

Importance of Lake Tonga for the wintering of Eurasian wigeon (*Anas penelope*) and gadwall (*Anas strepera*)

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ABSTRACT

The monitoring of the numbers of Eurasian wigeon and gadwall ducks during two winter cycles (2014/2015 and 2015/2016) at Lake Tonga, shows that Eurasian wigeon is an early overwinter; this duck is very sensitive to the cold wave. The gadwall is a late overwinter. Lake Tonga is classified as a nationally and internationally important wintering site for both species. The numbers recorded in 2014/2015 are higher than in 2015/2016, the drop in numbers is explained by climate change (the heat wave that reigned in Europe this year). The study of the diurnal behavior of the two species of Anatidae during their wintering at Lake Tonga showed that the two ducks exploit the studied site as a foraging area.

Key words: Lake Tonga, Anatidae, *Anas penelope*, *Anas strepera*, wintering, Rhythms of activity.

Introduction

The increasing interest in wintering waterfowl stresses the importance of some well known topics (food, feeding habits, habitats) and emphasises a few new ones (pair formation, bioenergetics), bringing to light the correlation between nutrient reserves of ducks at the end of winter and their reproductive rate a few months later (Krapu, 1981 in Tamisier, 1985). The winter period is not only a break between two successive breeding seasons, but also can be considered a preliminary phase in the reproductive processes (Tamisier, 1985).

Every winter, many waterbirds from northern and eastern Europe head south, seeking ice-free surfaces where they can feed and rest (LPO, 2017).

Eastern Algeria is placed on one of the most im-

portant migratory routes for waterbirds in the western Palaearctic. Ducks, coots and shorebirds leave their northern and northeastern European summer quarters to migrate to their winter quarters, the main ones of which are located in sub-Saharan Africa. Along this journey, it is imperative for them to provide migratory stopovers to compensate for the energy losses resulting from their efforts, in areas likely to provide them with food and rest. It is in this respect that the areas of the El-Kala (and Annaba) region play an important role (Benyacoub *et al.*, 2000). Among the most important wetlands in this region is Lake Tonga. This unique lake in Algeria and North Africa is a wintering and breeding site for aquatic avifauna (Chalabi, 1990). It feeds many surface ducks in winter (Ledant *et al.*, 1977).

The Eurasian wigeon is the most regular winter-

ing duck in the region. This species is ranked at the top of the list in terms of the size of wintering numbers in Lake Tonga (Chalabi, 1990). It is a northern species, from the boreal and arctic zones (Verroken, 2002). The Mediterranean population breeds in Russia and winters on the Mediterranean coast (Turkey to Spain) and North Africa (Oncofs, 2006).

The Gadwall overwinter late compared to other species (Ziane, 1999). The Northeastern European / Black Sea / Mediterranean population breeds in Central Europe, the Balkans and southern central Russia and winters mainly in southern Spain and France, Germany, Italy and in Algeria (Anonymous).

Materials and Methods

Study site

The study was carried out in Lake Tonga, located in the extreme northeast of Algeria, at 36 ° 51 'N and 08 ° 30' E. It is part of the large complex of wetlands in northeastern Algeria, in the region of El Kala (Lake Tonga, Lake Oubeira, Lake Mellah, Lake des oiseaux and the Mekhada marsh) (Figure 1). The climate of the region is the sub-humid version of the Mediterranean-type climate, with a hot and dry season between May and September and with a mild and wet season from October to April. Rainfall ranges from 650 to 1000 mm per year (Lahlah *et al.*, 2006). The lake occupies an area of 2600 ha. It is connected to the sea by a channel more than a kilometer long (Belhadj *et al.*, 2007).

The emergent vegetation of Lake Tonga is domi-

nated by common reed (*Phragmites australis* (Cav.)) and lesser reed mace (*Typha angustifolia* L.) with some admixture of common bulrush (*Scirpus lacustris* (L.)), and branched burred (*Sparganium erectum* L.) and yellow iris (*Iris pseudoacorus* L.). The submerged and surface-floating vegetation of this lake is dominated by white water-lily (*Nymphaea alba* L.), pondweeds (*Potamogeton lucens* L.), and water-milfoil (*Myriophyllum verticillatum* L.). (Bakaria *et al.*, 2009).

