sciendo

Ekológia (Bratislava) - Journal of the Institute of Landscape Ecology, Slovak Academy of Sciences Vol. 42, No. 3, p. 239–247, 2023

DOI:10.2478/eko-2023-0027

POPULATION DYNAMICS AND WINTERING BEHAVIOR OF BLACK-HEADED GULL *Chroicocephalus ridibundus* AT EL MELLAH LAGOON (NORTHEASTERN ALGERIA)

CHAIMA BOUKHARI[1], AMEL LAZLI ✉[2,3], NADA NOURI[2,3], SARRA BENMETIR[1], ROUMAISSA SOLTANI[3], MONCEF BELDI[2,3], MADJID NEBBACHE[2,4]

[1]Department of Biology, Chadli Bendjedid University, BP: 73, 36000 El Tarf, Algeria
[2]Laboratory of Environmental Sciences and Agro-ecology, Chadli Bendjedid University, BP: 73, 36000 El Tarf, Algeria; e-mail: am-lazli@univ-eltarf.dz
[3]Laboratory of Biodiversity and Ecosystems Pollution, Chadli Bendjedid University, BP: 73, 36000 El Tarf, Algeria
[4]El Kala National Park, BP:73, 36100 El Kala, W-El Tarf, Algérie

✉ Corresponding author

Received: 21 January 2023 / **Accepted:** 21 April 2023

Abstract

Boukhari Ch., Lazli A., Nouri N., Benmetir S., Soltani R., Beldi M., Nebbache M.: Population dynamics and wintering behavior of the black–headed gull *Chroicocephalus ridibundus* at El Mellah lagoon (Northeastern Algeria). Ekológia (Bratislava), Vol. 42, No. 3, p. 239–247, 2023.

The population dynamics and behavior of the black-headed gull of an Algerian coastal wetland, El Mellah lagoon (Lake Mellah), were studied during three consecutive wintering seasons (2018–2021). Maximum numbers of the species were counted in December and January depending on the year. A peak of 536 individuals was recorded in the first half of December 2018, another of 538 individuals in the second half of December 2019, and a final peak of 636 birds in the first half of January 2021. Diurnal activity patterns showed that feeding was the primary behavior, with a mean of 24% for the three seasons. It was followed by sleeping (21%), swimming (19%), preening (18%), and flight (17%). Black-headed gulls appeared to be more active in the morning than at other times of the day.
This study attempts to provide recent and unpublished data on the wintering and behavior of the black-headed gull, which remains poorly documented in North Africa and particularly in Algeria, and highlights the patterns of wetland use by these species, which could help to evaluate the importance of certain areas and develop management plans specific to coastal habitats and their avifaunal diversity.

Key words: Black-headed gull, *Chroicocephalus ridibundus*, El Mellah lagoon, numbers, behavior, diurnal activity patterns.

Introduction

Algeria homes a diversity of ecosystems that play an important role in hosting a rich and varied avifauna. In the north-east of the country, the wetlands of eastern Numidia occupy more or less vast areas. These areas are mainly composed of lakes, marshes, chotts, sebkhas, and gueltas, which are globally interconnected and offer excellent conditions for wintering, migration, and breeding of several bird species (De Belair, Bencheikh, 1987; Houhamdi, Samraoui, 2002; Lazli et al., 2018; Benmetir et al., 2020; Gherib et al., 2021). Among these wetlands, those located in the El Kala National Park are the most famous for the diversity of their species and habitats. Moreover, it is two wetlands, Lake Tonga and Lake Oubeira that are inscribed on Ramsar list in 1982 which earned the classification of this territory as a protected area in 1983.

Despite the existence of various works on Algerian aquatic avifauna, in particular, Anatidae, Rallidae, and Podicipedidae (Boumezbeur, 1993; Lazli et al., 2011a, b, 2014; Gherib, Lazli, 2017; Menasria, Lazli, 2017; Lazli et al., 2018; Bediaf et al., 2020; Benmetir et al., 2020; Mecif et al., 2020; Ziani et al., 2020; Gherib et al., 2021), few studies have been devoted to seabirds, which have so far received very little attention from researchers. Recent information on this subject is limited to occasional observations and local or global syntheses (Jacob, Coubet, 1980; Ledant et al., 1981; Doumandji et al., 1988; Hamza, Slimani, 1990; Thibault, 1993; Benyacoub, Chabi, 2000; Isenmann, Moali, 2000; Boukhroufa, 2001; Brahmia, 2002; Moulaï, 2006; Bougaham, Moulaï, 2013). The result is a very imprecise knowledge. Yet seabirds, in general, and larids, in particular, are attracting increasing interest in many countries; due to their colonial and territorial behavior, aggressiveness, opportunism, and abundance, they are now accused of causing multiple environmental problems.

The black-headed gull *Chroicocephalus ridibundus* is one of the Laridae species observed in Algeria. It is a medium-sized species whose range includes Europe, Asia, and Mongolia. This species is sedentary in Britain and in Mediterranean countries and migratory elsewhere. In winter, it is found from the Baltic Sea to the Mediterranean Sea, including the North African coast. In Algeria, the species winters abundantly on the coasts and in-

© The Author(s) 2023. This is an open access article licensed under the Creative Commons Attribution-NonCommercial-NoDerivs License (http://creativecommons.org/licenses/by-nc-nd/3.0/).

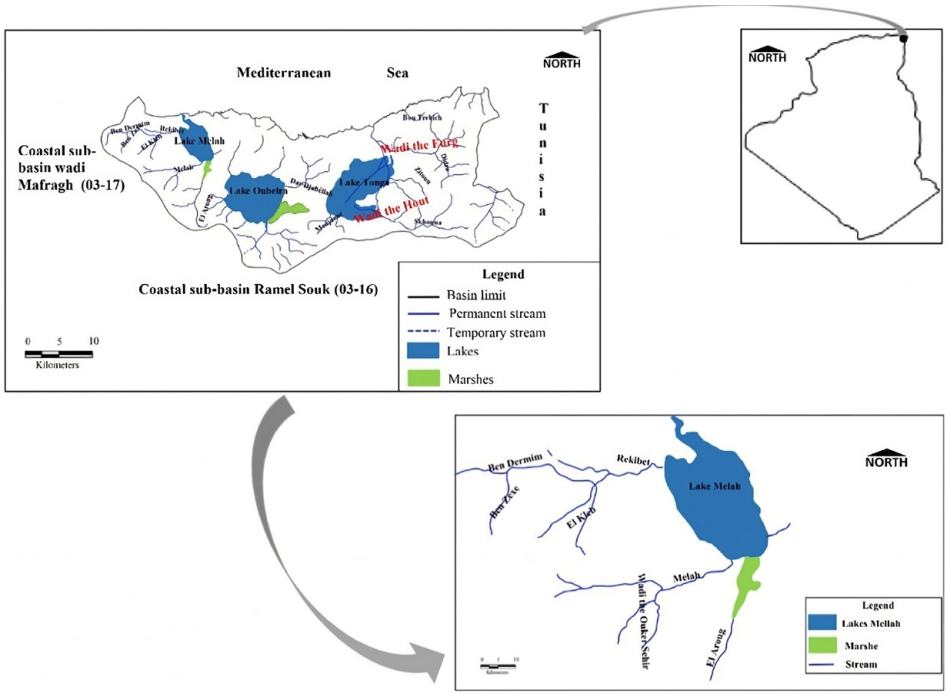


Fig. 1. Location of the study site, El Mellah Lagoon, in Northeastern Algeria.

land wetlands between September/October and March/April. It has also been recorded in the oasis wetlands (Touggourt, Ouargla, El Goléa, etc.) (Isenmann, Moali, 2000). Wintering birds originate from a wide area from Britain and France in the west to the Baltic and Hungary in the east (Glutz von Blotzheim, Bauer, 1982; Isenmann, Moali, 2000).

