2022): 473.

6. Azonningbo, Sagbo Hugues Wilfrid, Jacques Boco Adjakpa, and Emile Codjo Agbangba. 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* 78, no. 1 (2021): 117-139.

7. Khabbach, Abdelmajid, Mohamed Libiad, and Abdeslam Ennabili. An updated checklist of the wetland vascular flora from Morocco. *Moroccan Journal of Biology* 17 (2020): 1-35.
8. Zhang, Lu, and Zhiyun Ouyang. "Focusing on rapid urbanization areas can control the rapid loss of migratory water bird habitats in China." *Global Ecology and Conservation* 20 (2019): e00801.
9. Nakhli, Sanaa. "Environmental pressures and new management strategies on the Moroccan coast." *Mediterranean. Geographical review of Mediterranean countries/Journal of Mediterranean geography* 115 (2010): 31-42.
10. Bergier et al., (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).
11. EL AGBANI, Mohammed Aziz, Abdeljebbar QNINBA, Mohamed AMEZIAN, Fabrice CUZIN, and Mohamed DAKKI. The waterfowl population of the Smir wetlands complex (Northern Morocco): current status, heritage interest and evolution over the last four decades." *Bulletin of the Scientific Institute* (2009): 103-110.
12. Ramsar Sites Information Service. Annotated List of Wetlands of International Importance Morocco. [Internet]. [cited 2023 May 27]. Available from https://rsis Ramsar.org/sites/default/files/rsiswp_search/exports/Ramsar-Sites-annotated-summary-Morocco.pdf?1552328143
13. Ramsar Sites Information Service [Internet]. Complexe du bas Tahaddart. [cited 2023 May 27]. Available from: <https://rsis Ramsar.org/ris/1476?language=en>
14. Ramsar Sites Information Service [Internet]. Lagune et barrage de Smir. [cited 2023 May 27]. Available from: <https://rsis Ramsar.org/ris/2380?language=en>
15. Service d'information sur les Sites Ramsar [Internet]. Littoral de Jbel Moussa. [cited 2023 May 27]. Available from: <https://rsis Ramsar.org/fr/ris/2381>
16. Service d'information sur les Sites Ramsar [Internet]. Complexe du bas Loukkos [cited 2023 May 27]. Available from: <https://rsis Ramsar.org/fr/ris/1475>
17. S. HAMMADA Thèse de doctorat d'état ès-sciences. Biologie Spécialité : Ecologie végétale ETUDES SUR LA VEGETATION DES ZONES HUMIDES DU MAROC Catalogue et Analyse de la Biodiversité Floristique et Identification des principaux Groupements Végétaux (2007).
18. Green, Andy J., Mustapha El Hamzaoui, M. A. El Agbani, and J.Franchimont. The conservation status of Moroccan wetlands with particular reference to waterbirds and to changes since 1978. *Biological conservation* 104, no. 1 (2002): 71-82
19. M.A.El Agbani, & M. Dakki. Ornithological significance of the Smir region wetland complex. *Sensitive coastal ecosystems of the Mediterranean: case of the Smir coast. work Inst. Sci., Rabat, General series* 4 (2005): 61-64.
20. S.I.Cherkaoui, H. Saâd, N. Magri, M.A. El Agbani, and M. Dakki. Factors influencing species-richness of breeding waterbirds in Moroccan IBA and Ramsar wetlands: a macroecological approach. *Wetlands* 35, no. 5 (2015): 913-922.
21. Qninba, Abdeljebbar, H. Rguibi Idrissi, Oumnia Himmi, Abdelaziz Benhoussa, Mohammed Aziz El Agbani, and Michel Thévenot. "Nouveaux cas de nidification d'oiseaux dans le complexe de zones humides du Bas Loukkos (Nord-Ouest du Maroc)." *Bulletin de l'Institut Scientifique, Rabat* 30 (2008): 45-50..
22. UICN et HCEFLCD Stratégie et plan d'action pour la conservation de la grande outarde (Otis tarda) au Maroc 2016-2025. Malaga, Espagne : UICN/HCEFLCD. (2016). 52 pp.