Considered an important wintering site for many Anatidae, it is also home to the breeding of a large number of bird species such as the White-headed Duck (*Oxyura leucocephala*), Ferruginous Duck (*Aythya nyroca*), the Purple Swamp-hen (*Porphyrio porphyrio*), the Whiskered Tern (*Chlidonias hybridus*) and several species of herons as Grey Heron (*Ardea cinerea*) and Purple Heron (*Ardea purpurea*) (Lazli *et al.*, 2011).

Sampling methods

The phenology of the two species was studied from September to March during two consecutive wintering seasons (2014/2015 and 2015/2016). Weekly counts were carried out using a telescope (20 × 60) and pair binoculars (10 × 50). Depending on the case, we proceeded either to individual count if the group of birds does not exceed 200 individuals, or by visual estimation if the size of the group is greater than 200 individuals, we count as exactly as possible at one end, from the flock of birds, a batch of 100 individuals is then transferred as many times as necessary to the rest of the strip the area represented by the 100 individuals; in the field of the tele-

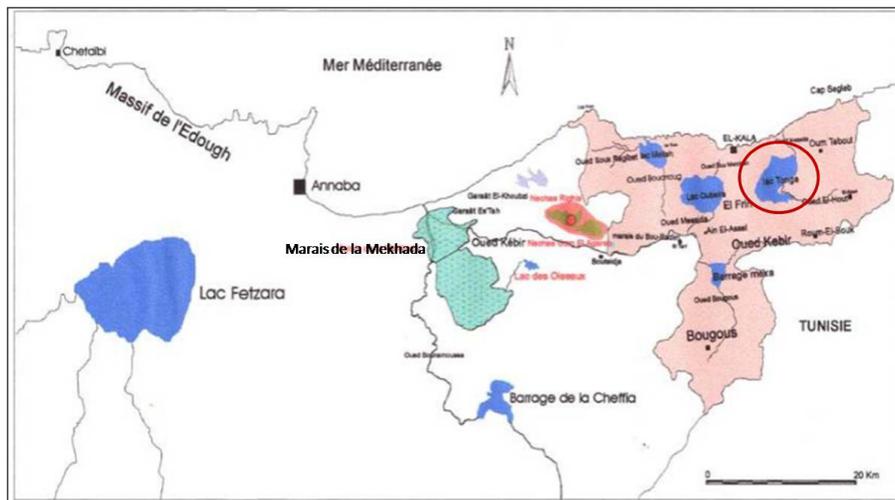


Fig. 1. Geographical position of Lake Tonga in El Kala National Park (Benyacoub *et al.*, 1998).

scope, we will thus mentally cut the flock of birds into as many fractions of 100 individuals (Blondel, 1968 in Chalabi, 1990).

Secondly, diurnal activities were monitored using the scan method in order to be able to determine the main requirements of the species and characterize the functioning of the site studied during the winter season. Monitoring was carried out every hour from 8 a.m. to 4 p.m. The activities measured are feeding, sleeping, swimming, preening and flying.

Results

Monitoring of phenology

Tracking the phenology of Eurasian wigeon

The Eurasian wigeon is faithful to its period of arrival; it frequents the lake from the beginning of the wintering season with low numbers (51 individuals for the year 2014/2015 and 31 individuals for the year 2015/2016) (Figure 2). These increase regularly to reach the peak in January with 914 individuals for the year 2014/2015 and 786 individuals for the year 2015/2016. A sharp drop is recorded from this month until March when the birds leave the lake towards the Mekhada marsh. At the end of March the whistlers leave the lakes of the region to reach the breeding quarters in Russia.