Although the black-headed gull has been studied and its numbers monitored in Europe, especially in France (Isenmann, 1976; Lebreton, Isenmann, 1976; Lebreton, 1987; Isenmann et al., 1991; Prévot-Julliard et al., 1998), Sweden (Andersson et al., 1981), Poland (Bukacińska, Bukaciński, 1993; Skórka et al., 2012), and Greece (Liordos, 2012), it remains little studied in North Africa and particularly in Algeria. Hence, this study is important as it aims to monitor the dynamics of the species during three consecutive wintering seasons and characterize its diurnal activity rhythm in a wetland, Lake Mellah (the only lagoon in Algeria), where a large part of the investigations have mainly focused on water quality, ichthyofauna, and malacofauna (Guelorget et al., 1989; Djebar et al., 2003; Chaoui et al., 2006; Benmarce, 2012; Draredja et al., 2012; Kherifi, Kherici-Bousnoubra, 2012; Melouah, 2014; Melouah et al., 2014). In addition, to our knowledge, the study of the time-budget of the species remains an undocumented aspect of its life traits in Algeria and elsewhere in North Africa.

In view of the few studies that have been carried out in the El Mellah lagoon on the wintering of waterbirds, particularly seabirds, including the black-headed gull, this study also attempts to verify, on the one hand, the current trends of the species studied in relation to the impact of human activities on the site and, on the other hand, the constancy or otherwise of its wintering chronology in comparison with the existing data in the country and elsewhere.

Material and methods

Study area

The study was conducted at El Mellah Lagoon (also named Lake Mellah), a Ramsar site and an integral zone of the El Kala National Park, located in the extreme north-east of Algeria (Figs 1, 2). This lagoon covers an area of 865 ha with a maximum depth of 6 m. Its connection with the sea is ensured by a long (almost 900 m) and narrow channel (10–20 m) (Draredja et al., 2012; Melouah et al., 2014). It is an ancient river valley invaded by the sea and which transformed into a lagoon. It is fed essentially in the south by Ouadi El-Aroug and Ouadi Mellah. In the north, Ouadi Reguibet and Ouadi Boumalek contribute in a relatively weak way to the feeding of this wetland. El Mellah lagoon is considered as the only lagoon in the Mediterranean region and is ranked fifth among the 14 North African lagoons (Baba Ahmed, 2008). It is an important site for waterfowl in winter and is considered as a foraging and staging site for several bird species (Benmetir et al., 2020). It provides habitat for many animal and plant species, including some endemic or rare species.

It has always been used by local residents for not only its fish resources and for swimming, but also for its water and plant resources. For several years, it has been the focus of development projects for fishing, tourism, and leisure activities. This wetland is renowned for its rich fishery, which is made up of about 15 species, including eels (*Anguilla anguilla*), sole (*Solea vulgaris*), wolffish (*Dicentrachus labrax*), and mullet species (*Mugil cephalus, M. saliens, Liza aurata*, etc.), which are extensively exploited. The lagoon also homes a rich population of benthic invertebrates consisting of annelids and bivalve molluscs (Boumezbeur, 2005). Two hundred phytoplankton species (Retima, 1999) and 47 zooplankton species



Fig. 2. View of El Mellah lagoon and its fishing concession (Nebbache, 2021).

(Haridi, 1999) have been identified. El Mellah lagoon hosts a very diverse avifauna composed of Anatidae, Laridae, Sternidae, and Phalacrocoracidae (Brahmia, 2002; Telailia et al., 2017).

Black-headed gull counts

Counts were conducted twice a month, from October to March, during three wintering seasons (2018–2019, 2019–2020, and 2020–2021) at El Mellah lagoon. Thirty-six surveys were carried out from 08:00 hours. Observations were made using a KONOS-POT telescope (20 × 60) and a pair of binoculars (8 × 30). Overall, we carried out an individual count when the groups of birds were at a distance of less than 200 m and a quantitative estimate when the groups of birds were greater than 200 or at a longer distance, this method being the most common in winter counts because of the often large number of individuals and the viewing distances (Lamotte, Bourlière, 1969; Blondel, 1975; Tamisier, Dehorter, 1999). All counts were performed from clear and dominant observation points, so as to cover the entire perimeter of the site and to avoid repeated counting of the individuals surveyed.

Monitoring of rhythm of the daily activities

Black-headed gull diurnal behavior was studied in the three wintering seasons under consideration. During this campaign, regular surveys of the diurnal activity rhythms were carried out. We chose an open area with a clear view, away from any disturbance for the birds and the observer. We used the "instantaneous scan sampling" or the "SCAN" method (Altman, 1974; Baldassare et al., 1988; Losito et al., 1989; Tamisier, Dehorter, 1999; Houhamdi, 2002; Bouali et al., 2021) fortnightly, with one scan every hour, that is, from 08:00 to 16:00 hours, thus making a total of 96 h of surveillance per wintering season. This method is based on the observation of a group of birds, allowing the instantaneous activities of each individual to be recorded and then, using mathematical transformations, brings out the temporal percentage of each of them (Altman, 1974). However, it is subjected to conspicuousness bias, since the most active individuals are more likely to be discovered (Holmes, Robinson, 1988; Morse, 1990; Liordos, 2012). Nevertheless, in the absence of obstacles that could have hindered the observations, the birds of El Mellah lagoon were all easy to detect and close to the observer. The monitored activities were feeding, sleeping, swimming, preening, and flying (comfort activities), as well as courtship.

Statistical analysis

Statistical analyses were carried out using Minitab 17 Inc.. To compare between seabird numbers, the data were analyzed with a parametric test (analysis of variance [ANOVA]) because they followed a normal distribution. $P < 0.05$ was used as the significance level.

