



Diversity of the Anatidae Population at Fountains of Gazelles Reservoir in Ziban Region (Algeria)

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ABSTRACT

We studied the structure and the abundance of waterbirds assemblages in an arid region of southeastern Algeria for the first time. The results which were obtained from monthly counts for four years from 2013 to 2016 at Fountains of gazelles reservoir, showed 09 species of Anatidae. Three species are sedentary Mallard *Anas platyrhynchos*, Ruddy shelduck *Tadorna ferruginea* and Shelduck *Tadorna tadorna*. Others are wintering birds Northern Shoveler *Anas clypeata*, Northern pintail *Anas acuta*, Eurasian Wigeon *Anas penelope*, Common Teal *Anas crecca*, Marbled teal *Marmaronetta angustirostris*, and Garganey *Anas querquedula*. Both the Common Teal *Anas crecca* and Northern Shoveler *Anas clypeata* were highly dominant species accounting for more than 60% of Anatidae. This reservoir has an important role in the preservation of the Anatidae population.

Keywords: Anatidae, Population, Reservoir, Algeria.

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1. INTRODUCTION

Waterbirds respond rapidly to habitat changes, and they are generally recognized as valuable bioindicators of wetland ecosystems' ecological status (Green & Elmberg, 2014). They adapt their behavior according to wintering quarters (Baldassarre & Bolen, 1994), which vary according to climatic conditions, trophic resource availability, water depth and anthropogenic pressures (Tamisier and Dehorter, 1999). Ducks are very important game birds and they are the focus of the habitat management and conservation efforts, and they have also served as model organisms in population and community's ecology (Arzel & Elmberg, 2004). They are represented by sixteen species, this group of waterbirds is the most abundant group in the wetlands of North Africa (Heim de Balsac & Mayaud, 1962; Isenmann & Moali, 2000; Thévenot et al., 2003), which shelters a great variety of wetlands for wintering and stopover sites for several Palearctic migratory birds (Fishpool & Evans, 2001). In Algeria, the majority of Anatidae regularly winters on the lakes and marshes of the northern coast where the ecology of their wintering has been studied (Houhamdi & Samraoui 2001, 2003, 2008; Aissaoui et al., 2009).

Other winterers further in the south use the large salt-water areas (garaets, chotts and sebkhet) of the Highlands and Sahara (Ledant et al., 1981; Van-Dijk & Ledant, 1987). A great diversity

of wetlands in Algeria, which are important wintering and breeding sites for large guilds of waterbirds, are located in the migratory flyways of many Palearctic and Sub-Saharan species (Samraoui et al., 2008).

In order to depict the changes in the community structure of Anatidae at this reservoir, this study is to present data on the diversity of these ducks and to highlight the ecological importance of this site.

2. MATERIAL AND METHODS

2.1. Study area and data collection:

The study was carried out in Fountains of gazelles reservoir (5°35'35" N, 35°6'58"E), located in the Wadi El-Hai watershed (Fig.1), Southeastern Algeria (Biskra department). This region has an arid Mediterranean climate, characterised by hot and dry summers, the average annual of rainfall is 361mm and evapotranspiration is 1125mm. It is a part of the Chott Melghir Great watershed. The water surface covers 160 ha for a maximum depth of 45 m and an original capacity of about 55 hm³ to ensure the irrigation of El Outaya plain. The vegetation in this area is characterized by climatic and edaphic formations influenced by the geomorphology of the region.

Bird censuses

This study was undertaken through Monthly total counts of waterbirds for four years (2013-2016). Counts were conducted, between 07h00 and 11h00 from several observation points around the site, using binoculars and a telescope KOWA (20 × 60); individual counts were conducted when the numbers of the present birds were small. When more than 200 birds were presented, the total numbers were estimated by dividing the flock into small equal blocks (50–200 birds, according to flock size) and then counting the number of blocks (Blondel, 1975). This method is the mostly used in the winter counts of waterfowls (Lamotte & Bourlière, 1969).

