

Biodiversity and nesting success of waterbirds at the Bougara Dam (Tissemsilt, North-West of Algeria)

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Our study was carried out for two successive years, between 2018 and 2019, at the Bougara Dam, located in northwestern Algeria. 62 species belonging to 17 families were inventoried during the first year of study, Anatidae and Scolopacidae are the best represented with 14 species, Ardeidae with 07 species. These species have shown different phenological statuses, including sedentary nesters, nesting summer visitors, winterers and transient migrants. Among them, 7 species are on the IUCN red list, others appear in international bird protection agreements (AEWA, CMS) or are protected by Algerian law.

The reproduction ecology of nesting waterbirds was studied in 2019, the monitoring of the reproduction of nesting waterbirds reveals the presence of 13 nesting species belonging to 07 families, 101 nests of all species were found, 316 eggs were analyzed. Laying and hatching dates varied by species, as did lay sizes and reproductive success.

Keywords: Biodiversity, Waterbirds, Nesting, Phenological status, Protection stauts, Bougara dam, Algeria.

Introduction

The Mediterranean region is an area extremely rich in biodiversity. Among the most remarkable ecosystems, wetlands are home to a great diversity of species. This ecosystem is also among the most threatened globally, mainly due to the recent and continuous increase in human populations and the joint development of irrigated agriculture, urbanization, industry, transport infrastructure and tourism.

Algeria has a vast and very diverse set of lentic wetlands (lakes, chotts, sebkhas, dayas, ponds and dams) of considerable ecological importance. However, the most precise and recent data are only available for certain water bodies, often the most interesting on an international scale such as Ramsar sites (Samraoui and de belair, 1997; Houhamdi and samraoui, 2001; 2002; 2003; 2008; Samraoui and Houhamdi 2002; Metallaoui and Houhamdi, 2008; 2010; Metallaoui et al., 2009; Metalaoui and Houhamdi, 2010; Baaziz et al., 2011; Guellati et al., 2014; Boudraa et al., 2014; Guergueb et al., 2014; Elafri, 2017; Guergueb et al., 2017; Lazli et al., 2018; Bourafa, 2019; Bediaf et al, 2020; Boubekeur et al, 2020). These hydrosystems, in addition to their sociological, economic, heritage and landscape value, should be considered as reservoirs of animal and plant biodiversity (Saheb et al., 2006; Samraoui et al., 2006; Boulekhssaim et al., 2006; Houhamdi et al., 2008; 2009; Boukrouma et al., 2011; Bensaci et al., 2012; Boudraa et al., 2014; Guellati et al., 2014; Elafri., 2017; Lazli et al., 2018; Bediaf et al., 2020).

The Bougara Dam is a wetland located in northwestern Algeria. It plays a primary role during the migration and reproduction of many avian species. With this objective, we were interested firstly in establishing a more or less exhaustive list of all the aquatic avian species which frequent it, and secondly, to follow the evolution of the numbers of these last during a whole annual cycle. in order to determine their phenological status and protection status, and thirdly, to monitor the nesting success of aquatic avifauna in this Dam.

Site description

The Bougara Dam (35°55'98.34"N, 1°90'75.50"E), is located in the Wilaya of Tissemsilt, on the Oued Nahr Ouassel, just upstream of the village of Bougara. The dam reservoir mainly takes place in the Wilaya of Tissemsilt. The aquatic ecosystem covering an area

of 433.6 ha includes the Bougara Dam reservoir and a swamp located in its northern part with a depth varying between 45 cm and 2 m (Fig. 1).

The lake system covers nearly 80% of the aquatic ecosystem and is essentially confined to the Bougara Dam reservoir. The depth exceeds 2 m over approximately 223 ha (limnic subsystem) and is less than 2 meters (coastal subsystem) over just over 121 ha. The marsh system includes the habitats associated with the temporarily flooded shrub swamp. This system is mainly located on the north shore and covers just under 20% of the wetland. The fluvial system occupies a little more than 2% of the wetland comprising the Oueds Nahr Ouassel and Boukala. Water flows almost continuously in these streams which can rise out of their beds seasonally (MATET, 2010).

The floral composition of the aquatic ecosystem is made up of 19 species belonging to 16 botanical families that have been identified in the wetland of the Bougara Dam. The floristic record shows a notable dominance of annual species which develop in mesophilic (moderately humid) to hygrophilic (very humid) conditions. These grassland formations are dependent on the duration of the flooding and the regularity of the rains. The main species are *Phragmites communis*, *Picris hieracioides*, *Galactites tomentosa*, *Cirsium vulgare*, *Lobularia mantor*, *Silene fuscata*, *Chenopodium album*, *Brassica nigra*, *Melilotus officinalis*, *Erodium moschatum*, *Avena sterilis*, *Papaver rhoeas*, *Calicotum spineus*, *Plantago major*, *Brexomus rubosa*, *Plantago major*, *Brexomus rubosa*, *Plantago major*, *Brexomus rubosa pulcher*, *Ziziphus lotus*, *Typha angustifolia* and *Tamarix gallica*.