Results

Evolution of population

Monitoring of black-headed gulls during the study period showed fluctuations in numbers. The highest numbers were counted in December or January depending on the wintering season considered: 536 individuals in the first half of December 2018, 538 individuals in the second half of December 2019, and 636 birds in the first half of January 2021 (Fig. 3). From this date, a gradual decrease in the number was observed. The lowest abundance was

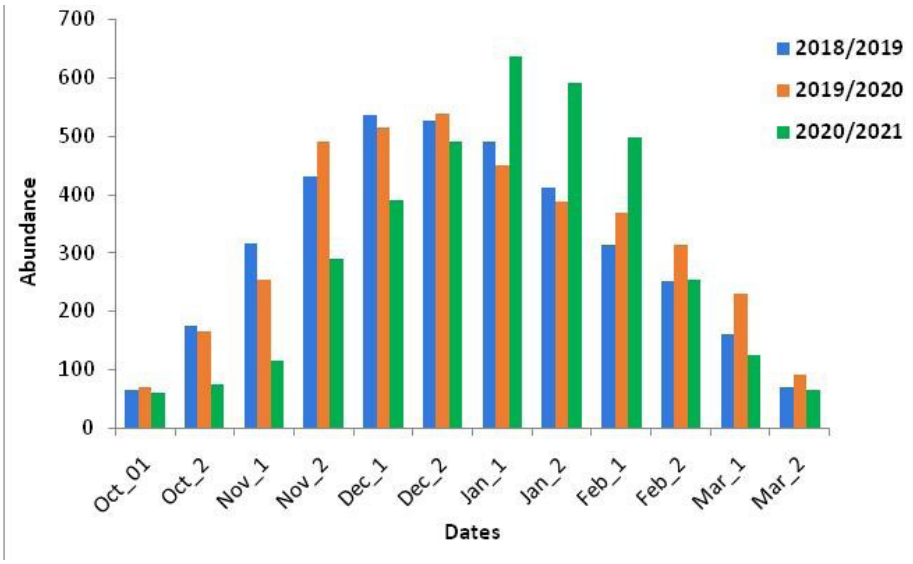


Fig. 3. Variation in the abundance of black-headed gull in El Mellah lagoon during the study period.

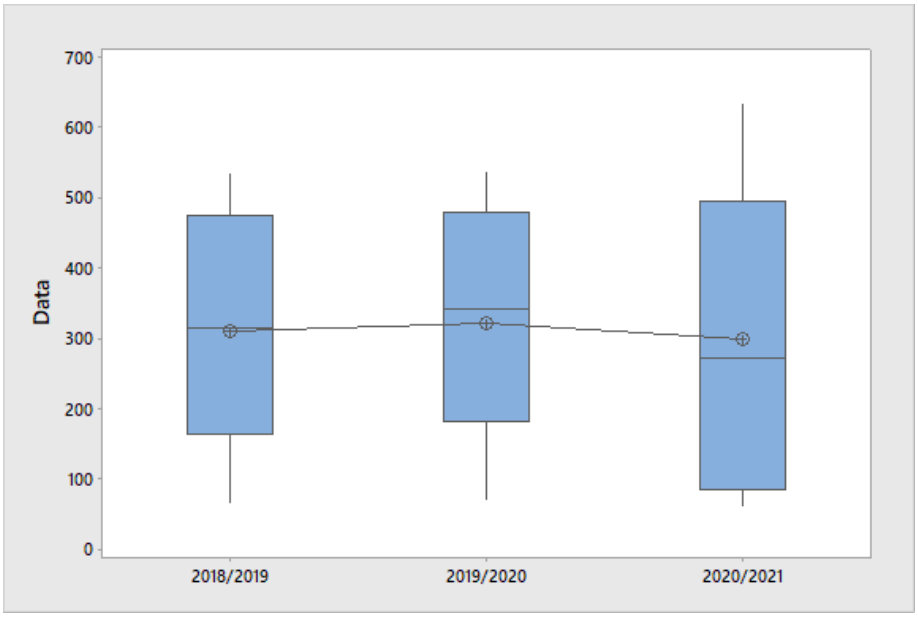


Fig. 4. Boxplot of 2018/2019, 2019/2020, and 2020/2021.

observed in the first half of October and second half of March (Fig. 3). No significant difference in abundance was recorded among the three years (ANOVA test, $F = 0.05$, $P = 0.950$) (Fig. 4).

Study of diurnal behaviors

Monitoring of diurnal behaviors showed different activities of black-headed gull, which was dominated globally by feeding, with a mean value of 24% for the three wintering seasons considered. It was followed by preening, swimming, and then sleeping (21.7, 18.7, and 17%, respectively). Flight was the penultimate activity and courtship holds a very small rate, close to 1% in this diurnal time-budget (Fig. 5).

Monthly variation in the diurnal activity patterns

Diurnal time-budget survey showed generally similar scheme across the three wintering seasons considered. Black-headed gulls were found to devote the majority of their time-budget to sleeping. This activity peaked in October or November according to years (Fig. 6a–c). It was followed by feeding, swimming, and flying between December and February. Preening also stood out during this period. Flight was noted from the first observations at the study site. This activity progressed gradually to reach maximum values during March (Fig. 6a–c). Courtship was observed with very low rates during the two last wintering seasons, but not in the first one.

Temporal evolution of the black-headed gull diurnal activity rhythm

Throughout the day, the diurnal activities showed quite large fluctuations during the study period. Preening activity was observed throughout the day with a dominance in the morning and late afternoon (Fig. 7a–c). Swimming exhibited fairly high values in the morning, with a peak around 11:00 hours. Feeding was the activity for which the gulls spent the most time between late morning and late afternoon, between 11:30 and 15:00 hours, with a peak around 13:00 hours (Fig. 7a–c).

Flying and sleeping showed more or less similar percentages among the three seasons studied, with lower percentages at the beginning and end of the day. However, flight was most noticeable in the mid-morning and mid-afternoon (Fig. 7a–c).

Courtship was recorded at the end of the day during the two latest study seasons (2019–2020 and 2020–2021), with a very low percentage varying between 1% and 2% of the species' time budget (Figs 5–7).

Discussion

El Mellah lagoon is an important wintering and feeding site for waterfowl. Since the enlargement of the channel linking it to the sea and the massive intrusion of seawater, the lagoon has become more marine due to the increase in water salinity, which has naturally been accompanied by a marinisation of trophic resources and avifauna, where piscivorous species (marine birds and waders) are now particularly dominant. Currently, the site hosts 30 wintering species, divided into nine families (Table 1). The wintering avifauna is dominated by the black-headed gull and the great cormorant *Phalacrocorax carbo*, which represents more than 80% of the abundance recorded (Brahmia, 2002; Benyacoub et al., 2011). According to Heim De Balsac, Mayaud (1962) and Ledant et al. (1981), the black-headed gull is a migratory and wintering bird.

Its wintering period is from October to April. Isenmann and Moali (2000) indicate that the species winters abundantly on the coasts and inland wetlands between September/October and March/April. The study conducted by Brahmia (2002) on the functional role of the lagoon for seabirds reports observations of the species between September and August, indicating its status as a winterer and resident. In this wetland, Amoura (2014) also found that black-headed gull wintering starts from September. In our study, this species was observed from October to March, which supports the data reported by previous work on the wintering of the species in the study site.

