ON THE BEHAVIOR OF MALLARD *ANAS PLATYRHYNCHOS* IN THE LAKE OF BIRDS (EL-TARF PROVINCE – NORTHEAST ALGERIA)

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ABSTRACT

This research show the daily behavior of the Mallard in Lac des Oiseaux. The study was conducted over three consecutive years (2020, 2021, 2022) (morning and afternoon). The variation in the number of Mallard individuals did not follow a time-series trend, with the peak number of individuals observed in November-December. Foraging dominated the diurnal time budget of this duck. The proportion of each activity differed significantly between the morning and afternoon periods, except for flying activity. Energetic activities were positively correlated and observed during both the morning and afternoon. Wetland management should incorporate behavior of the species in order to ensure effective conservation strategies.

RÉSUMÉ: Aperçu sur l’éthologie du canard colvert *Anas platyrhynchos* au Lac des Oiseaux (wilaya de El-Tarf – Nord Est de l’Algérie).

Cette étude met en avant le comportement du Canard colvert au Lac des Oiseaux. L’étude a été menée sur trois années consécutives (2020, 2021, 2022), le matin et l’après-midi. La variation du nombre d’individus de colvert n’a pas suivi une tendance chronologique, avec un pic d’observations enregistré en novembre-décembre. L’alimentation a dominé le budget du temps diurne de cette espèce. La proportion de chaque activité varie significativement entre les périodes du matin et de l’après-midi, à l’exception de l’activité de vol. Les activités énergétiques sont positivement corrélées et sont observées à la fois le matin et l’après-midi. La gestion des zones humides devrait prendre en compte le comportement de cette espèce afin d’assurer des stratégies de conservation efficaces.

REZUMAT: Despre comportamentul rației *Anas platyrhynchos* în lacul Păsărilor (Provincia El-Tarf – nord-estul Algeriei).

Acest articol documentează comportamentul zilnic al raței mari în Lacul Păsărilor. Studiul a fost realizat pe parcursul a trei ani consecutivi (2020, 2021, 2022), dimineața și după-amiaza. Variația numărului de indivizi de rață mare nu a urmat o tendință temporală, cu un vârf al numărului de indivizi observat în lunile noiembrie-decembrie. Hrănirea a dominat bugetul de timp diurn al acestei specii. Proporția fiecărei activități a diferit semnificativ între perioadele de dimineață și după-amiază, cu excepția activității de zbor. Activitățile energetice au fost corelate pozitiv și au fost observate atât dimineața, cât și după-amiaza. Gestionarea zonelor umede ar trebui să ia în considerare comportamentul acestei specii pentru a asigura strategii eficiente de conservare.

INTRODUCTION

The Mallard *Anas platyrhynchos* is the focal duck species of wild ecosystems in many European and African countries (Tracey et al., 2008). This species plays a turnover function in conservation, epidemiology, and ecosystems management (Bengtsson et al., 2014). The time of day, the weather condition such as temperature and rainfall and the rest of climatic conditions are associated with increased food availability and sources as well as metabolic rate in waterbirds (Meissner and Markowska, 2009). Thereby the management of waterbirds population during the breeding and wintering period improving the functioning of individual population, the reproduction rate, and the bird's survival (mainly the energetic activities such as feeding) (Flis et al., 2022; Flis and Brodzki, 2020; Janiszewski et al., 2018; Ljung et al., 2015; Vrtiska et al., 2013; Borman and Mattson, 2012). The behavior measurement allows assessment of the welfare of species in the wild environment under human management (Rose, 2021; Dawkins, 1989). It is known that the diet of the Mallard is dominated by seeds and invertebrates, but this foraging activity is not occurred only in proportion to wetland food availability (Tidwell et al., 2013). More life-history traits of waterbirds can influence the foraging activity such as feather molt intensity, breeding, migration, and climatic variation (Anderson et al., 2000). The particular characteristics of species behavior considered as an adaptative way (Arendt, 1997). The adequate strategy (i.e., time allow to foraging) used by each species during its life cycle can define its fitness (Nylin and Gotthard, 1998).

In this study, we aimed to assess the strategies employed by Mallards in Lac des Oiseaux from September to June over three consecutive years (2020, 2021, and 2022); throughout (i) the trend in Mallard population abundance and (ii) the characterization of its diurnal time budget.