Each year, this aquatic ecosystem welcomes an important bird diversity and easily meets the ZICO criteria (Zone of Importance for the Conservation of Birds) during the winter or breeding season.

The wetland of the Bougara Dam is home to species protected by national legislation: elegant avocet, white stilt, pink flamingo, white stork and black scap. The sedentary and nesting species are: Mallard, Eurasian coot, Moorhen, White stilt, Gray heron.

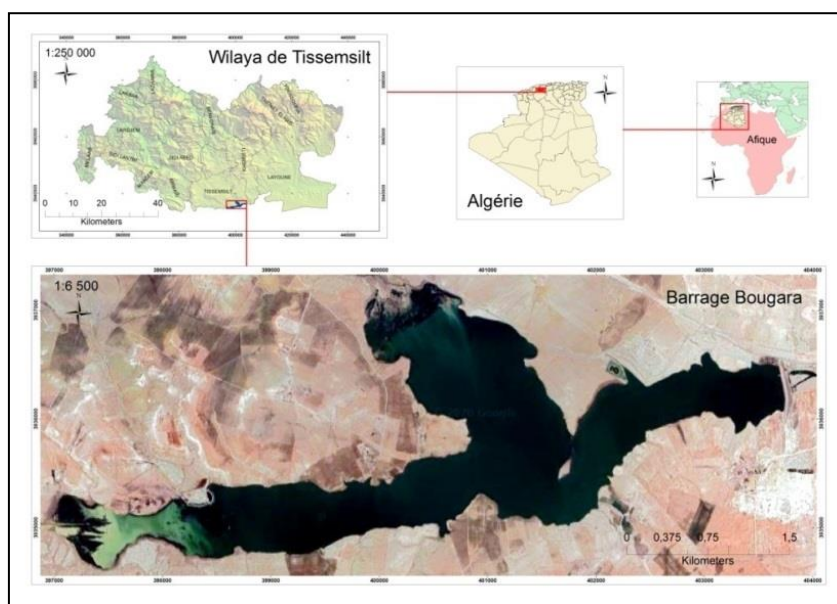


Fig. 1. Geographical location of the Bougara Dam (Meziane, 2018).

Materials and Methods

In order to inventory the aquatic avian population of the Bougara Dam and to determine its phenological status and protection status, a study was carried out over one year (from January 2018 to December 2018). Field trips were organized weekly throughout the study period. Our observations were made with a Konus-Spot ornithological spotting scope (20 × 60) and a pair of Soligor binoculars (10 × 40). The censuses and counts were carried out either individually when the group of waterbirds was close to the observation point and numbered less than 200 individuals, or by visual estimation in the opposite case, in other words, if the number of group was very large or if the birds were at a significant distance. This method of counting on foot is the most widely used in bird counts (Lamotte and Bourlière, 1969; Blondel, 1975; Houhamdi, 2002). Once these birds were counted, the location where they were found was marked on a map in order to determine the methods of distribution and spatial occupation of the body of water by the different species recorded. This method is the most used in winter censuses of aquatic avifauna, but has a margin of error of between 5 and 10%, depending on the experience of the observer, the equipment used and the structure of the environment, such as the presence of a vegetation belt and the height of the helophytes (Lamotte and Bourlière, 1969; Houhamdi, 1998; 2002).

Searches and inspections were carried out during 2019 at least twice a week from mid-February to July in order to identify the various places likely to shelter nests. After the first shipments of nest building materials were observed, we would make three visits per week until their construction was complete. Once found the nests were individually marked and recorded using a global positioning system (GPS), and its internal and external diameters, the height and depth of the water were measured, as was the medium on which the nest has been deposited. The eggs were weighed using a precision balance (0.1 g) (P) and measured (length [L] and width [B]) with a precision 0.1 mm electronic caliper. The measurements taken allowed us to calculate biometric clues in order to study more closely the physical characteristics of the eggs.



Fig. 2. General views of the Bougara (Meziane, 2018).

Results and Discussion

Sixty-two species of waterbirds belonging to seventeen families were recorded during the study period, including sedentary nesters, summer nesters, winterers and transient migrants (Table 1). In this stand, Anatidae and Scolopacidae are the best represented with 14 species, Ardeidae with 07 species (Fig. 3 and 4).

Among the species recorded, there are seven on the IUCN Red List, which represents 11% of the species recorded; such as Marbled Teal, Common Scaup, Nyroca Duck, White-headed Duck, Lapwing, Black-tailed Godwit, Common Curlew. Species protected under the AEWA agreement number 59, or 95% of the total number of waterbird species recorded. The species appearing on Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) number 44, or 71%. Other species are protected by Algerian legislation, in particular by decree N°83-509 of August 20, 1983, ordinance N°06-05 of July 15, 2006 relating to the protection of certain animal species threatened with extinction, more recently, Executive Decree No. 12-235 of May 24, 2012 establishing the list of protected non-domestic animal species. Of the 62 species inventoried during the study period, 25 are protected under Algerian law, or 40%, and 37 are unprotected, or 60% (Fig. 5).