The present study showed abundance variation of the species from the beginning to the end of the three wintering seasons. The highest numbers were counted between mid-November and January, with maximum values obtained in December for the first two seasons and in January for the third one. The peaks in abundance during these months could be attributed to the arrival of contingents from the wintering population, in addition to resident individuals. The abundance of this species during the wintering season in El Mellah lagoon has been mentioned in several reports and research works like those of Brahmia (2002), Benyacoub et al. (2011), Amoura (2014), and Telailia et al. (2017). Not far away, in Sidi Salem (about 30 km as the crow flies from the study site), Amoura (2014) found that the highest numbers

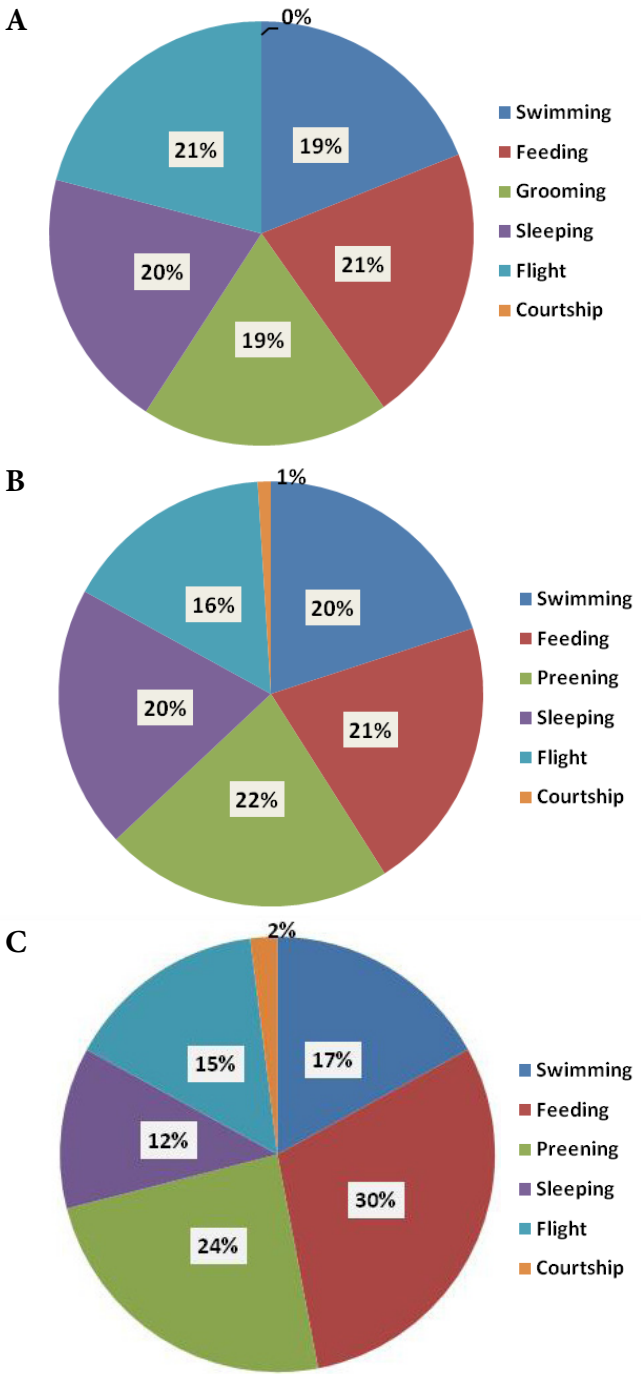


Fig. 5. Diurnal activities of the black-headed gull in El Mellah lagoon during the three wintering seasons studied (A: 2018–2019; B: 2019–2020; C: 2020–2021).

of black-headed gulls reached 1408 individuals during the autumn period, that is, in October, and 450 individuals in January at the study site. Other authors report the rarity of this Laridae in Sebkhet Djendli (Batna, East Algeria) and in several wetlands of the Hauts plateaux of East Algeria, but it remains a regular wintering bird in the wetlands of Numidia (Houhamdi, 2002; Houhamdi, Samraoui, 2008). The species was also observed in

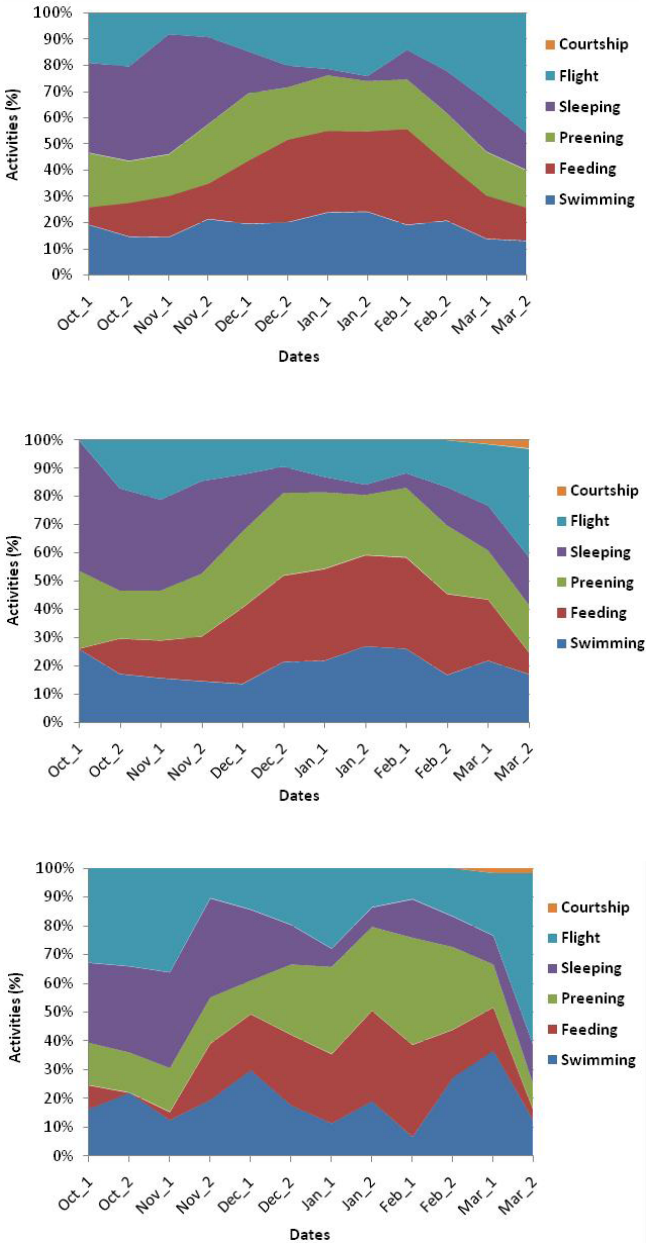


Fig. 6. Monthly evolution of diurnal activity patterns of black-headed gull at El Mellah lagoon (a: 2018–2019; b: 2019–2020; c: 2020–2021) (Oct = October; Nov = November; Dec = December; Jan = January; Feb = February; Mar = March; 1 = first half of the month; 2 = second half of the month)

