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# First study on waterbirds wintering at the southern Mekhada marsh (North-East Algerian Ramsar site)

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## ABSTRACT

The phenology of waterbirds was carried out in the south of the Mekhada marsh an important birds area (IBA) in the North-East of Algeria during two wintering seasons (2015-2016 and 2016-2017). We used a Optolyth telescope with 20-80X zoom, to conduct regular censuses of waterbirds in the studied area. In total, 40 species representing 12 families were recorded at this site. In winter, Ducks are well represented (10 species, with a maximum of 26835 and 33875 individuals were counted in January and February through the two wintering periods). The results of ecological indices (Shannon and equitability) and species richness showed an imbalance in the stand of waterbirds dominated by three families (Anatidae, Scolopacidae and Rallidae). We noted an increase in frequentation on the study area among the two wintering seasons ( $\chi^2$  test = 360, 12;  $df = 1$ ;  $p = 0, 0001$ ). The correspondence factor analysis showed three distinct periods representing (The beginning, middle and end of wintering season). This preliminary results, of wintering waterbirds monitoring showed that the Mekhada marsh seems to offer ideal conditions for wintering and resting migratory waterbirds.

*Key words* : Waterbirds, Wintering, Mekhada marsh, Algeria.

## Introduction

The Mediterranean region constitutes an outstanding centre of birds diversity (Cuttelod *et al.*, 2008). This diverse region, with its geology, topography, hydrology, is a mosaic of natural landscapes and constitute one of the world's richest places in terms of birds diversity (Mazzi, 2008). The north African wetlands, particularly Algerian ones play a very important role for a large number of bird species (Houhamdi *et al.*, 2008). Indeed, situated in the western Palearctic, Algerian wetlands are highly

used as wintering and breeding area or as stopovers during birds migration (Samraoui and Samraoui, 2008). One of the most important birds area (IBA), is the wetland complex of Numidia, in particular consists of a combination of salinity habitats, water depth and very variable vegetation cover (Samraoui and Samraoui, 2008). It is divided into two large complexes: Western Numidia, which includes the Guerbes-Sanhadja complex and Eastern Numidia, including two complexes, Annaba and El-Kala (Samraoui and De Bélair, 1997). Located in the North-East of Algeria, Eastern Numidia is bor-

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dered by the Mediterranean sea and the Algerian-Tunisian borders, this region is exceptional including several interlinked ecosystems providing favorable conditions for the wintering, breeding and migrating waterbirds (Houhamdi and Samraoui, 2002; Boulekhssaim *et al.*, 2006; Nedjah *et al.*, 2010; Bouchecker *et al.*, 2011; Samraoui *et al.*, 2012). Waterbirds are an important component of the dynamic of the wetland and are considered an efficient indicator of their ecological integrity (Amat and Green, 2010). Nevertheless, the role of wetlands as birds diversity reservoirs remains relatively poorly understood in Eastern Numidia region, particularly in the south of Mekhada marsh region. Despite its classification as Ramsar site since 2003, very few studies have been devoted to the Mekhada marsh. Consequently we used waterbirds as bioindicators to provide a new ecological assessment to this site. In this study we evaluate the use of the southern

Mekhada marsh as a refuge of waterbirds diversity, focusing on two questions: (1) Abundance and species richness during winter and, (2) how does the waterbirds population stand react with wintering season? This study presents the first monitoring evaluation of waterbirds diversity in the south of the Mekhada marsh during winter season, and aims to be a scientific baseline for the sustainable management and conservation of these wetlands.

#### Description of the study area

Located in the North-East of Algeria, the Mekhada marsh (10000 ha) is after Fetzara lake (15000 ha) the second biggest wetland in the region (Houhamdi, 2002 ; De Bélair and Bencheikh le Hocine, 1987). It is a marsh whose waters are mild, with the exception of its downstream part, whose waters are brackish because of the contact at the mouth with the Mediterranean sea (Figure 1). It is an immense swampy