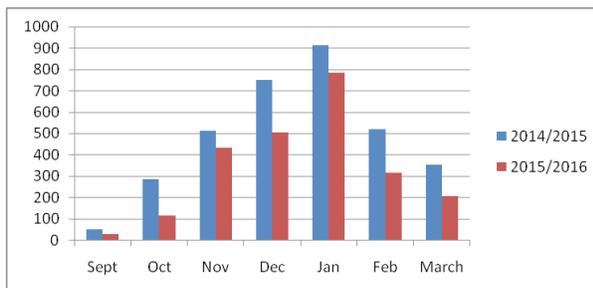


Fig. 2. Evolution of the maximum monthly numbers of the Eurasian wigeon for the two wintering seasons (2014/2015 and 2015/2016).

Monitoring of the Phenology of the Gadwall

The Gadwall is wintering from October to March, it begins to frequent the lake at the beginning of October with moderately large numbers (313 individuals for the year 2014/2015 and 218 individuals for the year 2015/2016) (Figure 3), these numbers increase regularly with the arrival of late birds to reach the peak in December with 890 individuals for the year

2014/2015 and 641 individuals for the year 2015/2016. At the beginning of January, we witness a decrease in numbers until March, at the end of this month; the number decreases and reaches a minimum of 197 individuals for the year 2014/2015 and 172 individuals for the year 2015/2016. The majority of individuals return to the Mekhada marshes in order to leave Algeria permanently for central Europe for reproduction.



Fig. 3. Evolution of the maximum monthly numbers of the Gadwall for the two wintering seasons (2014/2015 and 2015/2016).

Daytime behavior monitoring

Monitoring of the diurnal behavior of the Eurasian wigeon

During the wintering season, the *Eurasian wigeon* is a very active species, spending much of its time foraging while swimming. The feeding represents 37% and 36% of the diurnal time budget during the first and the second wintering period respectively followed by swimming with 25% and 27%, then Sleeping with 24% and 21%. Preening with 13% and 14%. The flying has the minimum value with 2% and 1% (Figure 4).

During the winter cycle, feeding is the dominant activity, it takes high values at the start and end of

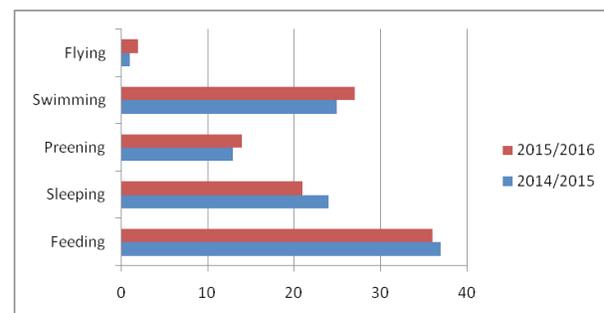
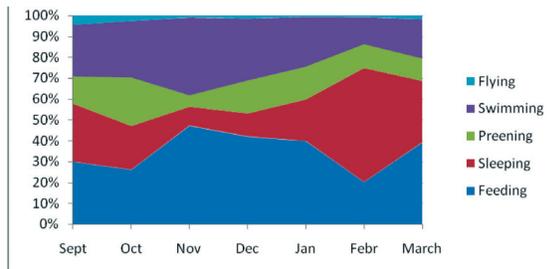
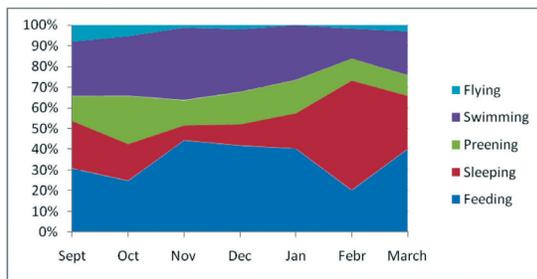


Fig. 4. Proportions of the different diurnal activities of the Eurasian wigeon during its wintering at Lake Tonga.

the season (30% and 31% in September of the first and the second wintering period respectively) (Figure 5), it gradually increases to reach its maximum value in November with 49% and 44%, from this month, and it decreases until the month of February when the lowest percentage was recorded (20%).



(A)



(B)

Fig. 5. Monthly evolution of time budget activities of the *Eurasian wigeon* during its wintering at Lake Tonga: (A) season 2014/2015 (B) season 2015/2016.