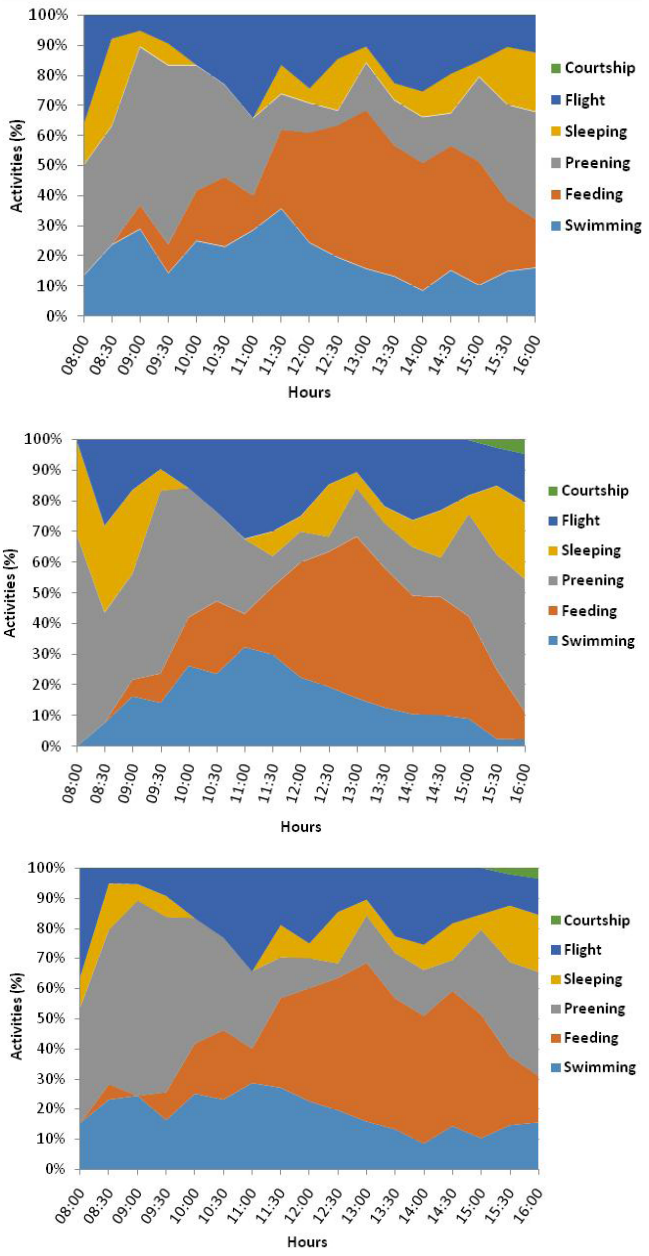


Fig. 7. Temporal evolution of diurnal activity rhythm of black-headed gull during the study period (a: 2018–2019; b: 2019–2020; c: 2020–2021).

December 1977 and January 1978 in the coastal regions, with particular concentrations in Oran (west of the country) and Algiers (center of Algeria) regions. Some individuals summer there between May and August (Michelot, Laurent, 1993).

Brahmia (2002) and Amoura (2014) report the constancy of this gull throughout the annual cycle and its abundance, particularly in the wintering period. However, its numbers gradually decline after that to reach their lowest level in summer. This confirms our results and other observations on the west coast of Bejaia (Moulaï, 2006) and on the coast west of Jijel (Bougahan, Moulaï, 2013), where an increase in number of black-headed gulls has been noted in the rainy season.

Monitoring of black-headed gull diurnal behavior showed that feeding was the dominant activity covering 24% of the observation time (average value of the three seasons studied). The next major activities to which the species allocated its time were

preening, swimming, and sleeping (Fig. 8). In his study on the contrasting patterns of wetland use by sympatric larids in winter, Liordos (2012) noted that black-headed gulls were more often engaged in comfort activities as well as locomotion and resting.

Monitoring of the temporal evolution of diurnal activities showed that the species fed mainly at noon (between 12:00 and 15:00 hours) and less at the beginning and end of the day (Fig. 9). The study carried out by Liordos (2012) on yellow-legged gull (*Larus michahellis*), black-headed gull (*L. melanocephalus*), and black-headed gull at the Vourkari inlet (Saronic Gulf, western Attiki, Greece) showed that these three species were mainly feeding in the late morning (from 9:00 to 12:00 hours; daytime period fixed in his study) and feeding least at noon (from 12:00 to 15:00 hours; daytime period fixed in his study). All this feeding time has been reported in some seabird research. Indeed, Goudie and Piatt (1991) noted that smaller birds spend more time feeding than larger ones due to constraint of their higher metabolic requirements. Based on the work of Pearson (1968), Liordos (2012) affirmed that body size explained 81% of the variation between species in seabird winter feeding activity.

Our study showed that black-headed gulls appeared to be more active in the morning than at other times of the day. This could be due to their movements between the sea and the lagoon, as well their movement across and all around the site, which may be or may not be associated with feeding or disturbance, as the El Mellah lagoon has been ceded as a concession for fishing and boats navigate practically all day.

According to Lack (1968), birds can increase their foraging time in winter, when environmental conditions make it more difficult to acquire food. Therefore, the pattern of movements observed in the present study should be further monitored and researched to answer these hypotheses and such behaviors.

Courtship was observed at the end of the wintering season and usually took place at the end of the day. In his study, Liordos (2012) claimed that yellow-legged gulls were involved in social interactions as the season progressed. This would mean that these birds might need to devote more time to activities such as pre-breeding courtship later in winter. This was effectively confirmed in our research for the studied biological model.

Conclusion

Our study showed that the black-headed gull is a wintering bird in El Mellah lagoon, where it settles from October and remains until the end of the season (end of March), with numbers that varied to reach the maximum in December and January depending on the year.

Diurnal activity patterns revealed the dominance of feeding activity followed by sleeping. This result suggests that the wintering period is not only a period of resting after a hard breeding period, but also rather a period of recovery of the energy needed to restart the annual cycle of all birds.

We would say that the data collected, while providing interesting results on a species that remains little or not documented, must necessarily be complemented by other diversified and in-depth work on migration corridors, habitat diversity, and modification by aquaculture impacts, as well as diet and food availability at the study site. These complementary studies will improve our knowledge of the species and also of the role of El Mellah lagoon in hosting remarkable avifauna.

Table 1. Checklist of wintering waterbirds recorded in El Mellah lagoon.

