Status and diurnal behavior of the greater flamingo *Phoenicopterus roseus* in Algerian eastern high plains

Leila Bouaguel¹, Menouar Saheb², Etayib Bensaci³, Sabrina Bougoudjil¹, Zihad Bouslama¹ and Moussa Houhamdi*⁴

¹Département de Biologie, Faculté des Sciences, Université Badji Mokhtar, Annaba (Algérie)
²Département de Biologie, Faculté des Sciences, Université Larbi Ben M’hibi, Oum El-Bouaghi (Algérie)
³Département de Biologie, Faculté des Sciences, Université Mohamed Boudiaf, M’sila (Algérie)
⁴Département des Sciences de la Nature et de la Vie, Faculté SNV-STU, Université 8 Mai 1945 de Guelma (Algérie)

ABSTRACT

The Greater Flamingo *Phoenicopterus roseus* has been well studied during the last decade in Algeria leading to highlight some aspects of its distribution, status, movements, and population dynamics. Knowing that an important part of the country has rarely or never been investigated, we studied the status and behavior of the species in two newly discovered wintering populations (Sebkhat Ouled Amara and Sebkhat Ouled M’barek) in the Northern limit of Sahara, Khanchela, Algeria. The number of individuals was higher in Sebkhat Ouled Amara than Sebkhat Ouled M’barek showing peaks of 8 000 and 1 452 in the winter, respectively. Diurnal activity budget revealed that feeding was the most dominant activity representing 73.5% of all activities. Locomotion, flight, preening, courtship, and resting counted for 12.3%, 6.2%, 4.0%, 2.8%, and 1.3%, respectively. There was no marked seasonal change in the behavior of flamingo except for courtship which increased in the breeding season. Diurnal activity rhythms showed that locomotion, preening, and resting decreased in the afternoon while courtship and flight increased.

Keywords: Greater Flamingo, wintering, breeding, status, activity budget.

INTRODUCTION

The Greater Flamingo *Phoenicopterus roseus* is the only breeding species of Phoenicopteridae within the Mediterranean region preferring saline and brackish shallow wetlands. The local population is thought to represent 60% of the global population which is estimated to about 500 000 individuals [13-7]. The regional largest colony occur in Spain at Fuente de Piedra lake where the species regularly bred with numbers ranging from 500–19,500 during the period of 1977–1999 [27]. The breeding success of flamingo appears to be mainly dependent on local rainfall [25-14]. Active site protection and water management in south Europe have played an important role in range expansion of the species southward due to the establishment of new colonies in Spain, Italy and Turkey [14-3]. A total of 9 currently active colonies were identified in the Mediterranean basin from which only 2 (Ezzemoul and El Goléa) were recorded in North Africa (Algeria). Banding schemes carried out during several decades in different populations have shown that exchanges of individuals through migration are frequent revealing the metapopulation structure of the species in the Mediterranean basin [4]. Although the role of Algerian populations in the Mediterranean metapopulation was underestimated in the past, recent observations have shown the opposite [21-29]. The colony of Ezzemoul as well as El Goléa were consisted mainly of Algerian flamingos but also of individuals born in Portugal, Spain, France, Italy, and Turkey [30-21-9].
In the present study, we provide (1) regular counts of the Greater Flamingo individuals in two salt marshes located in the Algerian high plains (Northeast Algeria) and (2) the time-activity budget of the species in both the wintering and breeding season.

**Study site**

This investigation was carried out in two semiarid saline wetlands namely Sebkhat Ouled Amara and Sebkhat Ouled M'barek situated in the Algerian high plains, Khencela, Northeast Algeria (Figure 1). Sebkhat Ouled M'Barek (35°23'39.60"N, 7°19'53.57"E) and Sebkhat Ouled Amara (35°20'55.44"N, 7°15'52.88"E) cover an area of 950 ha and 340 ha, respectively. The water level varies from 0.6 m in the dry season to 1.2 m in the wet season. Even though both wetlands are devoted from aquatic plants (Figure 2), they are surrounded by cereal crops consisted of Chenopodiaceae (Atriplex halimus, Atriplex patula, Salicornia fruticosa, Salsola fruticosa, Suaeda fruticosa), Brassicaceae (Mauricandia arvensis, Matthiola fruticulosa, Diploptaxis éricoides, Capsella bursa pastoris). Both wetlands harbor an important avifauna especially in the wintering season consisted of the Greater Flamingo.
Phoenicopterus roseus roseus, the Common Crane Grus grus, the Slender-billed Gull Larus genei, the Black-winged Stilt Himantopus himantopus, the Pied Avocet Recurvirostra avosetta, the Common Shelduck Tadorna tadorna and the Ruddy Shelduck Tadorna ferruginea.

MATERIALS AND METHODS

In order to determine the status and seasonal changes of the Greater Flamingo in both wetlands, weekly counts of individuals were carried out at noon from September 2011 to August 2012 with a telescope KONUS-SPOT 20x60. Counts were performed with two different methods depending on population size: first, individual counts when the number was lower than 200 individuals and second, visual estimation when it exceeded the latter number [23-8].

Diurnal time-activity budget was weekly surveyed only at Sebkhat Ouled Amara from September 2011 to August 2012 using instantaneous scan sampling in two different periods of the day (morning and afternoon) [1]. Behaviour of the Greater Flamingo was divided into 6 activities (feeding, resting, preening, locomotion, flying, and courting).

The statistical software SPSS 17.0 (SPSS Inc, 2007) was used to perform all statistical analyses. Data were first tested for normality and non-parametric tests were used when normality was violated. Mann Whitney U test was used to compare the number of individuals in both study sites.