Table 1. Check-list, phenological and protection status of waterbirds at Bougara Dam. Wi: wintering, RB: Residents breeder, TM: Transient migrant, SB: Summer breeder.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Min	Max	Pheno status	protection status
Podicipedidae																
Great Crested Grebe <i>Podiceps cristatus</i>	X	X	X	X	X	X	X		X	X	X	X	5	52	RB	AEWA/IUCN (LC)
Black-necked grebe <i>Podiceps nigricollis</i>	X						X			X		X	1	7	TM	AEWA/IUCN (LC)
Little grebe <i>Tachybaptus ruficollis</i>	X	X	X		X				X	X			2	48	RB	AEWA/IUCN (LC)
Phalacrocoracidae																
Great Cormorant <i>Phalacrocorax carbo</i>	X	X								X	X	X	5	189	TM	AEWA/IUCN (LC) Algerian legislation
Accipitridae																
March harrier <i>Circus aeruginosus</i>	X	X	X	X		X	X	X	X	X	X	X	3	27	RB	IUCN (LC)/Algerian legislation
Ciconiidae																
White stork <i>Ciconia ciconia</i>	X	X	X	X	X	X	X	X				X	2	76	SB	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Phoenicoptéridae																
Greater Flamingo <i>Phoenicopterus roseus</i>	X	X	X	X	X	X	X	X	X			X	1	60	TM	IUCN (LC)/Algerian legislation
Gruidae																
Common Crane <i>Grus grus</i>	X										X	X	4	38	Wi	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Threskiornithidae																

Spoonbill <i>Platalea leucorodia</i>	X	X	X	X	X	X		X		X	X	X	1	23	TM	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Glossy ibis <i>Plegadis falcinellus</i>				X	X	X							2	15	SB	AEWA/CMS(A.II)/IUCN (LC) Algerian legislation
Ardeidae																
Squacco heron <i>Ardeola ralloides</i>				X	X	X	X	X	X				1	10	SB	AEWA/IUCN (LC) Algerian legislation
black-crowned night heron <i>Nycticorax nycticorax</i>				X	X								3	7	SB	AEWA/IUCN (LC) Algerian legislation
Cattle Egret <i>Bubulcus ibis</i>			X				X	X	X	X	X	X	39	70	RB	AEWA/IUCN (LC)
Great white heron <i>Ardea alba</i>	X	X		X	X	X	X			X	X		1	14	TM	AEWA/CMS(A.II)/IUCN (LC) Algerian legislation
Little egret <i>Egretta garzetta</i>	X	X	X	X	X	X	X	X	X	X	X	X	5	62	TM	AEWA/IUCN (LC) Algerian legislation
Purple Heron <i>Ardea purpurea</i>		X		X	X	X							1	41	TM	AEWA/CMS(A.II)/IUCN (LC) Algerian legislation
Grey Heron <i>Ardea cinerea</i>	X	X	X	X	X	X	X	X	X	X	X	X	4	77	RB	AEWA/IUCN (LC)
Anatidae																
Common Shelduck <i>Tadorna tadorna</i>	X	X	X	X	X	X	X	X	X		X		1	93	RB	AEWA/CMS(A.II)/IUCN (LC) Algerian legislation
Ruddy shelduck <i>Tadorna ferruginea</i>	X		X	X	X	X	X	X					2	247	RB	AEWA/CMS(A.II)/IUCN (LC) Algerian legislation
Mallard <i>Anas platyrhynchos</i>	X	X	X	X	X	X	X	X	X	X	X	X	93	1624	RB	AEWA/CMS (A.II)/IUCN (LC)
Northern Shoveler <i>Spatula clypeata</i>	X	X	X			X		X	X	X	X		5	460	Wi	AEWA/CMS (A.II)/IUCN (LC)
Eurasian Wigeon <i>Mareca penelope</i>	X	X	X				X						54	362	Wi	AEWA/CMS (A.II)/IUCN (LC)
Gadwall <i>Mareca strepera</i>	X	X	X	X	X		X				X		4	139	Wi	AEWA/CMS (A.II)/IUCN (LC)
Northern Pintail <i>Anas acuta</i>		X											1	1	Wi	AEWA/CMS (A.II)/IUCN (LC)
Marbled duck <i>Marmaronetta angustirostris</i>				X	X	X					X		1	4	Wi	AEWA/CMS (A.I)/IUCN (VU) Algerian legislation
Common Teal <i>Anas crecca</i>	X	X	X					X	X	X	X		85	621	Wi	AEWA/CMS (A.II)/IUCN (LC)
Garganey <i>Spatula querquedula</i>					X	X							8	12	TM	AEWA/CMS (A.II)/IUCN (LC)
Pochard <i>Aythya ferina</i>		X	X								X		8	22	RB	AEWA/CMS (A.II)/IUCN (VU) Algerian legislation
Ferruginous Duck <i>Aythya nyroca</i>	X		X	X	X	X		X			X		2	12	RB	AEWA/CMS (A.I)/IUCN (NT) Algerian legislation
White-headed duck <i>Oxyura leucocephala</i>	X	X		X									2	16	RB	AEWA/CMS (A.I)/IUCN (EN)
Red-crested pochard <i>Netta rufina</i>	X	X											2	5	Wi	AEWA/CMS (A.II)/IUCN (LC)
Rallidae																
Common Moorhen	X	X	X	X	X	X	X	X	X	X	X	X	2	37	RB	AEWA/IUCN (LC)