N°	Families	Species
01	Scolopacidae	*Actitis hypoleucos* *Arenaria interpres* *Calidris alpina* *Calidris ferruginea* *Calidris minuta* *Limosa lapponica* *Tringa erythropus* *Tringa nebularia* *Tringa ochropus* *Tringa totanus*
02	Ardeidae	*Ardea alba* *Ardea cinerea*
03	Charadriidae	*Charadrius alexandrinus* *Charadrius dubius* *Charadrius hiaticula* *Pluvialis apricaria*
04	Laridae	*Chroicocephalus genei* *Chroicocephalus ridibundus* *Gelochelidon nilotica* *Ichthyaetus audouinii* *Larus fuscus* *Thalasseus sandvicensis*
05	Anatidae	*Aythya ferina* *Aythya fuligula* *Marmaronetta angustirostris*
06	Phalacrocoracidae	*Phalacrocorax carbo*
07	Podicipedidae	*Podiceps nigricollis*
08	Glareolidae	*Glareola pratincola*
09	Haematopodidae	*Haematopus ostralegus*

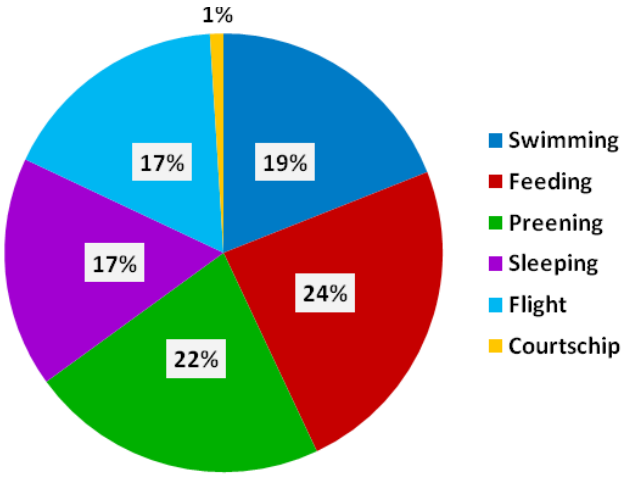


Fig. 8. Diurnal activities of the Black-headed Gull in El Mellah lagoon during the study period (2018-2020).

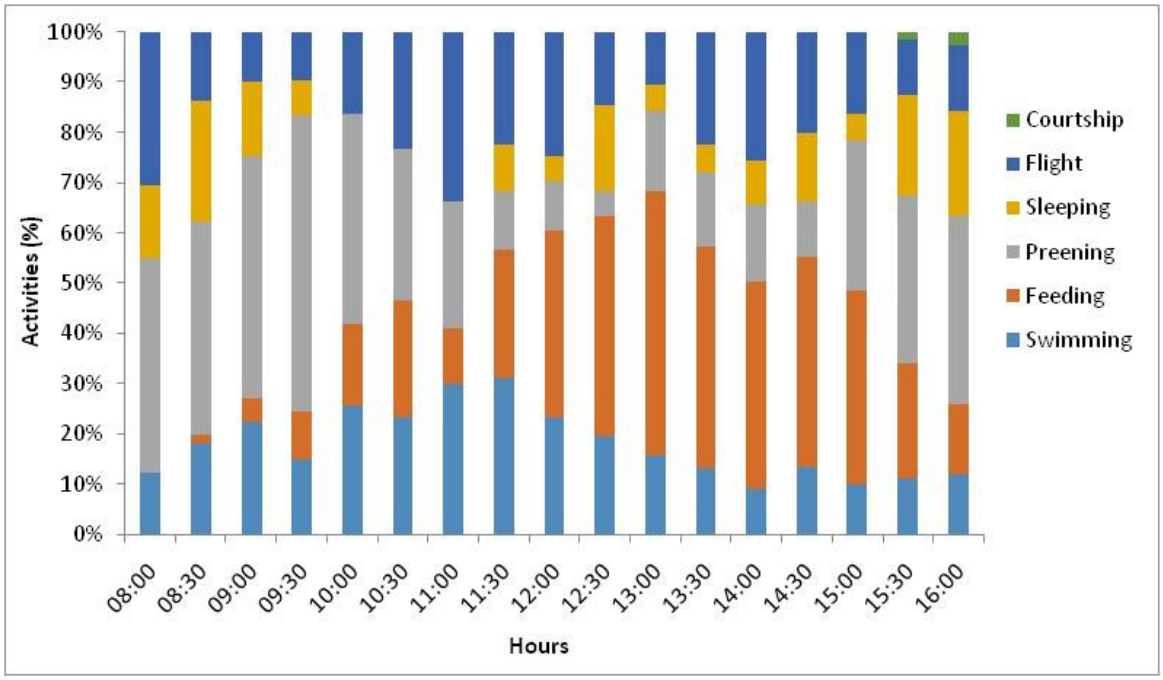


Fig. 9. Temporal evolution of diurnal activity rhythm of Black-headed Gull during the study period (2018-2020).

The results obtained in the present study will serve as a database not only for future research, but also for the establishment of an adequate management plan for the safeguard and preservation of biodiversity and habitats of this Ramsar site.

Acknowledgements

We would like to thank all those who participated in this work, especially Mr Abdesslem GRIRA of the El Kala National Park, who accompanied and helped us throughout our field investigations. We would like to express our gratitude to Pr BAHROUN Sofia for her assistance in mapping the study site. Through this study, we pay tribute to our friend and dead colleague, Mrs BEDIAF Samra, for her scientific contributions on avifauna.

References

Altmann, J. (1974). Observational study of behaviour: sampling methods. *Behaviour,* 49, 227–267. DOI: 10.1163/156853974x00534.

Amoura, W. (2014). *Ecologie et santé des Laridés dans le nord-est Algerien*. Thèse de Doctorat, Université Badji Mokhtar, Annaba, Algérie.

Andersson, M., Gotmark, F. & Wiklund C.G. (1981). Food Information in the Black-Headed Gull, *Larus ridibundus. Behav. Ecol. Sociobiol.,* 9, 199–202. DOI: 10.1007/BF00302938.

Baba-Ahmed, R. (2008). *Identification des sources d'effluents domestiques et voies de contamination d'une zone humide: cas du lac Mellah*. Mémoire de Magister, Université Badji Mokhtar, Annaba, Algérie.

Baldassare, G.A., Paulus, S.L., Tamisier, A. & Titman R.D. (1988). Workshop summary: Techniques for timing activity of wintering waterfowl. In M.W. Weller (Ed.), *Waterfowl in winter*. Minneapolis: University Minnesota Press.

Bediaf, S., Benmetir, S., Boucheker, A. & Lazli A. (2020). Diversité de l'avifaune aquatique Hivernante du marais de la mekhada. État actuel et valeur patrimoniale d'un site Ramsar (Nord-est Algérien). *Bull. Soc. Zool. Fr.*, 145(2), 97–118.

Benmarce, S. (2012). *Potentialités aquacoles de la lagune Mellah à travers la connaissance du chaînon de la macrofaune benthique*. Mémoire de Magister, Univ. Badji Mokhtar, Annaba, Algérie.

Benmetir, S., Bediaf, S., Boucheker, A., Gherib, A. & Lazli A. (2020). Données préliminaires sur l'hivernage du Grand Cormoran [*Phalacrocoraxcarbo* (Linnaeus, 1758)] dans la Numidie orientale (Nord-est Algérien). *Bull. Soc. Zool. Fr.,* 145(2), 155–167.