Swimming is positively correlated with feeding, the highest value was recorded in November (36% and 35%), the *Eurasian wigeon* is a very active species, it feeds while swimming, on the other hand, sleeping is negatively correlated with the two previous activities, it is low at the start of the season, it peaks in February with 55% and 53%.

Preening is a secondary activity; it is manifested with low values. Flying is rarely observed, it is manifested during disturbance (fishing or poaching) or to move from feeding sites to places of roosting.

Statistical analyzes

Multivariate statistical analysis expressed in the 1x2 factorial design informs us that the abscissa axis F1 separates the main activities (feeding, swimming and sleeping) from other activities (preening and flying). On the other hand, the y-axis F2 separates feeding and swimming from other activities (Figure 6).

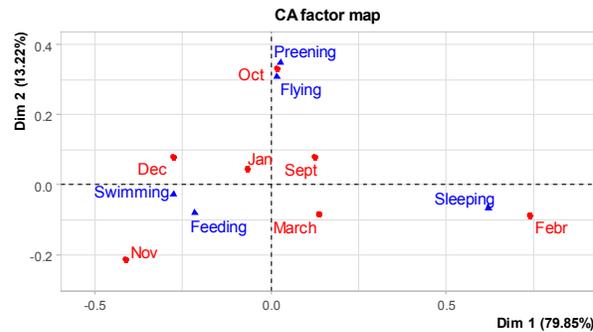


Fig. 6. AFC 1x2 factorial planes. Distribution of the diurnal activities of the Eurasian wigeon at Lake Tonga.

The preening and the flying are the two activities that essentially characterize the beginning of the wintering period. Feeding and swimming dominate the actual wintering period. Sleeping dominates the Eurasian wigeon’s record of activities during the end of the Wintering season.

Monitoring the diurnal behavior of the Gadwall

The time budget of the Gadwall is dominated by feeding with a rate of 38% and 37% of the diurnal time budget during the first and the second wintering period respectively, this activity is associated with swimming, the latter represents 27% and 26%. Sleeping comes in third place with 21% and 20% followed by the Preening with 12% and 15%. The flying was stable, represents 2% (Figure 7).

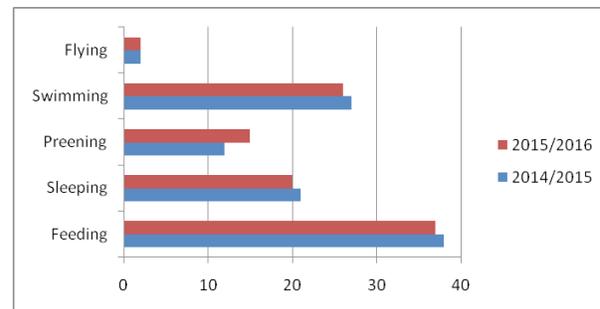


Fig. 7. Proportions of the different diurnal activities of the Gadwall during its wintering at Lake Tonga.

The feeding is manifested by this duck as soon as it arrives on the lake with high values to recover the weight loss after a long trip (40% and 42% is recorded in October of the first and the second wintering period respectively) (Figure 8), the time devoted to this activity increases to take its scale in December (46% and 47%). From this month, the values of

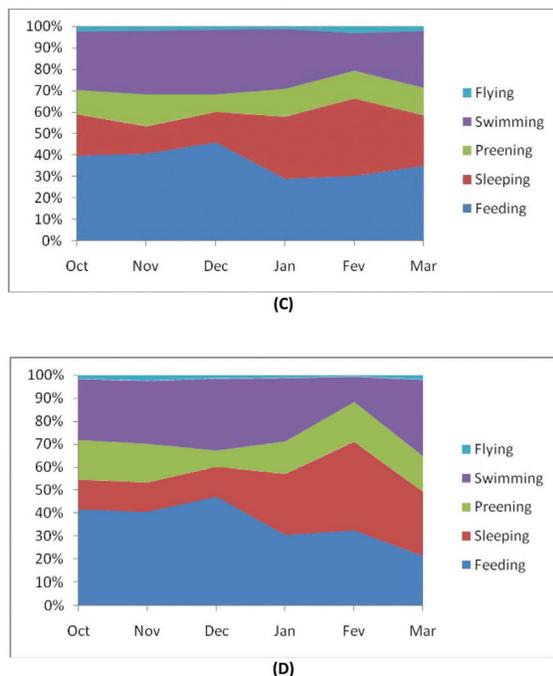


Fig. 8. Monthly evolution of time budget activities of the Gadwall during its wintering at Lake Tonga: (C) 2014/2015 season (D) 2015/2016 season.