MATERIAL AND METHODS

Study area

This field research was conducted in Lac des Oiseaux (northeast Algeria, 36°42'N, 8°07'E; (Fig. 1), which is part of El Tarf Province (Algeria). This wetland is bordered by El Kala City to the east and Annaba to the west. It is characterized by a Mediterranean climate, with wet winters and warm, dry summers. Lac des Oiseaux is a 40-hectare freshwater lake that can expand to 70 hectares during periods of heavy rainfall (Loucif et al., 2020). It shares a watershed with the Mekhada Marshes, from which it is separated by a road. The lake attracts a variety of bird species, including some listed on the IUCN Red List, such as the white-headed duck (*Oxyura leucocephala*), the ferruginous duck (*Aythya nyroca*), and the western swamphen (*Porphyrio porphyrio*). The vegetation in the area is diversified, dominated by fringes of *Phragmites australis*, *Scirpus lacustris*, *Sporobolus maritimus*, *Potamogeton lucens*, and *Myriophyllum spicatum*. Additionally, grassy lawns (*Cynodon dactylon* and *Paspalum distichum*), Asteraceae species (*Bellis annua* and *Senecio vulgaris*), *Juncus acutus*, and *Asphodelus aestivus* are also present (Houhamdi and Samraoui, 2002).

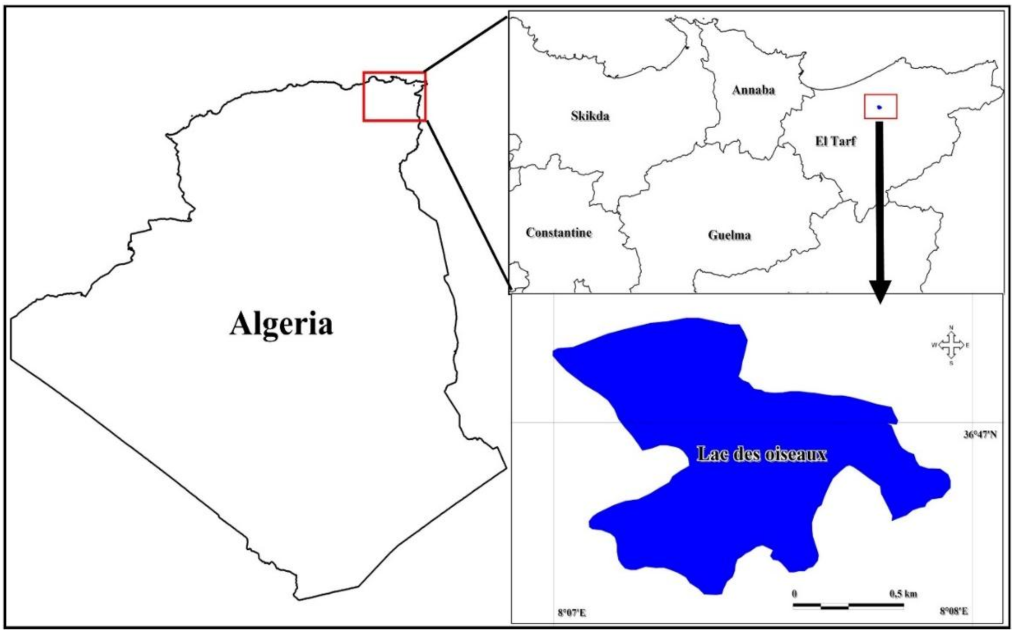

Figure 1: Geographical location of Lac des Oiseaux (northeast of Algeria).

Field sampling

Weekly counts of Mallards during the wintering seasons (2020-2022) were done using the "look-see" technique (Sutherland et al., 2004). Observations began in early September 2020 and continued until June 2022, conducted at the same time of day, during the twilight period. A telescope (KITE 20 × 60) was used for counting. When the number of individuals was fewer than 200, population size was counted individually (Blondel, 1975; Altmann, 1974). For larger groups, we defined a focal group as a flock of individuals of a single species, where the visually estimated distance between intra-group members was less than ten meters. For estimating the number of Mallards in such cases, the visual field was divided into bands, and the average number of birds in each band was recorded (Li et al., 2011). This method has a maximum margin of error of about 10% (Merzoug et al., 2015). Additionally, we recorded the daily time budget activities of Mallards during both the morning and afternoon periods. The observed time budget did not distinguish between sexes or age groups and was classified into five activities: resting, locomotion, feeding, grooming, and fly.