<i>Gallinula chloropus</i>																
Common Coot <i>Fulica atra</i>	X	X	X	X	X	X	X	X	X	X	X	X	13	318	RB	AEWA/CMS (A.II)/IUCN (LC)
Water Rail <i>Rallus aquaticus</i>		X	X		X								2	8	Wi	AEWA/IUCN (LC) Algerian legislation
Glareolidae																
Collared Pratincole <i>Glareola pratincola</i>					X	X	X	X					3	30	TM	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Recurvirostridae																
Black-winged stilt <i>Himantopus himantopus</i>	X		X	X	X	X	X	X	X	X		X	1	39	SB	AEWA/IUCN (LC) Algerian legislation
Pied Avocet <i>Recurvirostra avosetta</i>					X	X	X	X	X				13	42	SB	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Charadriidae																
Little ringed plover <i>Charadrius dubius</i>					X	X	X	X					9	170	SB	AEWA/CMS (A.II)/IUCN (LC)
Common Ringed Plover <i>Charadrius hiaticula</i>				X	X	X							2	9	TM	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Kentish plover <i>Charadrius alexandrinus</i>			X	X	X	X	X	X	X				7	160	RB	AEWA/CMS (A.II)/IUCN (LC)
Northern Lapwing <i>Vanellus vanellus</i>	X	X							X	X	X	X	1	89	Wi	AEWA/CMS (A.II)/IUCN (NT)
Scolopacidae																
Sanerling <i>Calidris alba</i>					X				X				1	3		AEWA/CMS (A.II)/IUCN (LC)
Little stint <i>Calidris minuta</i>	X			X	X	X	X					X	4	142	Wi	AEWA/CMS (A.II)/IUCN (LC)
Dunlin <i>Calidris alpina</i>							X					X	2	4	Wi	AEWA/CMS (A.II)/IUCN (LC)
Common Snipe <i>Gallinago gallinago</i>	X								X	X	X	X	1	9	TM	AEWA/CMS (A.II)/IUCN (LC)
Black-tailed Godwit <i>Limosa limosa</i>					X			X	X				2	8	Wi	AEWA/CMS (A.II)/IUCN (NT)
Ruff <i>Calidris pugnax</i>	X					X	X	X	X	X			2	110	TM	AEWA/IUCN (LC)
Spotted redshank <i>Tringa erythropus</i>	X							X	X	X	X		1	12	TM	AEWA/CMS (A.II)/IUCN (LC)
Common Redshank <i>Tringa totanus</i>								X					5	5	TM	AEWA/CMS (A.II)/IUCN (LC)
Greenshank <i>Tringa nebularia</i>	X							X		X	X		1	12	TM	AEWA/CMS (A.II)/IUCN (LC)
Green sandpiper <i>Tringa ochropus</i>	X										X		1	10	TM	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Wood sandpiper <i>Tringa glareola</i>	X				X	X	X		X		X		1	10	TM	AEWA/CMS (A.II)/IUCN (LC)
Common Sandpiper <i>Actitis hypoleucos</i>				X	X	X	X	X	X		X		1	24	Wi	AEWA/CMS (A.II)/IUCN (LC)
Marsh Sandpiper <i>Tringa stagnatilis</i>											X		2	2	TM	AEWA/CMS (A.II)/IUCN (LC)
Eurasian Curlew <i>Numenius arquata</i>	X											X	2	3	Wi	AEWA/CMS (A.II)/IUCN (NT) Algerian legislation
Laridae																

Common Black-headed Gull <i>Larus ridibundus</i>	X	X	X		X	X	X	X	X	X	X	X	13	145	RB	AEWA/IUCN (LC)
Slender-billed gull <i>Larus genei</i>					X	X							26	30	TM	AEWA/CMS (A.II)/IUCN (LC)
Yellow-legged Gull <i>Larus michahellis</i>	X			X	X						X		2	6	TM	AEWA/IUCN (LC)
Sternidae																
Black Tern <i>Chlidonias niger</i>				X	X	X							1	6	TM	AEWA/CMS (A.II)/IUCN (LC)
Whiskered Tern <i>Chlidonias hybrida</i>				X	X	X	X						1	14	TM	AEWA/IUCN (LC) Algerian legislation
Gull-billed Tern <i>Gelochelidon nilotica</i>					X	X	X	X	X	X			2	9	MP	AEWA/CMS (A.II)/IUCN (LC) Algerian legislation
Burhinidae																
Stone-curlew <i>Burhinus oedicnemus</i>													5	5	Wi	CMS (A.II)/IUCN (LC)/Algerian legislation