2.2. Data analysis

To evaluate the abundance and diversity of species, and also the composition and structure process of Anatidae community each year, data were analyzed by using the program: SPSS (SPSS, Chicago, IL, USA) software package. The indexes used to examine Anatidae population were: average annual numbers (min and max), species richness (S), abundance (A), Shannon diversity index (H), and Equitability (J).

We used ANOVA test for each species during the study period, the significance level of the test was $p \leq 0.05$.

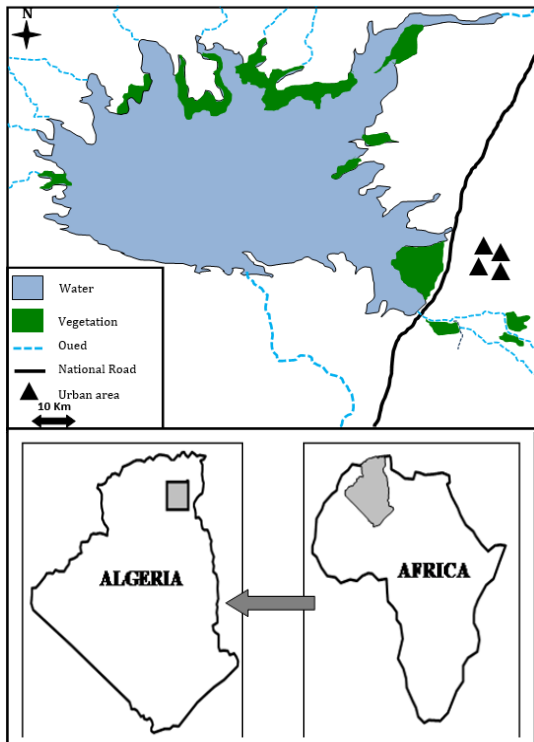


Figure 1: Study area's location

3. RESULTS

This work was done in order to study the inventory and the ecology of the Anatidae population in Fountains of gazelles reservoir. During the study period, this site hosted 09 duck species. As for the relative abundance of individuals, Common Teal *Anas crecca* was highly dominant with 33.16% of the birds observed throughout the years, followed by several species such as Northern Shoveler *Anas clypeata* (29.48%), Marbled teal *Marmarometta angustirostris* (16.95%), Northern pintail *Anas*

acyta (7.37%) and Shelduck *Tadorna tadorna* (4.05%) with intermediate frequency, while other species had the relative abundance less than 4% (Tab. 1).

Specific richness varied between 07 and 09 species where the lowest was noted during the year 2013, we noticed the lack of two species: *A. querquedula* and *T. ferruginea* (Tab 1; Fig. 2). The conducted biomonitoring showed also a variation and fluctuation of Anatidae numbers, Anova Test for equal means indicates differences in mean abundance between species ($F(35; 8) = 7.656, P < 0.0001$). The high Average number shown for *A. crecca* with 712 individuals is (± 214.85) and the max number is 450 individuals. *A. clypeata* occupied the second place in the study population. However, *A. querquedula* presents the low Average number with 08 individuals (± 4.78) (Tab. 1). These birds were usually observed in small flocks on the borders of the sites and on the islets. They were also observed along the borders of the reservoir.

The Percentage of the Anatidae population at the Fountains of gazelles reservoir during the study period indicated that these birds were common and abundant (Fig. 2). The abundance rate in the first year of our study presented by the dominance of *M. angustirostris* with 40.77 %, *A. clypeata* with 26.86% and *A. crecca* 24.94 % and each of the remaining species occupies a small proportion.

However, in the rest of the study period, the high percentage is shown by *A. crecca* 45.93 %, 38.53% and 43.59% respectively in the years 2014, 2015 and 2016.