Data analysis

The Shapiro-Wilk normality test was used to assess the distribution of Mallard abundance (2020: W = 0.88964, p-value = 0.0002566 / 2021: W = 0.89051, p-value = 0.0002731/2022: W = 0.89373, p-value = 0.000345) along the study. Since the data did not follow normality distribution, we transformed them using the *Rcmdr* function. The Kruskal Wallis test was used to compare between Mallard abundance across the years (2020, 2021, and 2022). Also, we applied the Wilcoxon signed rank test to compare activities between morning and afternoon. We admit that alternative hypothesis: true location shift is not equal to 0.

The seasonal Mann-Kendall test was used. It will tell us whether there is a trend due to seasonality (seasonality = 10 months). The number of Mallard individuals presented as an abundance of this waterbirds during three-study period (2020, 2021, and 2022). The sen's slope estimator was calculated in order to estimate the magnitude of the trend (Rani et al., 2023). We consider α as a significant level of 5%.

A correlation matrix of the activities (5 × 2) was calculated using Pearson coefficient. PCA "principal component analysis" was done in order to point the relationship between the daily activities of Mallard (morning versus afternoon). Tamisier and Tamisier (1981) shown that ducks exhibit two types of activities: energetic activities "feeding and resting" and accessory activities "grooming, fly, locomotion, courtship". For testing this relationship, all these five variables are considered as a variable. PCA plot included only the five activities with the highest contributions to the analysis. The statistical analysis was conducted using R (v 4.3.3) 2024 "FactoMineR and corrplot package" and XLSTAT 2014.5.03 for generating seasonality curve (XLSTAT, 2014).

RESULTS

Trend of Mallard population abundance

The seasonal Mann-Kendall test was used. It will tell us whether there is a trend due to seasonality (seasonality = 10 months). The number of Mallard individuals presented as an abundance of these waterbirds during three-study period (2020, 2021, and 2022) (Fig. 2). The sen's slope estimator was calculated in order to estimate the magnitude of the trend (Rani et al., 2023). We consider α as a significant level of 5%.

The abundance of Mallard revealed no significant difference between 2020, 2021, and 2021 (Kruskal-Wallis chi-squared = 3.3508, df = 2, p-value = 0.1872). We noted that the Mallard number of individuals did not follow up a trend (Kendall's tau = –0.0320, p-value = 0.8183). The number of individuals in Lac des Oiseaux displays a bell-shaped fitness (Sen's slope estimator = –0.3774, confidence interval [–15.0403; 16.7639]) (Fig. 3).

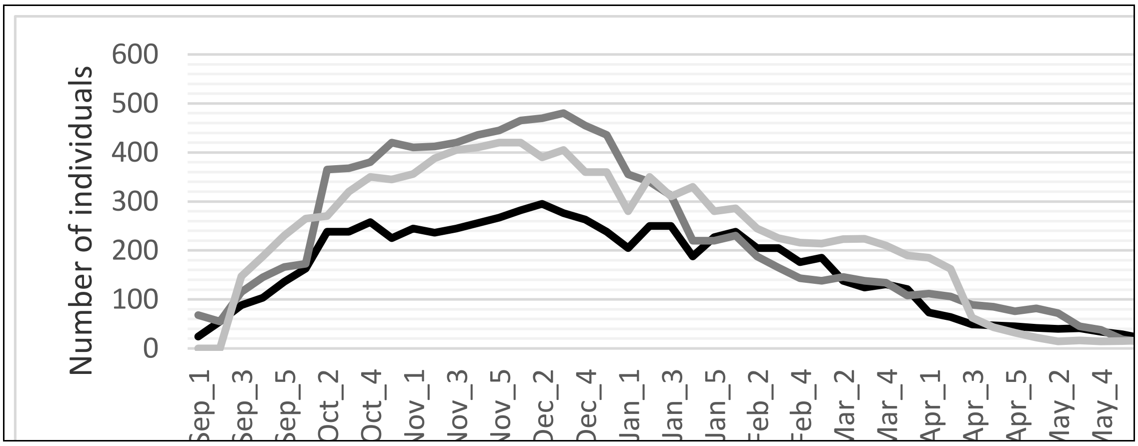

Figure 2: Monthly variation of Mallards' number of individuals in Lac des Oiseaux during 2020, 2021, and 2022.