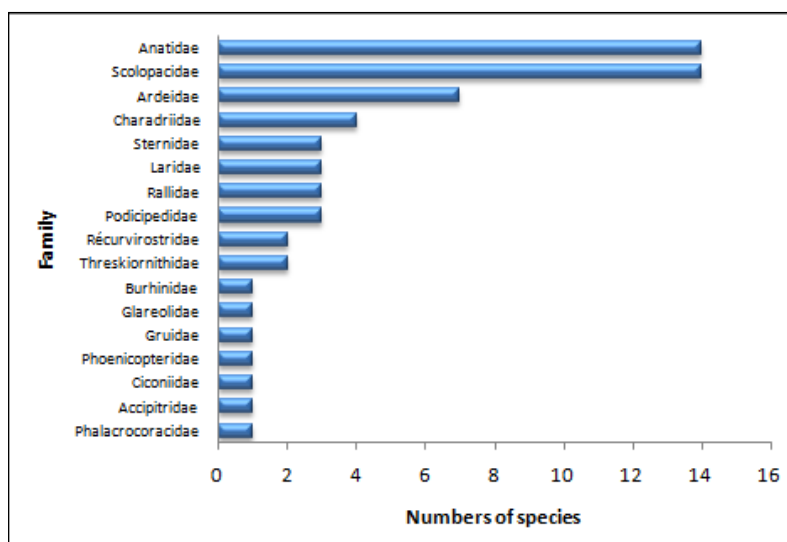


Fig. 3. Composition by families of the waterbirds in Bougara Dam.

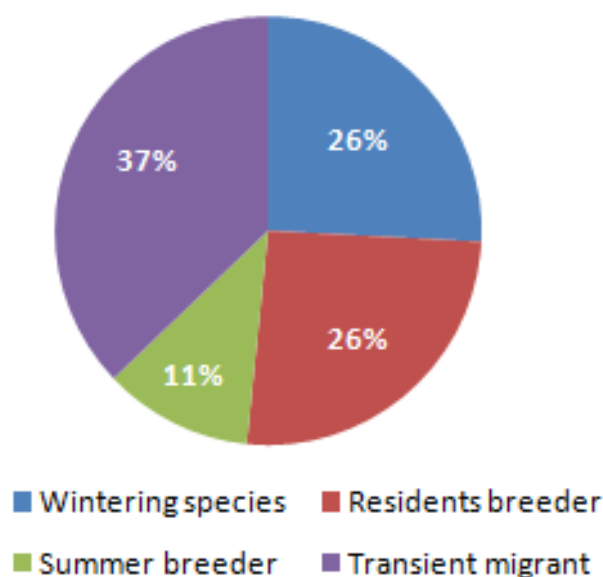


Fig. 4. Phenological status of waterbirds at Bougara Dam.

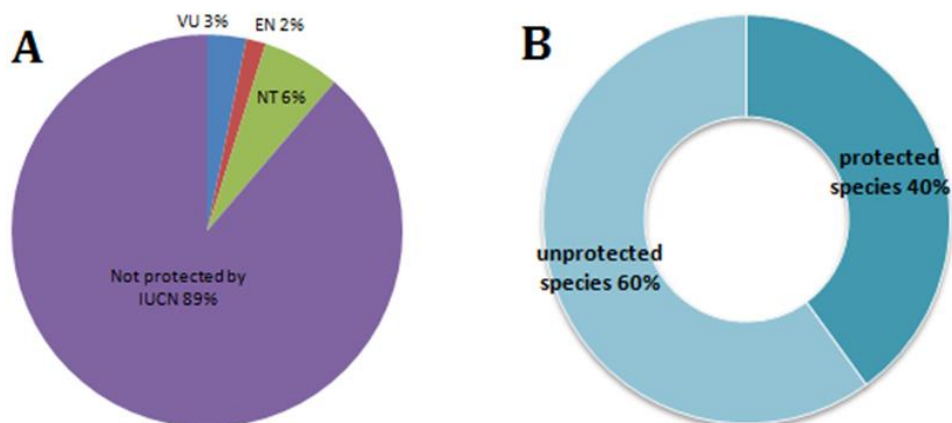


Fig. 5. Percentages of protected and non protected species. (A) according to the IUCN red list categories (VU: Vulnerable, NT: Near Threatened, EN: Endangered), (B) Algerian legislation.