Table 1. Specific average of annual numbers at the Fountains of gazelles reservoir (2013-2016)

Annual average Numbers	Average (\pm SD)	Annual relative abundance (%)	P
<i>Anas platyrhynchos</i>	45,25 ($\pm 20,42$)	1,92	0.934 **
<i>Anas clypeata</i>	420 ($\pm 125,7$)	29,48	0.492**
<i>Anas acuta</i>	66,25 ($\pm 35,78$)	7,37	0.049*
<i>Anas penelope</i>	71,75 ($\pm 21,65$)	3,68	0.416**
<i>Anas crecca</i>	712,75 ($\pm 214,8$)	33,16	0.298*
<i>Marmaroea angustirostris</i>	281,5 ($\pm 23,03$)	16,95	0.423**
<i>Anas querquedula</i>	8,5 ($\pm 4,78$)	0,59	0.348**
<i>Tadorna tadorna</i>	64,25 ($\pm 26,81$)	4,05	0.552*
<i>Tadorna ferruginea</i>	65,25 ($\pm 23,80$)	2,80	0.608**

SD: standard deviation, *: Significant, **: insignificant

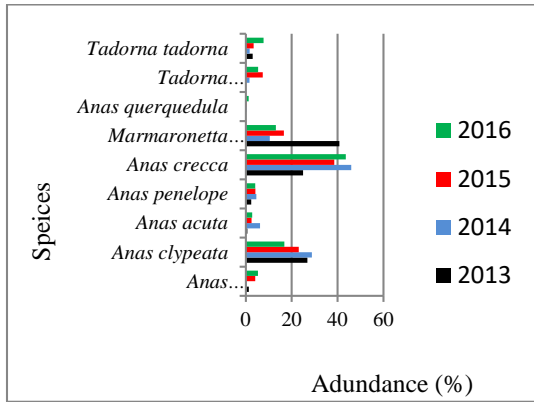


Figure 2: Abundance (%) of the Anatidae population during the study period (2013-2016)

The variations in Shannon index indicate a maximum of 1.72 bit which was noted during the year 2016 and the minimum of 1.35 bit in 2013, which reflect a moderate diversity of anatidea at these four years. Equitability exposes partially high values with 0.78 noted during the year 2016, while the minimum of 0.65 was recorded during the year 2014. These values reflect the same distribution of the anatidea in the studied years. It tends towards unity so it reflects that the species have a regular distribution (Marcon, 2013) (Tab. 2).

Table 2. Diversity indexes of Anatidea during the study period (2013-2016)

	Taxa S	Shannon_H	Equitability_J
2013	07	1.35	0.69
2014	09	1.44	0.65
2015	09	1.68	0.76
2016	09	1.72	0.78

4. DISCUSSION AND CONCLUSION

The management of a wetland frequented by the migratory birds cannot be considered after a study of the overall functioning of the site towards the various species present during an annual cycle.

The site is frequented by a large number of Anatidae that use it especially during the winter period. Its evolution during the study period reveals that the first migrants appear at the beginning of September, their arrival in mass is noted in November, and the maximum number is reached in February then decreased progressively until April. The fall in the numbers in February can be attributed to the phenomenon of migration in the sense of pre-nuptial migration. Then, the low number recorded after April seems to have marked the end of wintering for the majority of species. The wintering of the species and particularly the Anatidae corresponds to their more or less prolonged stay during the winter months far from their nesting areas (El Agbani, 1997).

Diversity indices provide more information than only the number of the existing species. The most commonly used indices are based on the estimation of relative abundance of species in samples (Heip et al., 1998). The value of the Shannon

index obtained in the four years are associated with stands dominated quantitatively by one or a few species, and the highest value is recorded for a specific wealth maximum of 09 species and a maximum abundance of 3000 individuals. The equitability variation in our study indicates that the avian community exhibits a balance at some levels during the study period.

4.1. Specific analysis

Mallard A. platyrhynchos

Mallard is a species that includes sedentary and other migratory individuals (Isenmann & Moali, 2000); the population shows a clear trend of evolution over time by the presence of a wide range of habitat types that would increasingly affect the breeding success of this duck in the site. It prefers open water plans covered with trees with slight emergent vegetation (Jorde et al., 1984) and is easily established in artificial wetlands built by humans (El Agbani, 1997). The species did not show a significant difference in its annual average (P =0.934).