this activity decrease and the percentage of sleeping increases, the maximum is recorded in February (36% and 39%), at the end of the winter season, the Gadwall tends to conserve energy. Swimming is important; the ducks move around to look for feeding or when disturbed. Preening is most evident at the start and end of the season.

Statistical analyzes

The analysis of the activity report data collected during the study period by a multivariate statistical analysis expressed in the factorial plan 1 x2 shows us that the x-axis F1 separates the two main activities (feeding and sleeping) other activities (swimming, preening and flying). On the other hand, the y-axis F2 separates sleeping and preening from other activities (Figure 9).

The beginning of the wintering season is characterized by the predominance of feeding. The month of January is dominated by the preening. Sleeping dominates the record of the Gadwall activities during the end of wintering.

Discussion

The West European population of Eurasian wigeon

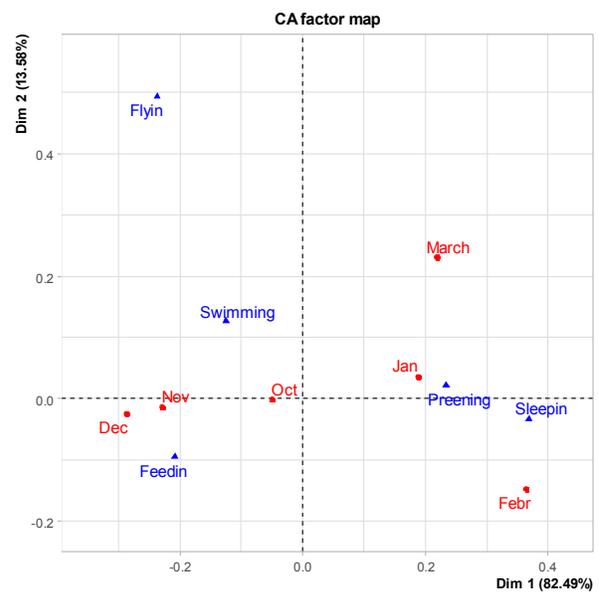


Fig. 9. AFC 1x2 factorial planes. Distribution of diurnal activities of the Gadwall at Lake Tonga.

is said to be increasing, while that of the Mediterranean stock shows a significant decline (Oncofs, 2006). The first individuals of this species appear in September on the lakes of the El-kala region. A very small number arrive from the second decade of September, the bulk of migrants reach the tell in October-November, the last in December (Ledant *et al.*, 1981).

During the two study seasons, the Gadwall was faithful to its arrival period. Ducks start to concentrate in Lake Tonga in October; this date is confirmed by Ziane (1999), Chalabi (1990) and in the Camargue by Allouche *et al.* (1989). At the level of Garaet Timerganine (in the highlands of Constantinois), the arrival takes place during the first half of November (Maazi, 2009), of which the maximum in this site is 125 individuals for the month of February. In Morocco, the Gadwall is classified as a declining species during the period 1970-1990; currently, this duck has not yet recovered to previous numbers, but its decline has stopped (El-Agbani, 2009).

At the beginning of wintering, the two species studied concentrate in Lake Tonga. During this period, the water level is not too high which makes food resources easily accessible for these two surface ducks. We are witnessing a decrease in numbers; birds are moving towards the Mekhada marsh, this movement is explained by the increase in the

water level of the lake.

The year 2014/2015 was marked by higher numbers than those in 2015/2016. The fall in numbers is explained by the heat wave that reigned in Europe (nesting sites) this year. These climatic conditions are responsible for the late departure of birds, the adult males of which tend to stay in the north, in favor of wintering areas located in the south of Europe.