101 nests were found with different types of vegetation, divided into 13 nesting species belonging to 07 families (Ardeidae, Accipitridae, Podicipedidae, Rallidae, Charadriidae, Recurvirostridae and Anatidae) (Table 2). These are the nests of the Little Egret *Egretta garzetta*, the Crab-eating Heron *Ardeola ralloides*, the Gray Heron *Ardea cinerea*, the Night-heron *Nycticorax nycticorax*, the Harpey *Harpey Circus aeruginosis*, the Great Crested Grebe *Podiceps cristatus*, the Moorhen *Gallinula chloropus*, the Eurasian coot *Fulica atra*, the Lesser Plover *Charadrius dubius* and the Mallard *Anas platyrhynchos*.

Seventeen nests found were abandoned during the study period: 6 Moorhen nests, 4 Coot nests, 4 Little Egret nests, 2 Gray Heron nests and 1 Harpey Harrier nests. The cause would probably be our visit or predation, but also nests whose construction has not been completed.

Due to the nature of the habitat (density of vegetation), it was difficult for us to monitor brood survival. Cases of predation on nests have been recorded. The Horseshoe Snake (*Coluber hyppocrepis*) has been observed on several occasions at the site. In addition, due to the proximity of the dwellings, the study site is subject to multiple disturbances and continued poaching of eggs.

21.78% of Little Egret nests, 16.83% of Crab-eating Heron nests and 11.88% of Night-heron *Nycticorax nycticorax* were located on the branches of *Tamarix gallica*. 13.86% of Gray Heron nests were found in *Phragmites communis* and 7.92% of Harpey Harrier nests were found in *Phragmites communis* and *Tamarix gallica*.

Table 2. Temporal distribution of nests found.

Families	Species	Number of Nests	Number of abandoned nests	Total number of nests	Number of nests/family	Percentage
Podicipedidae	Great crested grebe <i>Podiceps cristatus</i>	5	-	5	5	4.95
Falconidae	March harrier <i>Circus aeruginosis</i>	7	1	8	8	7.92
	<i>Squacco heron Ardeola ralloides</i>	17	-	17		16.83
	<i>black-crowned night heron Nycticorax nycticorax</i>	12	-	12	65	11.88
Ardeidae	<i>Little egret Egretta garzetta</i>	18	4	22		21.78
	Grey Heron <i>Ardea cinerea</i>	12	2	14		13.86
Anatidae	Mallard duck <i>Anas platyrhynchos</i>	2	-	2	2	1.98
Rallidae	Common Moorhen <i>Gallinula chloropus</i>	4	6	10	17	9.90
	Common Coot <i>Fulica atra</i>	3	4	7		6.93
Charadriidae	Little ringed plover <i>Charadrius dubius</i>	4	-	4	4	3.96
Total		84	17	101	101	100

Common Moorhen and Eurasian coot nests were found in the trunks of *Tamarix gallica* and Mallard nests were located in an island at the base of *Bromus rubeus*. Great Crested Grebe nests have been found in deep water and are built at the base of *Phragmites communis*. The Gray Heron, Harpey Harrier, Great Crested Grebe and Night-Heron have the largest nests (Tables 3-5).

Table 3. Nest and egg measurements for Great Crested Grebe, March harrier and Grey Heron.

Caractéristiques	Great Crested Grebe			March harrier			Grey Heron		
	Mean ± SEM	(Min-Max)	N	Mean ± SEM	(Min-Max)	N	Mean ± SEM	(Min-Max)	N
External diameter of the nest (cm)	39.20 ± 6.83	(30-45)	5	43.86 ± 1.68	(41-46)	7	47.25 ± 1.22	(46-49)	12
Internal diameter of the nest (cm)	16.00 ± 1.00	(15-17)	5	19.14 ± 2.19	(17-22)	7	28.58 ± 0.67	(28-30)	12
Nest height (cm)	13.60 ± 2.19	(10-15)	5	130.00 ± 35.12	(100-200)	7	221.67 ± 22.50	(190-270)	12
Water depth (cm)	103.00 ± 4.47	(100-110)	5	70.71 ± 24.40	(45-120)	7	150.00 ± 00.00	(150-150)	12
Egg weight (g)	37.30 ± 2.34	(34-41)	20	29.45 ± 2.47	(26-35)	29	52.07 ± 2.96	(48-56)	28
Egg length (mm)	57.91 ± 2.79	(49-62)	20	41.13 ± 8.12	(27-50)	29	57.88 ± 1.32	(56-60)	28
Egg width (mm)	40.74 ± 2.31	(36-44)	20	29.73 ± 8.85	(15-41)	29	41.56 ± 1.35	(39-43)	28

Table 4. Nest and egg measurements for Squacco heron, black-crowned night heron and Little egret at the study are.