RESULTS

Abundance

The numbers of Greater Flamingo were significantly higher in Sebkhat Ouled Amara than Ouled M’barek (U = 398.5, P < 0.0001). The pattern of seasonal change was relatively similar in both sites (Figure 3) with a peak in early winter and a minimum in midsummer. At Sebkhat Ouled Amara, the number of individuals increased substantially from September to December reaching a maximum of 8000. It started to gradually decrease from late January to early July when the remaining individuals counted for 725. The number gently increased afterwards. At Sebkhat Ouled M’barek, on the other hand, fluctuations in numbers were less marked with a peak of 1452 individuals in early January and a minimum of 128 in the second week of August.

![Figure 3. Regular counts of the Greater Flamingo at Sebkhat Ouled Amara and Ouled M'barek. Black and open bars present Sebkhat Ouled Amara and Ouled M'barek, respectively](image)

Diurnal activity budget

Feeding was the most dominant activity representing 73.5% of all activities. Locomotion and flight counted only for 12.3% and 6.2% respectively. Preening (4.0%), courtship (2.8%), and resting (1.3%) were the least recorded behaviours representing 8.1% of all activities. Figure 4 presents the diurnal activity budget of the species in the morning and afternoon at Sebkhat Ouled Amara. When we compare the species behaviour in the morning with that of the afternoon, only feeding remained relatively constant (Table 1). Locomotion, preening, and resting decreased while courtship and flight increased (Table 1).
Activity budget was not markedly different in the wintering and breeding season (Table 1). Only courtship showed a substantial increase, feeding and flight were relatively stable, and resting, preening, and locomotion gently decreased.

**DISCUSSION**

The distribution and status of the Greater Flamingo in Algeria in both the wintering and breeding season are not well known because a substantial part of the country where potential wintering grounds and breeding populations may occur has rarely been investigated namely the western Algeria and the Sahara. Likewise, data on activity budget of the species are scarce and this leads to the misunderstanding of how flamingos use local wetlands throughout the different seasons. This study aimed to document these aspects as part of the conservation of the Greater Flamingo in North Africa.
The presence of the Greater Flamingo was noted in Sahara about half a century ago [22]. After the discovery of the colony of Garaet Ezzemoul in high plains in 2002 [30], a successful breeding was reported at El Goléa in the center of the country [10-21] raising the hypothesis that more colonies might regularly winter or breed in neighboring wetlands. The species has been observed in different sites during the wintering season in Algeria [24-2] but never at Sebkhat Ouled Amara and Ouled M'barek which are located in the northern limits of Algerian Sahara. In this study, a total of 8 000 individuals were recorded in the former site which is well higher than the largest breeding population of Ezzemoul [30].

Both sites combined (taking the maximum) represent 7.87% to 9.45% of the sub-Saharan African populations estimated between 100 000 and 120 000 [18]. The substantial difference in the number of individuals in both study sites was mainly due to their surface, Sebkhat Ouled Amara being markedly larger than Ouled M'barek supporting a large populations of crustaceans [17] notably the brine shrimp Artemia salina which is the preferred prey of the species [12]. The increase in number during the winter was due to the arrival a migrant population that was substantially large in Sebkhat Ouled Amara. Individuals started to leave the site in late winter. It is important to note that no breeding attempt was recorded in both study sites. Throughout all the year, feeding was the dominant activity showing no marked variation from one season to another. Feeding was slightly lower in the morning than in the afternoon during the wintering season. These results are consistent with the study of Khaleghizadeh (2010) at a coastal wetland in the Persian Gulf on the same species. The general pattern of flamingo feeding in different regions worldwide is that it peaks in the morning, decreases at noon then increases again late in the afternoon [28-26-11-19-6] Locomotion peaked in November and December when the number of individuals was maximal which induced a high competitive pressure among individuals for food as was observed in the American Flamingo (P. ruber ruber) [6]. Therefore, less dominant individuals (usually young flamingos) walked more to seek for good foraging sites. This assumption was supported by the fact that locomotion was higher in the morning because individuals tended to be more clustered in a large flock compared to the sporadic spatial distribution in the afternoon. Preening which plays an important role in deparasitisation and feather adjustment [15-16] peaked in September (the post breeding period) then showed no significant variation. Preening was more observed in the morning than in the afternoon like was reported by Khaleghizadeh (2010). Similarly to preening, flight did not show marked seasonal changes but individuals spent more time flying in the afternoon partly because a fraction of the population left the site to go to another one after having taken the required food intake, and also disturbance by raptors occurred mainly in the afternoon. Courtship was among the least observed activities starting in January and peaking in the spring when breeding pairs prepared themselves to the reproductive season [21]. Resting was rarely recorded in the wintering season and less so afterwards. However, this activity known for taking place at noon indifferent species [6] was almost exclusively noted in the morning. The proportion of time devoted to resting was not consisted with the study of Khaleghizadeh (2010) who found a percentage exceeding 10% with no diurnal temporal preference.

CONCLUSION

As all flamingo species, the Greater Flamingo is very sensitive to human disturbance and even to natural predation [29-21]. Earlier observations have shown that a whole colony of thousands of nests can easily be abandoned following an insignificant source of disturbance [5]. The most important threat that appears to reduce the survival rate of juveniles and breeding success of adults is water shortage due to extensive water pumping for agricultural use.
or to high rate of evaporation. An effective protection of wetlands and water management will help the species to expand its range in Algeria and North Africa.

Acknowledgements

We would like to thank Pr. Abdelkader Khiari (Director of the laboratory RNAMS, University of Oum El-Bouaghi) and M. Abdelatif Gasmi (Forestry Directorate, wilaya of Batna) for field assistance. Thanks also to all students in ecology and environment who helped us in the field.

REFERENCES