Diurnal time budget of Mallard

We observed a significant difference in activities between the morning and afternoon for resting (V = 9870, p-value < 2.2e-16), locomotion (V = 13, p-value < 2.2e-16), feeding (V = 2714.5, p-value = 0.0001403), and grooming (V = 388, p-value < 2.2e-16). However, no significant difference was recorded for fly activity (V = 876, p-value = 0.6948) throughout the day (morning versus afternoon) (Fig. 4).

Resting and feeding dominated the morning time budget of Mallards, accounting for 42.63% and 38.28% in 2020, 44.51% and 40.04% in 2021, and 40.54% and 40.36% in 2022, respectively. In the afternoon, however, feeding and locomotion took a larger proportion, with 40.69% and 38.36% in 2020, 41.61% and 34.13% in 2021, and 42.04% and 35% in 2022, respectively (Fig. 4).

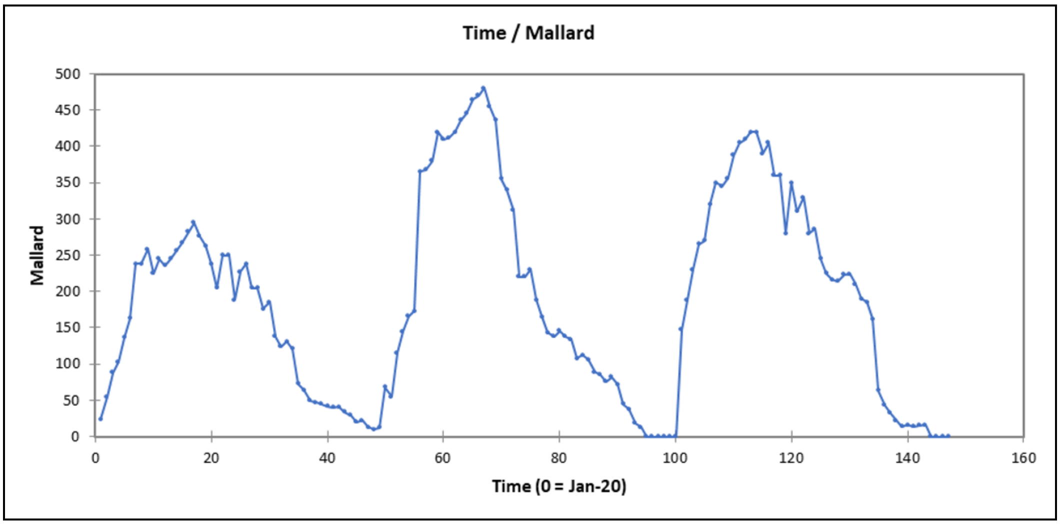

Figure 3: Characterization of the Mallard population trend during the three-study period (2020, 2021, 2022). Seasonal Mann-Kendall test (Kendall's tau = –0.0320, p-value = 0.8183).

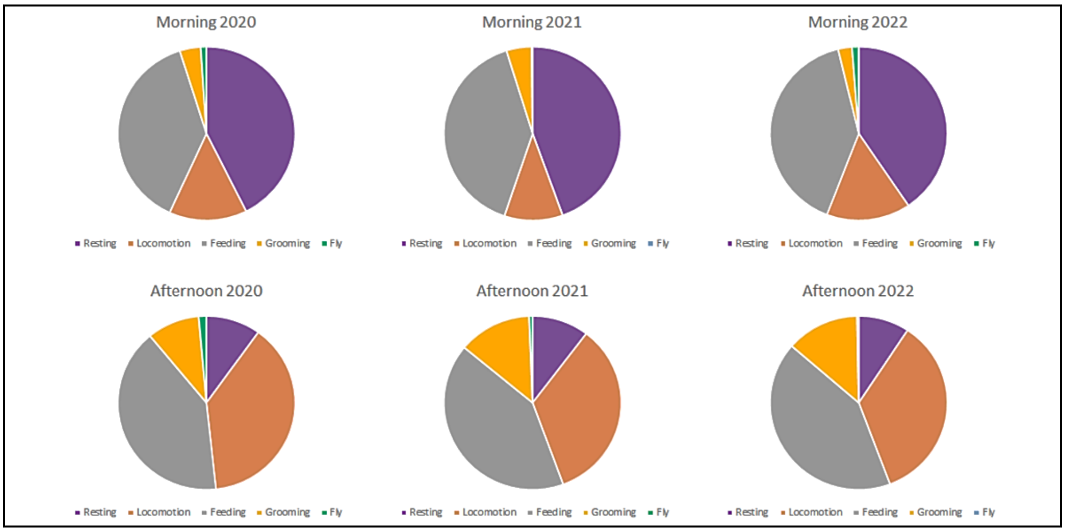

Figure 4: Proportion of each activity in the day time budget of Mallard in Lac des Oiseaux.