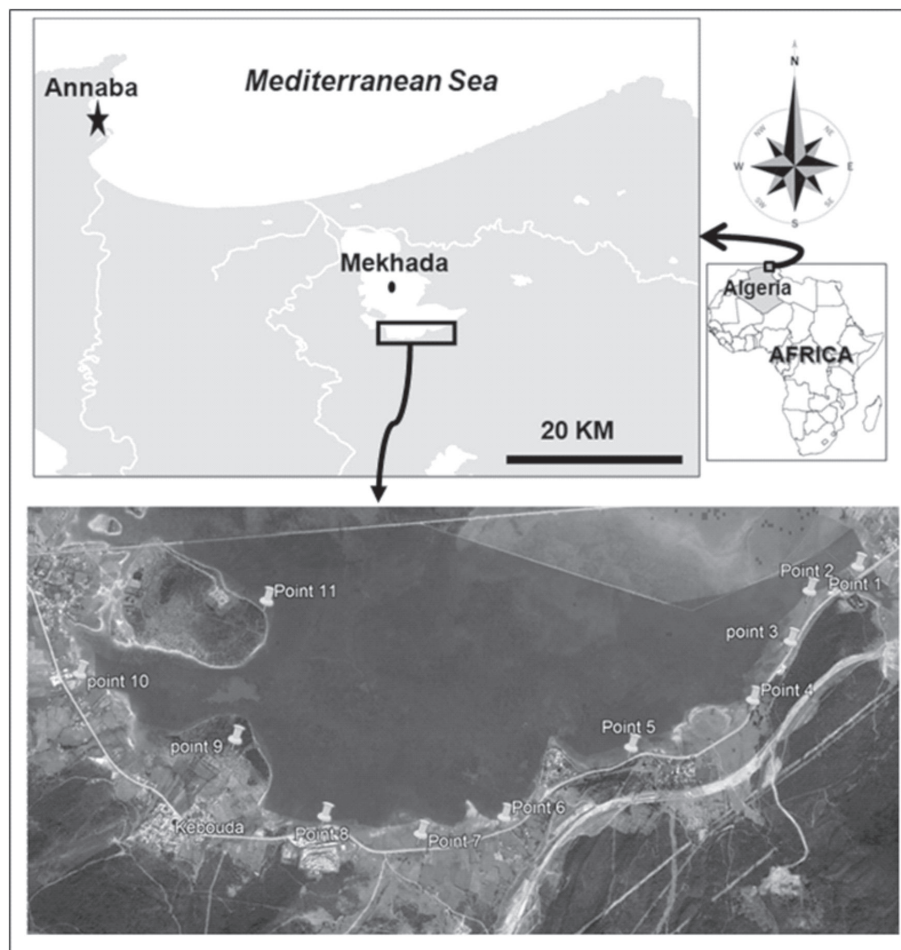


Fig. 1. Map of geographical location of the study site with the different observation points.

zone with an average depth of 1 meter, and is characterized by a nearby salt concentration of 4.6 g / l (Morgan, 1982). Its vegetation covers more than 80% of its surface, it consists mainly of bulrushes (*Scirpus lacustris*, *Scirpus Littoralis* and *Scirpus maritimus*) (De Bélair and Bencheich Le Hocine 1987). This is where the largest concentration of water birds in the wetland complex of the El Kala region meet. Our study area is focussed on 1500 ha (15% of the total Mekhada marsh area) located at the southern of this site.

## Material and Methods

Bi-monthly visits were carried out from October to April during two winter seasons 2015/2016 and 2016/2017. Censuses of avian populations have been carried out from eleven points (Figure 1) to allow the most exhaustive count of species and their numbers. Observations of water birds were made from 8h to 14h using a telescope (Optolyth 20 x 80), an individual count was made when the group of birds was less than 200 individuals and when the group was very far away and / or more than 200 individuals, we made visual estimates per group of 100 individuals (Lamotte and Bourlière, 1969). The study of the ecology of these birds was measured by some ecological indices: total abundance, specific richness, Shannon-Weaver diversity index, and equitability index, and the results are presented as monthly averages. To make comparisons between the two wintering seasons, a Chi-square test and a multivariate CFA (Correspondence Factor Analysis) were used. Statistical analysis were applied using the R-version software. 3.4.3 (30-11-2017).

## Results

### Evolution of ecological parameters

The monitoring of waterbirds in the southern region of the Mekhada marsh up the two years of study made it possible to inventory a total of 40 species belonging to 12 families (Table 1). During both winters, more than 80% of the individuals counted belong to the Anatidae followed by Rallidea 5%, Ardeidea and Charadriidea 3%, and did not exceed 1% for all other remaining families (Figure 2). The comparison of site visits during the two winters showed a highly significant difference ( $\chi^2 = 360,12$ ,  $df = 1$ ,  $p = 0,0001$ ).