Benyacoub, S. & Chabi Y. (2000). Diagnose écologique de l'avifaune du Parc National d'El-Kala. Composition, Statut et Répartition. *Synthèse*, 6(1), 7–98.

Benyacoub, S., Baba Ahmed, R., Kara, H. & Brahmia Z. (2011). Plan Directeur de Gestion des Sites Ramsar du Parc (Lac Mellah). T.A.D Consult.

Blondel, J. (1975). Les écosystèmes de Camargue. *Courrier de la Nature*, 35, 43–56.

Bouali, N., Baaloudj, M., Touarfia, I., Houhamdi, I., Maazi, M.C. & Houhamdi M. (2021). Ecology, phenology and wintering behavior of Anatidae in the wetlands of Souk-Ahras (north-eastern Algeria). *Arxius de Miscellània Zoològica*, 19, 135–149. DOI : 10.32800/amz.2021.19.0135.

Bougaham, A.F. & Moulai R. (2013). Observations sur quelques espèces d'oiseaux de la côte à l'ouest de Jijel (Algérie). *Go-South Bulletin,* 10, 76–85.

Boukhroufa, M. (2001). *Rôle fonctionnel du marais du Mellah pour les oiseaux d'eau: Caractérisation et analyse de la variation des paramètres de structure du peuplement*. Mémoire Ingénieur, Univ. Annaba.

Boumezbeur, A. (1993). *Écologie et biologie de la reproduction de l'Érismature à tête blanche* Oxyura leucocephala *et du Fuligule nyroca* Aythya nyroca *sur le Lac Tonga et le Lac des oiseaux, Est algérien*. Thèse de Doctorat, Université de Montpellier.

Boumezbeur, A. (2005). Fiche descriptive sur les zones humides Ramsar: Réserve intégrale du Lac El Mellah (Wilaya d'El Tarf). Direction générale des forêts (DGF). Alger.

Brahmia, Z. (2002). *Rôle fonctionnel du lac Oubeira et du lac Mellah (parc national d'El-Kala) pour les oiseaux marins*. Mémoire de Magistère, Université Badji Mokhtar. Annaba, Algérie.

Bukacińska, M. & Bukaciński D. (1993). The Effect of Habitat Structure and Density of Nests on Territory Size and Territorial Behaviour in the Black-headed Gull (*Larus ridibundus* L.). *Ethology*, 94, 306–316. DOI: 10.1111/j.1439-0310.1993.tb00447.x.

Chaoui, L., Kara, M.H., Faure, E. & Quignard J.P. (2006). Growth and reproduction of the gilthead seabream *Sparus aurata* in Mellah lagoon (north-eastern Algeria). *Sci. Mar.*, 70(3), 545–552. DOI: 10.3989/scimar.2006.70n3545.

De Belair, G. & Bencheikh M. (1987). Composition et déterminisme de la végétation d´une plaine côtière marécageuse: La Mafragh (Annaba, Algérie). *Bulletin d'Ecologie*, 18(4), 393-407.

Djebar, A.B., Messerer, Y., Tandjir, L. & Bensouilah M. (2003). Equilibres Hydrologiques Du Lac Mellah (Complexe Lacustre d'El Kala). *Sciences & Technologie, C, Biotechnologies,* 20, 15–20.

Doumandji, S., Benkouider, M., Bakkar, H., Mertad, H., Biche, M., Harizia, A. & Koudour A. (1988). Recensement hivernal des oiseaux d'eau dans l'Ouest Algérien en Janvier 1988. *Annales de l'Institut National Agronomique El-Harrach,*12(2), 99-119.

Draredja, B., Melouah, K., Beldi, H. & Benmarce S. (2012). Diversité de la macrofaune benthique de la lagune mellah (Parc National d'El-Kala, Algérie nord-est). *Bull. Soc. Zool. Fr.,* 137(1-4), 73-86.

Gherib, A. & Lazli A. (2017). Les oiseaux d'eau nicheurs de l'Arboretum du Lac Tonga (Nord-Est algérien). *Bull. Soc. Zool. Fr.,* 142(3), 119-142.

Gherib, A., Lazli, A., Naili, S., Boucheker, A., Ikhlef, D. & Mechaka N.-I. (2021). Avifauna diversity and phenology in a Ramsar site: Lake Tonga (Northeastern Algeria). *Arxius de Miscellania Zoologica*, 19, 321–344. DOI: 10.32800/amz.2021.19.0321.

Glutz Von Blotzheim, U.N. & Bauer K.N. (1982). *Handbuch der Vogel Mitteleuropas*. Vol. 8. Wiesbaden: Akad. Verlaggesellschaft.

Goudie, R.I. & Piatt J.F. (1991). Body size and foraging behaviour in birds. In *Proceedings: 20th international ornithological congress* (pp. 811–816). International Ornithologists' Union.

Guelorget, O., Frisoni, G.F., Ximenes, M.C. & Perthuisot J.P. (1989). Expression biologique du confinement dans une lagune méditerranéenne: le lac Mellah (Algérie). *Revue d'Hydrobiologie Tropicale*, 22(2), 87-99.

Hamza, A. & Slimani S. (1990). *Contribution à l'étude de l'hivernage des oiseaux d'eau hivernant dans le Lac Mellah (Parc National d'El-Kala).* Mémoire Ingénieur. Univ. Annaba, Algérie.

Haridi, A. (1999). *Le zooplancton de la lagune Mellah (El-Kala, Algérie). Bilan d'échange avec la mer et incidences écologiques en hiver et au printemps 96-97*. Thèse Magister en Océanographie Biologique, ISMAL, Alger.

Heim De Balsac, H. & Mayaud N. (1962). *Les oiseaux du Nord-Ouest de l'Afrique.* Paris: Paul Le Chevalier.

Holmes, R.T. & Robinson S.K. (1988). Spatial patterns, foraging tactics, and diets of ground-foraging birds in a northern hardwoods forest. *Wilson Bull.*, 100, 377–394.

Houhamdi, M. (2002). *Écologie des peuplements aviens du Lac des Oiseaux (Numidie orientale).* Thèse de Doctorat d'État, Université Badji Mokhtar, Annaba, Algérie.

Houhamdi, M. & Samraoui B. (2002). Occupation spatiotemporelle par l'avifaune aquatique du Lac des Oiseaux Algerie. *Alauda*, 70(2), 301-310.

Houhamdi, M. & Samraoui B. (2008). Diurnal and nocturnal behaviour of ferruginous duck *Aythya nyroca* at Lac des Oiseaux, northeast Algeria. *Ardeola*, 55(1), 59-69.

Isenmann, P. (1976). Contribution à l'étude de la biologie de la reproduction et de l'écologie du Goéland argenté à pieds jaunes (*Larus argentatus* Michahellis) en Camargue. *Revue d'Ecologie (Terre & Vie),* 30, 551-563.

Isenmann, P., Lebreton, J.D. & Brandl R. (1991). The Black-headed Gull in Europe. In *Acta XX Congressus Internationales Ornithologici* (pp. 2384-2389). Wellington: New Zealand Ornithological Congress Truss Board.