Characterization of Mallard daily behavior

Figure 5 summarizes the relationship between activities recorded in the morning and afternoon. Feeding in the morning was positively and significantly correlated with feeding in the afternoon (r = 0.876, p-value = 0.0327). Additionally, feeding activity in the afternoon was positively correlated with locomotion in the afternoon (r = 0.871, p-value = 0.0366), while feeding in the morning was negatively correlated with locomotion in the morning (r = –0.923, p-value = 0.006). Furthermore, the resting activities were negatively correlated with feeding activity (Fig. 5).

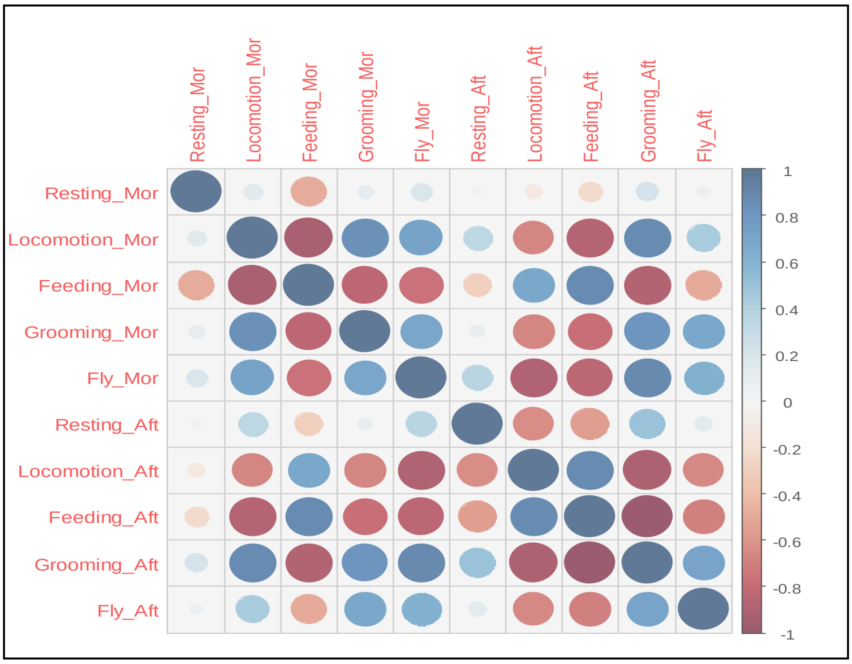

Figure 5: Correlation map of the Mallard daily time budget activities in Lac des Oiseaux during 2020, 2021 and 2022.

The PCA separated between two categories of activities that allowing welfare of Mallard. In figure 6, we accepted only the first five activities with the highest contributions to the analysis: feeding (morning and afternoon), locomotion, grooming, and flying, all of which showed a strong contribution to the PCA. The analysis explained 66.95% of the total variance.

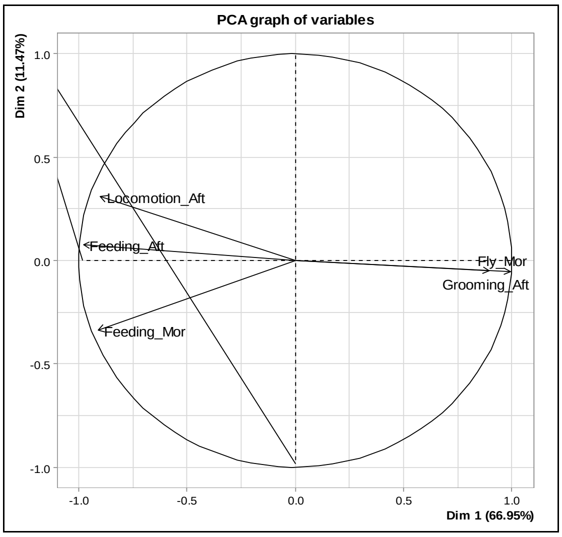

Figure 6: PCA illustration of Mallard daily time budget activities in Lac des Oiseaux during 2020, 2021, and 2022. We select only the first five activities with a high contribution in PCA.