**Table 1.** Waterbirds frequenting southern Mekhada marsh area during the two wintering study periods (2015-2016 & 2016-2017).

	Winter 2015-2016		Winter 2016-2017	
	Min	Max	Min	Max
<b>Accipitridae</b>				
<i>Circus aeruginosus</i>	2	13	3	12
<b>Anatidae</b>				
<i>Anas acuta</i>	13	115	5	125
<i>Anser anser</i>	3	6	2	8
<i>Anas clypeata</i>	25	1001	19	841
<i>Anas crecca</i>	60	10091	59	12264
<i>Anas penelope</i>	95	17214	18	17050
<i>Anas platyrhynchos</i>	5	99	8	127
<i>Anas strepera</i>	12	1111	25	649
<i>Anas querquedula</i>	8	8	4	4
<i>Aythya nyroca</i>	4	16	8	24
<i>Tadorna tadorna</i>	1	8	2	14
<b>Ardeidae</b>				
<i>Ardea alba</i>	1	20	8	25
<i>Ardea cinerea</i>	1	20	1	38
<i>Bubulcus ibis</i>	44	310	56	389
<i>Egretta garzetta</i>	11	46	13	62
<b>Charadriidae</b>				
<i>Charadrius alexandrinus</i>	6	44	8	40
<i>Charadrius dubius</i>	11	22	15	24
<i>Pluvialis apricaria</i>	28	42	39	58
<i>Vanellus vanellu</i>	39	888	44	959
<i>Ciconia ciconia</i>	1	28	1	38
<b>Phalacrocoracidae</b>				
<i>Phalacrocorax carbo</i>	12	49	6	342
<b>Podicipedidae</b>				
<i>Podiceps cristatus</i>	2	2	4	4
<i>Tachybaptus ruficollis</i>	1	13	1	31
<b>Rallidae</b>				
<i>Fulica atra</i>	12	1536	14	1923
<i>Gallinula chloropus</i>	1	6	2	21
<i>Porphyrio porphyrio</i>	1	15	1	17
<b>Recurvirostridae</b>				
<i>Himantopus himantopus</i>	6	355	15	454
<b>Scolopacidae</b>				
<i>Actitis hypoleucos</i>	1	8	1	11
<i>Calidris alpina</i>	1	1	2	2
<i>Calidris ferruginea</i>	2	4	2	8
<i>Calidris minuta</i>	3	5	5	8
<i>Gallinago gallinago</i>	1	52	2	88
<i>Limosa limosa</i>	6	45	7	55
<i>Tringa erythropus</i>	1	4	1	6
<i>Tringa ochropus</i>	1	7	1	9
<i>Tringa nebularia</i>	1	16	1	24
<i>Tringa totanus</i>	3	5	3	5
<b>Threskiornithidae</b>				
<i>Plegadis falcinellus</i>	15	198	11	306
<i>Platalea leucorodia</i>	12	98	35	100
<b>Laridae</b>				
<i>Chroicocephalus ridibundus</i>	298	298	156	260

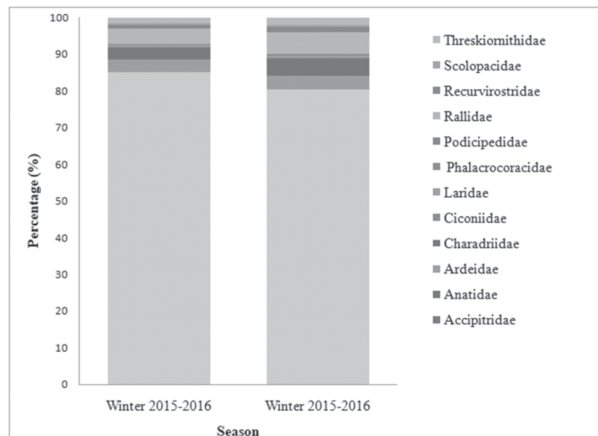


Fig. 2. Percentage of waterbirds families frequenting southern Mekhada marsh area during the two wintering study periods (2015-2016 & 2016-2017).