23. Dhaif Allah et al. (2021) . Extent Of Measurement And Disclosure Of Environmental Information In Financial Reports Under (IFRS & IAS) For Yemeni. E3S Web of Conferences, 319, 01079
24. Elamrani, H. Slopes of seasonal variations of time series and forecasts: Practical case on weather. IOP Conference Series: Earth and Environmental Science, 2022, 975(1), 012003
25. International Union for Conservation of Nature and Natural Resources. IUCN 2023. The IUCN Red List of Threatened Species. Version 2022-2. <https://www.iucnredlist.org> ISSN 2307-8235
26. Azonningbo, S.H.Wilfrid, J.B. Adjakpa, DGF Chidikofan, and Emile Codjo AGBANGBA. "Indicator bird species of the Wetland of International Importance of Southwest Benin (Ramsar Site 1017)." Africa SCIENCE 15, no. 5 (2019): 229-237.
27. Cherif, El Khalil, Martin Vodopivec, Nezha Mejjad, Joaquim CG Esteves da Silva, Simona Simonovič, and Hakim Boulaassal. "COVID-19 pandemic consequences on coastal water quality using WST Sentinel-3 data: case of Tangier, Morocco." Water 12, no. 9 (2020): 2638.
28. Sun, Bin, Yonglong Lu, Yifu Yang, Mingzhao Yu, Jingjing Yuan, Ran Yu, James M. Bullock et al. "Urbanization affects spatial variation and species similarity of bird diversity distribution." Science Advances 8, no. 49 (2022): eade3061.
29. Li, Zhaobin, Lei Ma, Dongmei Gou, Qianqian Hong, Leungkam Fai, and Bo Xiong. "The Impact of Urban Development on Wetland Conservation." Sustainability 14, no. 21 (2022): 13747.
30. Rahlin, Anastasia A., Sarah P. Saunders, and Stephanie Beilke. "Spatial drivers of wetland bird occupancy within an urbanized matrix in the Upper Midwestern United States." Ecosphere 13, no. 9 (2022): e4232.
31. Basukriadi, Adi, and Erwin Nurdin. "Spatial Biodiversity of Birds in Land Covers of Wetlands on Jakarta's North Coast." Biota: Jurnal Ilmiah Ilmu-Ilmu Hayati (2023): 51-58.
32. BirdLife International State of the World's Birds 2022: Insights and solutions for the biodiversity crisis. Cambridge, UK: BirdLife International (2022) ISBN: 978-1-912086-62-7
33. Duraimurugan, V., P. Jeevanandham, and J. Paramanandham. "Abundance and diversity of waterbirds in Karaikal Mangrove, Puducherry Union Territory." International Journal of Management, IT and Engineering 9, no. 1 (2019): 104-131.
34. Barik, Souvik, Goutam Kumar Saha, and Subhendu Mazumdar. "Influence of land cover features on avian community and potential conservation priority areas for biodiversity at a Ramsar site in India." Ecological Processes 11, no. 1 (2022): 25.
35. Grand, Joanna, Sarah P. Saunders, Nicole L. Michel, Lisa Elliott, Stephanie Beilke, Annie Bracey, Thomas M. Gehring et al. "Prioritizing coastal wetlands for marsh bird conservation in the US Great Lakes." Biological Conservation 249 (2020): 108708.
36. Hannou, E. "Aménagement du territoire et développement du littoral: Cas de la partie septentrionale du Maroc." In 2nd FIG Conference, pp. 1-13. 2003.
37. Irvine, Kenneth, Chris Dickens, Leandro Castello, Ian Bredin, and C. Max Finlayson. "Vegetated wetlands: from ecology to conservation management." In Fundamentals of Tropical Freshwater Wetlands, pp. 589-639. Elsevier, 2022.
38. Pateau, Melanie. "From hazard to natural risk: case of the Tangier-Tetouan region (Rif, Morocco)." Geo-Eco-Trop 38, no. 1 (2014): 23-32.

39. Le guide ornitho Delachaux Collection Guide du naturaliste. Edition Delachaux et Niestlé. (2021) 448 pages.