Table 1 summarizes the eigenvalue and % variance for each principal component. The first axis (Dim. 1) of the analysis separated feeding in the morning, feeding in the afternoon, and locomotion in the afternoon (classified as energetic activities) from flying in the morning and grooming in the afternoon (recorded as comfort movements).

These two categories can be grouped as welfare activities for the birds. It is noteworthy that resting activity was not represented on the PCA map, despite being recorded at a high proportion in the morning (recorded as an energetic activity) (Fig. 4). Except for locomotion, categorized as an accessory activity, was associated with both: 1) energetic activities (feeding in the morning and afternoon) and 2) comfort movements (in this context, locomotion refers to bathing or swimming behavior in Mallards).

Table 1: Principal component analysis describing the Mallard daily time budget activities in Lac des Oiseaux during 2020, 2021. and 2022. We selected the three dimensions (Dim. 1, Dim. 2, Dim. 3, with a high % variance).

Dim.	Eigenvalues	% variance
1	6.659	66.95
2	1.147	11.47
3	1.056	10.55

DISCUSSION

Li et al. (2011) reported that Mallard displays a long period of foraging. Boos et al., (2002) showed that in winter Mallard carry more fat per body mass unit. This ability is known increasing the fitness of this birds to withstand fasting period (Meissner and Markowska, 2009). We suppose that during breeding period Mallard rely on lipidic reserves in order to maintain protein reserve and this body lipid was structured during the winter to the overall reproductive output. In Lac des Oiseaux, Mallard spent a long daily time feeding with resting in the morning and motion in the afternoon, it did not displayed time in vigilance mode and neglect mild disturbances that are often misjudged as serious risks. In the Hengshui Lake National Nature Reserve (China), Mallard extended the vigilance mode at the expense of other behavior such as foraging and resting (Li et al., 2011). We noted that Mallard was less vigilant than other waterbirds probably due to the high level of foraging offered by Lac des Oiseaux.

Motion starting when mallard slides from the shore into the water in the afternoon. This behavior is extended by a “group bathing signal” (swimming or bathing – which mean locomotion), this activity can be released by the bathing behavior of another Mallard in the same wetland (Pulliainen, 1963). All these activities (locomotion or bathing/swimming) known as fundamental for the welfare of waterbirds “comfort movement” (Baerends and Baerends-van Roon, 1950; Kortland, 1942). The locomotion is mostly associated to feeding (Mallard need some movements during foraging). And also, grooming (preening) which is known as a comfort movement (Baerends and Baerends-van Roon, 1950; Kortland, 1942).

Not only foraging availability that modeling the behavior of Mallard, Guillemain et al, (2002) reported that the temperature of the wintering site determining the mallard budget time. The plasticity of this duck allowing increasing foraging during the winter (when the temperature is low) through an intensive and extended time allow to feeding (Meissner and Markowska, 2009). Moreover, it is known that there is a significant difference between male and female Mallard during foraging. The greater metabolic rate and body weight of the males suggests that they can tolerate lower temperature extremes than the females (Smith and Prince, 1973). But, this fitness of the Mallard is noted only when a temperature decreasing at low ambient degrees. The variation in tolerance of this duck reflects the life-history trait, fitness, plasticity and behavior of this species (Li et al., 2011; Nylin and Gotthard, 1998)

Secondly, the fly activity of Mallard is noted only at dawn and dusk time (Fig. 4), this activity was negatively correlated with energetics activities (feeding and resting) which were noted all the day (morning and afternoon) (Fig. 6). The fly activity was recorded when ducks moving from the foraging area. This finding is in accordance with previous studies (Bengtsson et al., 2014) and showed a "commuting behavior" (Sauter et al., 2012).

The data on waterbirds behavior and ecological requirement is critical for the biodiversity management and conservation. This history-life trait knowledge can provide informations than can be used to develop a management guideline. We recommended more management implication in Lac des Oiseaux in order to maintain the ecological function of this wetland.

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