### Abundance

At the beginning of the first wintering season (October), the Mekhada marsh hosted 297 individuals constituted mainly of Cattle Egret (*Bubulcus ibis*). However, at the end of January a very large variation was noted with a maximum of 26835 individuals constituted mainly of three species of ducks: Eurasian Wigeon (*Anas penelope*), Eurasian Teal (*Anas crecca*) and Northern Shoveler (*Anas clypeata*). At the end of the first wintering season, the numbers were reduced to 181 individuals composed of Great Egret (*Ardea alba*), Gray Herons (*Ardea cinerea*) and White Storks (*Ciconia ciconia*). During this first wintering season an average of  $6589 \pm 9315$  individuals were counted. The second wintering season recorded the same trend with an average of  $7207 \pm 10295$  individuals and a maximum of 33875 individuals noted at the beginning of February. By the way, the second winter season was characterized by a sudden decrease in numbers during the second half of January (2461 individuals) (Figure 3a).

### Species Richness

During both study periods, the southern region of the Mekhada Marsh was frequented by a minimum of 9 species observed during October for both winters. However, maximums were recorded at the end of January and the beginning of February (31 species) for the two wintering seasons, respectively (Figure 3b). This maximum wealth was dominated by two families Anatidae and Scolopacidae (10 species for each family) (Table 1).

### Shannon Diversity Index

In general, the Shannon diversity index shows a slight fluctuation. The average values of the Shannon index for the first wintering season were  $1,75 \pm 0,50$  with a minimum of 0,69 noted at the end of December and a maximum of 2,48 noted at the end of October. Thus, during the second wintering season we have noted an average of  $1,87 \pm 0,48$  with a minimum of 1,12 noted at the beginning of January and a maximum of 2,63 at the end of October (Figure 3c).

### Equitability index

Equitability index shows that the mean values for the first and second wintering seasons were between  $0,58 \pm 0,17$  and  $0,60 \pm 0,15$  respectively. The minimums were noted during late December and early January for both wintering seasons, respectively (Figure 3c).

### Correspondence factor analysis

The factorial plan (Axes 1 and 2) of the Correspondence factor analysis of the count families waterbirds frequenting the southern region of the Mekhada marsh during the two winters had inertia of 58% (Figure 4). These results show that the families of Anatidae, Scolopacidae, Recurvirostridae, Phalacrocoracidae and Charadriidae were observed in the midst of both winter seasons, whereas the families of Rallidae, Accipitridae, Ciconiidae, Threskiornithidae, Laridae, Recurvirostridae, Podicipedidae and Ardeidae were observed at the beginning, or at the end of both winter seasons.

### Discussion

The very high numbers of waterbirds counted during the two wintering seasons reflect the potential of the Southern Mekhada marsh. It is important to point out that the use of this ecosystem by waterbirds depends mainly on its water level as well as the abundance of trophic resources. The Austin (2002) study, showed a direct relationship between the number of ducks observed and the water level. However, it also suggests taking into account the spatio-temporal factors of the areas studied. Another study by Gawlik (2002) showed an increase in the number of waterbirds as a function of prey density. The presence of a National Gendarmerie (state police force) barracks near the site being studied is also a means