Caractéristiques	Squacco heron			black-crowned night heron			Little egret		
	Mean ± SEM	(Min-Max)	N	Mean ± SEM	(Min-Max)	N	Mean ± SEM	(Min-Max)	N
External diameter of the nest (cm)	24.71 ± 2.76	(20-30)	17	35.75 ± 4.90	(30-45)	12	32.00 ± 2.29	(30-36)	18
Internal diameter of the nest (cm)	14.12 ± 1.27	(12-17)	17	24.25 ± 4.61	(16-30)	12	22.17 ± 2.71	(16-25)	18
Nest height (cm)	159.59 ± 41.64	(90-230)	17	149.58 ± 37.20	(110-200)	12	194.00 ± 44.38	(100-260)	18
Water depth (cm)	59.71 ± 8.74	(40-70)	17	53.08 ± 16.84	(30-73)	12	54.44 ± 12.35	(30-65)	18
Egg weight (g)	16.73 ± 0.84	(15-18)	71	26.57 ± 1.21	(23-29)	42	32.23 ± 1.60	(30-36)	64
Egg length (mm)	37.65 ± 1.22	(35-41)	71	45.64 ± 1.80	(43-50)	42	47.85 ± 2.38	(43-52)	64
Egg width (mm)	27.99 ± 0.84	(26-30)	71	33.02 ± 0.75	(31-34)	42	34.99 ± 2.21	(32-41)	64

Table 5. Nest and egg measurements for Common Coot, Comon Moorhen, Mallard duck and Little ringed plover at the study are.

Caractéristiques	Common Coot			Comon Moorhen			Mallard duck			Little ringed plover		
	Mean ± SEM	(Min-Max)	N	Mean ± SEM	(Min-Max)	N	Mean ± SEM	(Min-Max)	N	Mean ± SEM	(Min-Max)	N
External diameter of the nest (cm)	29.50 ± 1.80	(28-32)	3	18.50 ± 3.11	(16-23)	4	25.00 ± 1.41	(24-26)	2	8.50 ± 0.58	(8-9)	4
Internal diameter of the nest (cm)	15.33 ± 0.58	(15-16)	3	13.00 ± 1.41	(12-15)	4	16.00 ± 1.41	(15-17)	2	5.50 ± 0.58	(5-6)	4
Nest height (cm)	6.67 ± 2.89	(5-10)	3	21.25 ± 11.09	(10-35)	4	-	-	2	-	-	4
Water depth (cm)	70.00 ± 26.46	(50-100)	3	27.50 ± 12.58	(10-40)	4	-	-	2	-	-	4
Egg weight (g)	36.73 ± 2.74	(32-41)	15	21.35 ± 2.32	(17-24)	17	43.43 ± 4.43	(38-51)	14	6.50 ± 0.52	(6-7)	16
Egg length (mm)	53.59 ± 1.59	(51-56)	15	44.06 ± 1.68	(42-47)	17	55.57 ± 2.21	(52-59)	14	29.13 ± 0.64	(28-30)	16
Egg width (mm)	36.37 ± 0.70	(35-37)	15	29.40 ± 0.78	(28-31)	17	39.23 ± 0.62	(38-40)	14	21.28 ± 1.13	(19-23)	16

316 eggs were analyzed, the highest number of eggs found from the Ardeidae family with 205 eggs followed by the Rallidae family with 32 eggs, then the Falconidae family with 29 eggs and the Podicipedidae family with 20 eggs.

The other families, Charadriidae 16 eggs and the family Anatidae 14 eggs (Tables 3-5 and Fig. 6 and 7).

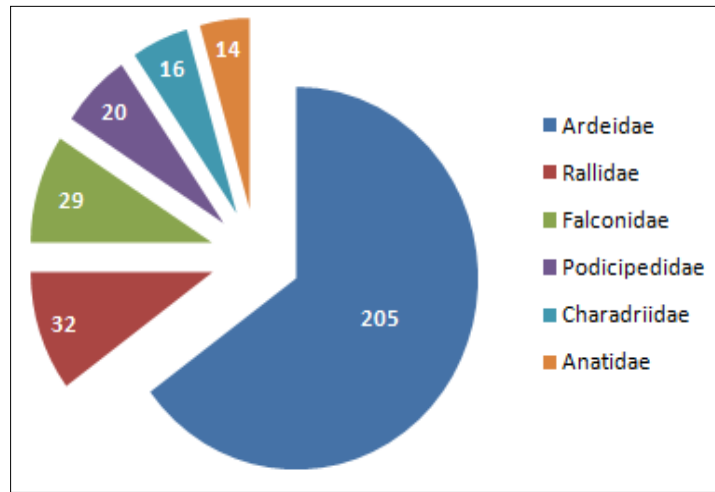


Fig. 6. Number of eggs by bird family found at the study site.