Northern Shoveler A. clypeata

The population in North West Europe is estimated at 65,000 individuals, distributed mainly in the South of France and Spain. The population of the Mediterranean and Black Sea exceeds 60,000 individuals (Ogilvie, 1975). During the study period, the species has not shown any significant differences in its annual average (P = 0.492). This waterbird showing a gregarious character has mostly occupied the proximities of the eastern banks of the site where it indulges in the toilets or in the central region of the site.

Northern pintail A. acuta

This species showed a significant difference in its annual average (P <0.05) during the study period. The weak presence during the study period allowed us to adjust a weak model of population evolution. Nevertheless, it seems that irregular growth is occurring on this site.

Eurasian Wigeon A. penelope

In Fountains of gazelles reservoir, no significant variation in the numbers of this duck has been observed during the study period in its annual average (P = 0.416). The growth process of this population was resulted by relative stand stability from 2013 to 2016.

Common Teal A. crecca

At the level of wetlands with emergent vegetation, the species is the most often observable between this one and the open water (El Agbani, 1997). The temporal evolution of this Anatidae showed a growth model type with no significance in its annual average (P = 0.298) and a percentage presence of 38% during the period study (Fig. 2).

Marbled teal M. angustirostris

The regional wintering population has a total of the order of 3000 individuals (Scott & Rose, 1996) based on the average size (300 individuals), we are allowed to say that our wetland has housed an average of 10% of the regional wintering population. At this wetland, no significant variation in the numbers of the Marbled teal was observed (P = 0.423). The population therefore has a stable evolution with an annual average population growth of 281 individuals (±23.03). The species regularly nests in the Saharan wetlands (Bouzegag et al., 2014).

Garganey A. querquedula

Garganey is the only species of the totally migratory genus, it breeds in Europe, but rarely winters on the continent. It migrates towards the South through the Sahara, towards East

and West Africa (Ogilvie, 1975; Cramp & Simmons, 1977). This bird showed no significant difference in its annual average ($P = 0.348$).

Shelduck T. tadorna

Shelduck in Algeria is a part of the dispersed Mediterranean/Black Sea population, which is scattered across both sides of the Mediterranean Sea (Cramp & Simmons, 1977). Over the entire study period, the species did not show any significant differences in its annual average ($P = 0.552$).

Ruddy shelduck T. ferruginea

The Ruddy shelduck is a species that coexists at the shores of fresh water, the steppes, the deserts, mountains; and it is becoming scarce (Heinzel et al., 2004). This bird regularly frequents large and shallow sites (Nouidjem et al., 2012). No significant variation in the average annual numbers of this duck has been showed ($P = 0.608$). This species has been observed throughout the study period, that develops a phenology characterized by a low abundance between the months of September and October. While there is a large number of staff in the middle of the wintering period, then the species shows a decrease in numbers. This state is certainly due to a departure of the species to sites that are in further south.

The data analysis divided the Anatidea population into two groups according to the trend of their numbers. The first, stable and composed of Mallard, Shelduck and Ruddy shelduck; the second, clearly increasing and consisting of the six remaining wintering species. Indeed, our data were similar to those found in East of Algeria by Metallaoui & Houhamdi (2010), Bara et al., (2013), Guergueb et al. (2014) and Nouri et al. (2013).

This current study shows the importance of this reservoir for the conservation of waterbirds in Southeast of Algeria, and the role played by this aquatic ecosystem for the retention of endangered species the Marbled teal. Therefore, the preservation of this aquatic ecosystem in its function as a quarter of wintering for waterbirds rests on promoting scientific research on these environments, and classification of this site as a protected environment. Moreover, we suggest a management plan which will allow the conservation of this biodiversity in these ecosystems.

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