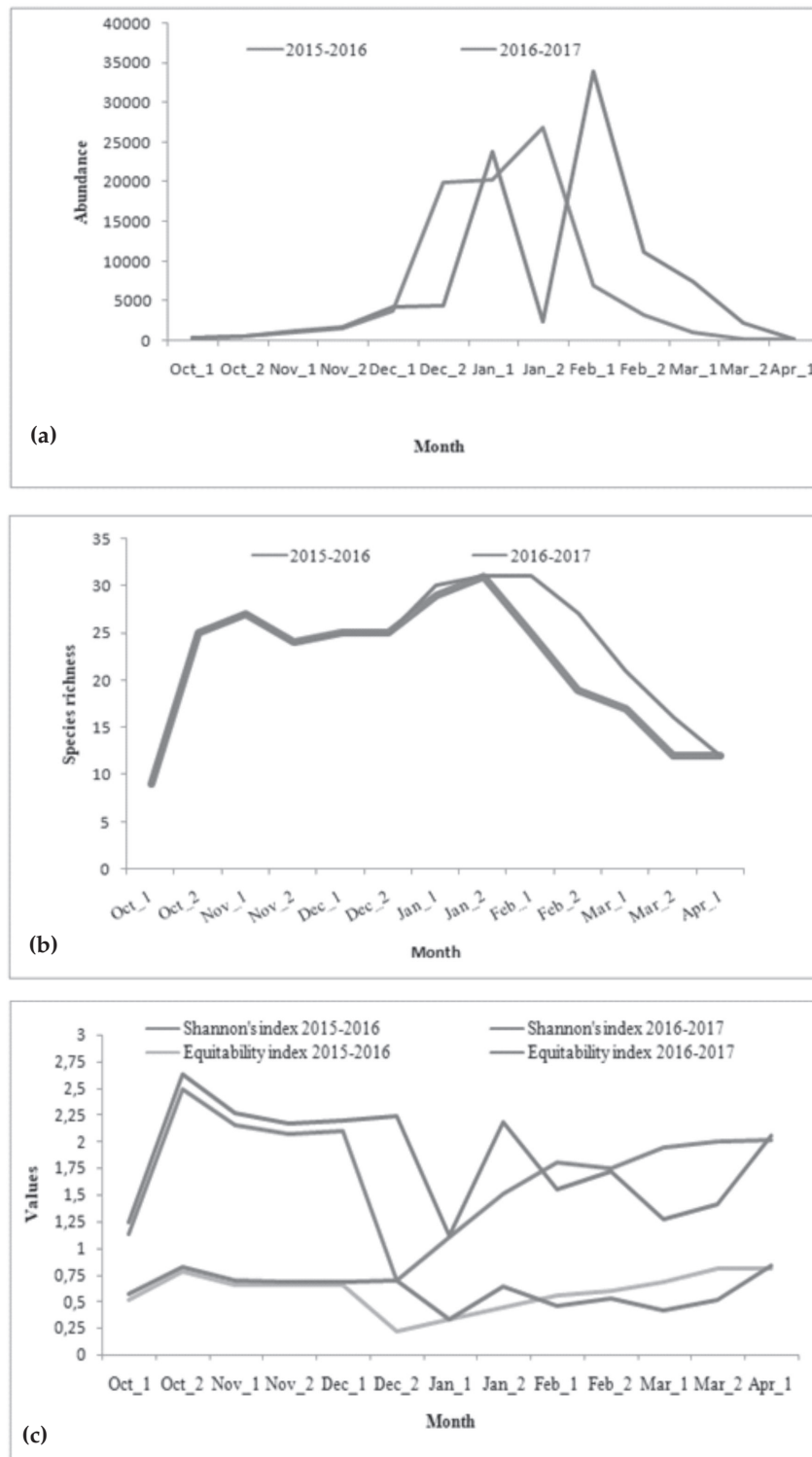


Fig. 3. (a) Variation of total numbers, (b) Variation of species richness and (c) Variation of Shannon's diversity and equitability indices of waterbirds frequenting southern Mekhada marsh area during the two wintering study periods (2015-2016 & 2016-2017).

of protecting for waterbirds against hunters and poachers (Tamisier and Dehorter, 1999).

Therefore, the results obtained allow us to show that the southern region of the Mekhada marsh seems to offer favorable conditions for overwintering large numbers of waterbirds. However, the decrease in numbers (the second half of January) at the second winter season is mainly due to adverse weather conditions (heavy rainfall and violent winds). During this period the families of Rallidae, Charadriidae and Phalacrocoracidae were dominant.

The values of species richness and ecological indices (Shannon and Equitability) during the two winter seasons showed that the stand was dominated by the families; Anatidae, Scolopacidae and Rallidae. Previous studies of others sites in the region have found similar results (Houhamdi and Samraoui, 2001; Houhamdi and Samraoui, 2003;

Metallaoui and Houhamdi 2011). The factorial correspondence analysis (FCA) showed a temporal succession of the occupation of the Southern Mekhada marsh by waterbirds. Three periods were distinguished: The first corresponds to the beginning of wintering (October) characterized by low numbers. This period is made up of a particular stand due to the breeding period is not yet over. As well as the birds present have not yet adopted the typical gregariousness of the winter period (Metallaoui and Houhamdi, 2011). A second winter period (end of December to the beginning of February) is characterized by a sudden increase in the total population and dominated by Anatidae family, and a third period corresponding to the end of wintering. (Months of March and April), where we witness a collapse of wintering species, translated by the return to the breeding sites. This period is composed mainly of sedentary and summering species