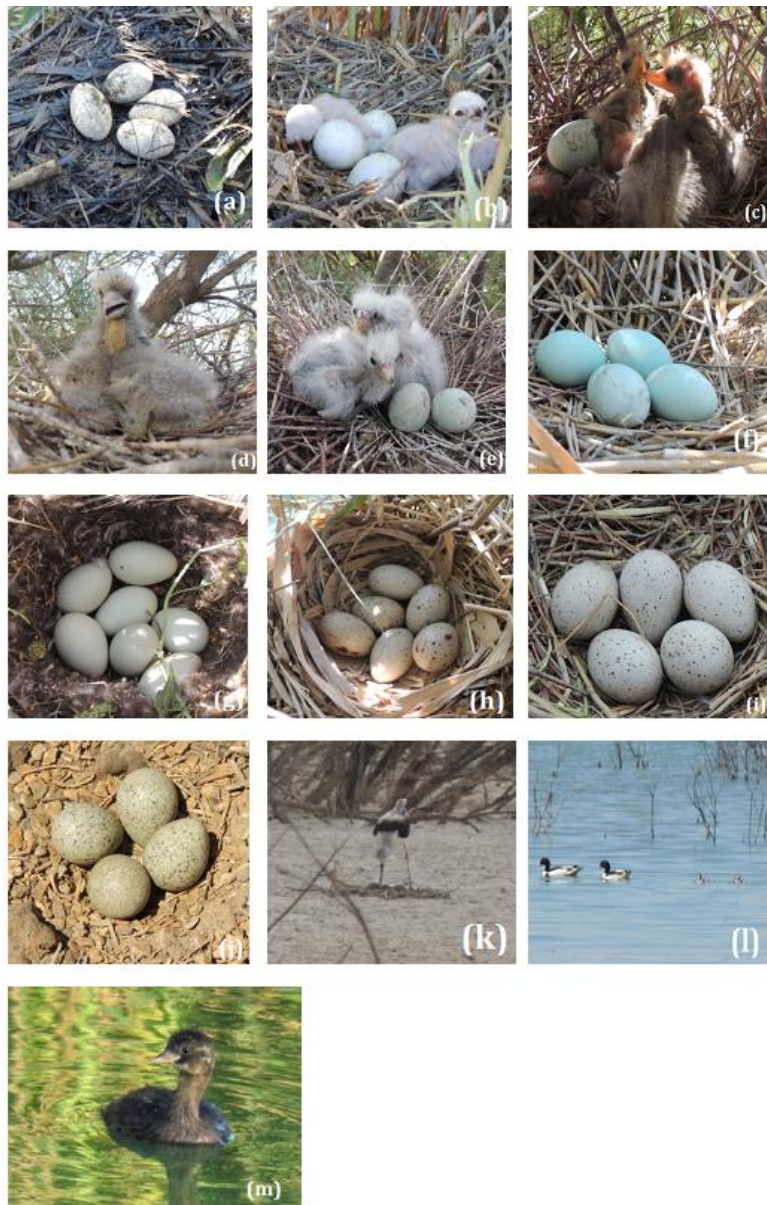


Fig. 7. (a): Nest with eggs of Great Crested Grebe; **(b):** Hatching of eggs in a March harrier nest; **(c):** Hatching of eggs in a Squacco heron nest; **(d):** Hatching of eggs in a black-crowned night heron nest; **(e):** Nest with eggs of Little egret; **(f):** Nest with eggs of Grey Heron; **(g)** Nest with eggs of Mallard; **(h)** Nest with eggs of Common Moorhen; **(i)** Nest with eggs of Common Coot; **(j)** Nest with eggs of Little ringed plover; **(k):** Nest with eggs of Black-winged stilt; **(l):** Chicks of Common Shelduck; **(m):** Chicks of Little grebe.

Conclusion

The Bougara Dam was used throughout the study year by 62 species of waterbirds belonging to 17 families, of which the Anatidae are the most represented. Many species frequenting this dam are protected, whether IUCN or by Algerian legislation or by other international conventions or treaties, which attributes great heritage value to this artificial ecosystem. Seven species listed on the IUCN Red List were inventoried there, among them three species of Anatidae (the Common Scaup *Aythya nyroca*, the Marbled Teal *Marmaronetta angustirostris* and the White-headed Duck *Oxyura leucocephala*).

During our study, the Bougara Dam sheltered several species of waterbirds that could be divided into four categories. We record 16 sedentary species, 16 wintering species, 07 summer species and 23 migratory passing species which only frequent the Dam during small periods (migratory transit periods).

The Bougara Dam, a wintering and nesting site, plays an important role as an ideal refuge for many species of waterbirds, such as Anatidae and Ardeidae. It was during periods of migratory transit that we recorded the greatest diversity and balances of populations. It is also an essential nesting place for many species.

These results have enabled us on the one hand to update our knowledge of the aquatic avifauna of this Dam and on the other hand to create a database for future work, and to identify its importance at the national level. Finally, we hope to draw attention to the need to protect this particular ecosystem which remains little or not studied, must necessarily be complemented by other more diversified and more in-depth work on this site, the diversity of habitats and on the ecology of some species. These additional studies will improve knowledge of the role of the Bougara Dam in welcoming remarkable bird diversity.

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