Isenmann, P. & Moali, A. (2000). *Les Oiseaux d'Algérie*. Paris: SEOF.

Jacob, J.P. & Courbet B. (1980). Oiseaux de mer nicheurs sur la côte en Algérie. *Le Gerfaut*, 70, 385–401.

Kherifi, W. & Kherici-Bousnoubra H. (2012). Evolution saisonnière de la qualité microbiologique des eaux du Lac Mellah (Nord-est Algérien). *Larhyss Journal*, 11, 109-118.

Lack, D. (1968). *Ecological adaptations for breeding in birds*. London: Methuen.

Lamotte, J. & Bourliere A. (1969). *Problèmes d'écologie: l'échantillonnage des peuplements animaux des milieux terrestres*. Masson.

Lazli, A., Benmetir, S., Beddiaf, S., Mazni, S., Messai, Z. & Iboud M.T. (2018). L'avifaune aquatique hivernante du Lac Oubeira (Nord-est Algérien): état actuel et intérêt patrimonial. *Alauda*, 86(2), 95-108.

Lazli, A., Boumezbeur, A., Moali-Grine, N. & Moali A. (2011a). Évolution de la population nicheuse de l'Érismature à tête blanche *Oxyura leucocephala* sur le Lac Tonga (Algérie). *Revue d'Ecologie (Terre & Vie)*, 66(2), 173–181.

Lazli, A., Boumezbeur, A., Perennou, C. & Moali A. (2011b). Biologie de La reproduction de l'Érismature à tête blanche *Oxyura leucocephala* au Lac Tonga (Algérie). *Revue d'Ecologie (Terre & Vie)*, 66(3), 255-265.

Lazli, A., Nouari, I., Chater, N. & Moali A. (2014). Diurnal behavior of breeding White-headed Duck *Oxyura leucocephala* at Lake Tonga, North-East Algeria. *Revue d'Ecologie (Terre & Vie)*, 69, 131-141.

Lebreton, J.D. (1987). Régulation par le recrutement chez la Mouette rieuse (*Larus ridibundus*). *Revue d'Ecologie (La Terre et la Vie),* Suppl.4, 173-181.

Lebreton, J.D. & Isenmann P. (1976). Dynamique de la population camarguaise de Mouettes rieuses *Larus ridibundus* L.: un modèle mathématique. *Revue d'Ecologie (Terre & Vie),* 30, 529-549.

Ledant, J.P., Jacob, J.P., Jacobs, P., Malher, F., Ochando, B. & Roche J. (1981). Mise à jour de l'avifaune Algérienne. *Le Gerfaut,* 71, 295-398.

Liordos, V. (2012). Contrasting patterns of wetland use by sympatric larids in winter. *Acta Ethologica*, 15, 81–89. DOI: 10.1007 / s10211-011-0112-y.

Losito, M.P., Mirarchi, E. & Baldassare G.A. (1989). New Techniques for Time- Activity Studies of Avian Flocks inView-restricted Habitats. *J. Field Ornithol.*, 60, 388–396.

Mecif, F., Boucheker, A. & Lazli A. (2020). Biologie de la reproduction du Grèbe huppé Podiceps cristatus au Lac Tonga (Nord-est Algérien). *Bull. Soc. Zool. Fr.,* 145(3), 225-246.

Melouah, K. (2014). *Etude de la faune malacologique de la lagune Mellah avec un intérêt particulier pour Le bivalve* Cerastoderma glaucum. Thèse de Doctorat, Université Badji Mokhtar, Annaba.

Melouah, K., Draredja, B. & Beldi H. (2014). Dynamique de la coque *Cerastoderma glaucum* (Mollusca, Bivalvia) dans la lagune Mellah (Algérie Nord-Est). *Revue des Sciences et Technologie, Synthèse,* 28, 34-45.

Menasria, B. & Lazli A. (2017). Aspects of habitat selection of White-headed Duck *Oxyura leucocephala* in Lake Tonga (North-Eastern Algeria). *Alauda,* 85(4), 283-294.

Michelot, J.-L. & Laurent L. (1993). Observations estivales d'oiseaux marins sur les plages algériennes et marocaines. *Le Bièvre,* 13, 109-117.

Morse, D.H. (1990). Food exploitation by birds: some current problems and future goals. *Studies in Avian Biology,* 13, 134–143.

Moulaï, R. (2006). *Bioécologie de l'avifaune terrestre et marine du Parc National de Gouraya (Béjaia), cas particulier du Goéland leucophée*, *Larus michahellis* Naumann, 1840. Thèse Doctorat d'état, INA, El Harrach.

Pearson, T.H. (1968). The feeding biology of sea-bird species breeding on the Farne Island, Northumberland. *J. Anim. Ecol.,* 37, 521–552. DOI: 10.2307/3073.

Prévot-Julliard, A.C., Lebreton, J.D. & Pradel R. (1998). Re-evaluation of adult survival of Black-headed gulls (*Larus ridibundus*) in presence of recapture heterogeneity. *The Auk*, 115(1), 85-95. DOI: 10.2307/4089114.

Retima, A. (1999). *Incidences des échanges hydrologiques, chimiques, biochimiques et phytoplanctoniques sur la fertilité de la lagune Mellah et du littoral voisin (El-Kala, Algérie) selon le régime de marée dix ans après l'aménagement du chenal de communication.* Thèse Magistère, Univ. Annaba.

Skórka, P., Wójcik, J.D., Martyka, R. & Lenda M. (2012). Numerical and behavioural response of Black-headed Gull *Chroicocephalus ridibundus* on population growth of the expansive Caspian Gull *Larus cachinnans*. *J. Ornithol.,* 153, 947–961. DOI: 10.1007/s10336-012-0824-4.

Tamisier, A. & Dehorter O. (1999). *Camargue, canards et foulques. Fonctionnement et devenir d'un prestigieux quartier d'hiver*. Nîmes: Centre Ornithologique du Gard.

Telailia, S., Boutabia, L., Dhaya El-Hak Khemis, M., Elafri, A. & Djebbari N. (2017). Multiannual and seasonal patterns of waterbird assemblages in a mediterranean and coastal lagoon (El Mellah Lagoon) of Northeastern Algeria. *Ekológia* (*Bratislava*), 36, 146-157. DOI: 10.1515/eko-2017-0013.

Thibault, J.C. (1993). Breeding distribution and numbers of Cory's Shearwater *Calonectris diomedea* in the Mediterranean. In J.S. Aguilar, X. Monbailliu & M. Paterson (Eds.), *Status and Conservation of Seabirds* (pp. 25–35). Madrid: Sociedad Española de Ornitologia.

Ziani, R., Ziani, B.E.C., Dik, B., Marniche, F. & Lazli A. (2020). Louse species (phthiraptera: amblycera, ischnocera) collected on the common coot, *Fulica atra* (Linnaeus, 1758), and their microhabitat selection. *Bull. Soc. Zool. Fr.*, 145(2), 135-153.