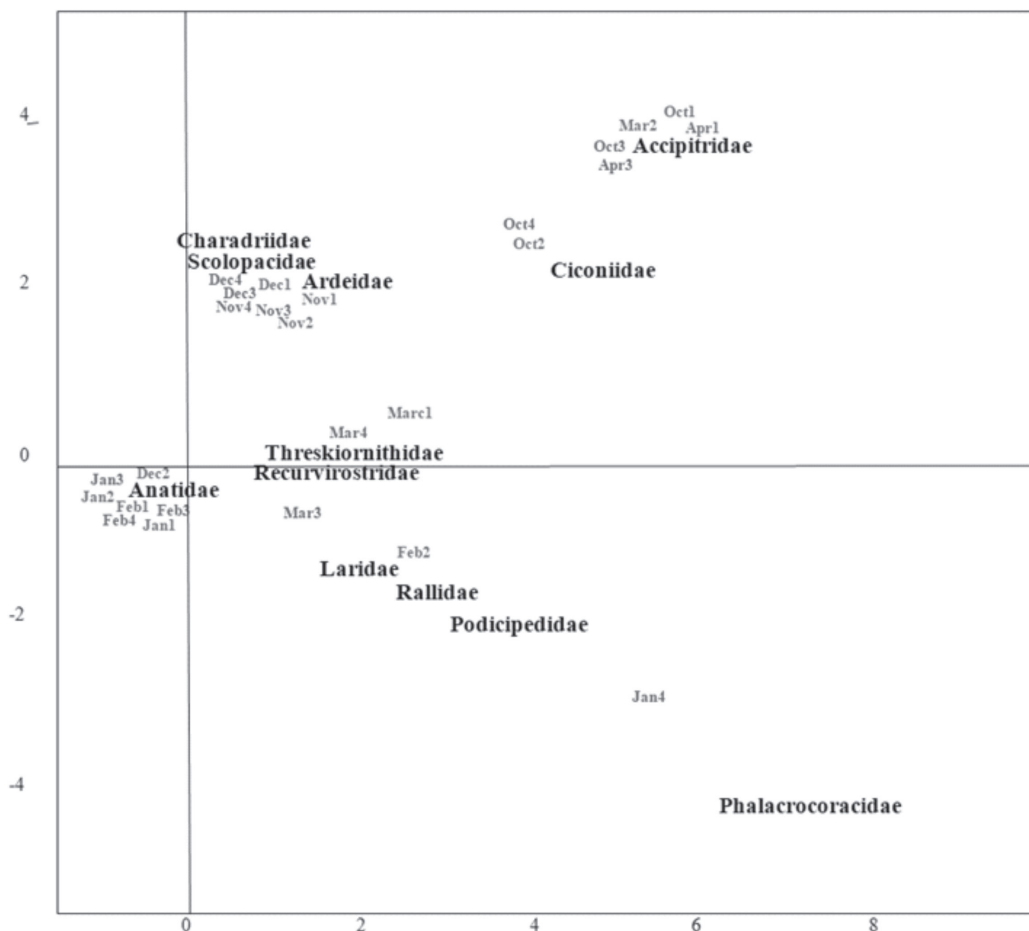


Fig. 4. Correspondence factor analysis of waterbirds families southern Mekhada marsh area during the two wintering study periods (2015-2016 & 2016-2017) (Oct1&2=October 2015-2016, Oct3&4=October 2016-2017).

(Rallidae, Ciconiidae and Threskiornithidae).

Behavioral Anatidae studies in the north-East Algerian wetlands during winter showed that more than 70% of the time has been spent on alimentation (Metallaoui *et al.*, 2014). Indeed, survival and breeding success of waterbirds is directly linked to the accumulated reserves during winter season (Baillie and Peach, 1992; Sherry and Holmes, 1996; Norris *et al.*, 2004; Newton, 2010; Pulido, 2007; Briggs, 2007; Studds *et al.*, 2008; Reudink *et al.*, 2009).

The Mekhada marsh appears to be a prime site for Anatidae, which they use as a resting site during migratory (stopovers) or as a wintering site. Species such as Eurasian Teal (*Anas crecca*), Eurasian Wigeon (*Anas penelope*) and Northern Shoveler (*Anas clypeata*) have overwintered in this site with a large number. In view of our results, the protection of this site is of most importance for the preservation and conservation of waterbirds. Thus protective measures are more than necessary to ensure the sustainability of those species.

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