Upon arriving at the site in September and after a long voyage, The Eurasian wigeon tends to feed to recover from weight loss. Feeding is therefore important from September to November. During this period, food resources are easily accessible (low water level). In December, the water level rises and food resources become inaccessible. From this month, rest is the strategy adopted by this duck to reduce energy expenditure. Towards the end of wintering, feeding dominates this period; birds need to store reserves for pre-nuptial migration.

At the lake des oiseaux, Houhamdi *et al.* (2003) found that feeding represents 55% of the activity rhythm followed by swimming 20% and preening 20%, sleeping 3% and flying 2%.

At the start of the wintering season, which may be October for the Gadwall, the birds exhausted by a long migration get fat to recover from the weight loss. During the period from October to December, Feeding is dominant. In their foraging behavior, Gadwalls, surface ducks, cannot take food beyond 35-40 cm below the water surface (Allouche *et al.*, 1990), so these ducks take advantage of favorable months (low water level and accessibility of resources). Beyond the month of January, birds adopt a strategy to reduce energy expenditure (increasing the time spent sleeping and reducing feeding and swimming). At the end of the wintering period, the ducks prepare to return to their breeding quarters, during this period, feeding is increased to store reserves for prenuptial migration.

At the level of Garaet Hadj Tahar (in the eco-complex of Guerbes-Sanhadja), the diurnal time budget of this Anatidae was dominated by swimming activity (32.6%), followed by sleeping (24.7%), feeding (19.9%), preening (13.6%) and flying (6.7%) (Merzoug *et al.*, 2015).

Analysis of the activity rhythms indicates that Lake Tonga is used by the Eurasian wigeon and the Gadwall as foraging area. The two species are herbivores. The Eurasian wigeon is distributed mainly in environments of low salinity rich in submerged

aquatic plants which serve as food for them, and always little disturbed by human activities (Tamisier *et al.*, 1992). Like the Eurasian wigeon, the Gadwall feeds on the vegetative parts of aquatic plants (Allouche *et al.*, 1990). Ducks feed mainly at night. However, at the beginning and at the end of wintering (period of migration), they have feeding durations that exceed the length of the nights (Schricke *et al.*, 2012).

Indeed, Lake Tonga is considered a place of roosting and foraging, but the presence of very dense aquatic vegetation and human activity (fishing and poaching) are factors that affect the tranquility of the ducks. Wintering ducks are known to move between Lac Oubeïra which is a more suitable diurnal roost (less vegetation and less hunting disturbance) and this site, where they feed by night (Coulthard, 2001).

Conclusion

Analysis of data from counts of two ducks Eurasian wigeon and Gadwall during two winter cycles shows that both species are regular winterers on Lake Tonga with considerably large numbers. This wetland appears to be an area of national and international importance for the wintering of the two ducks.

This site, by its location in a complex of wetlands, plays the role of distributor, it receives the first winterers at the beginning of the wintering season and towards the end of the season, the birds move towards other sites in the region. These movements reveal functional relations between the different lakes in the El-Kala region.

The wetlands of the national park are part of a much larger functional unit, this unit is made up of bodies of water that are diverse in size, physico-chemical characteristics, productivity and function vis-à-vis for bird's water. This structural diversity of the lakes results in a real interdependence between the sites, as evidenced by the numerous exchanges of birds; suggesting a functional complementarity between the lakes (Benyacoub *et al.*, 2000).

The relationships between the lakes are determined by four factors: the fluctuation of the water level of the lakes (which is linked by rainfall), the presence of aquatic vegetation but also its density and height, the accessibility and availability of food resources (this factor is correlated by the first) and lately the disturbance factors at lake level (distur-

bances by human activities: fishing and poaching).

The monitoring of the activity rhythms during two winter cycles at the level of the studied site shows the importance of the feeding for the Eurasian wigeon and the Gadwall during the wintering period; the two species exploit the lake as a place of foraging. Birds need to store as much energy as possible in order to meet the demands of the following phases for better breeding success.

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