sciendo

Ekológia (Bratislava) - Journal of the Institute of Landscape Ecology, Slovak Academy of Sciences Vol. 41, No. 1, p. 70–77, 2022
DOI:10.2478/eko-2022-0008

# PHENOLOGY AND DIURNAL BEHAVIOUR OF RUDDY SHELDUCK *Tadorna ferruginea* AT OGLAT EDDAIRA (AIN BEN KHLIL) WETLAND, SOUTHWEST OF ALGERIA

ABDELKRIM BENARADJ[1,2], NABIL CHARCHAR[3], HAFIDA BOUCHERIT[1], MOHAMED-LAID OUAKID[2], MOUSSA HOUHAMDI ✉[4]

[1]Laboratoire de Gestion Durable des Bio-Ressources dans les Zones Arides et Semi Arides, Centre Universitaire Salhi Ahmed de Naâma, Algérie
[2]Département de Biologie, Faculté des Sciences, Université Badji Mokhtar d'Annaba, Algérie
[3]Centre de recherche en biotechnologie (CRBt), Constantine, Algérie
[4]Laboratoire Biologie, Eau et Environnement (LBEE), Faculté SNV-STU, Université 8 Mai 1945 Guelma. BP. 401 24000 Guelma, Algérie; e-mail: houhamdi-moussa@yahoo.fr, moussa.houhamdi@univ-guelma.dz

✉ Corresponding author

**Received:** 17 November 2020 / **Accepted:** 5 March 2021

Abstract

Benaradj A., Charchar N., Boucherit H., Ouakid M.-L., Houhamdi M.: Phenology and diurnal behaviour of ruddy shelduck *Tadorna ferruginea* at Oglat Eddaira (Ain Ben Khlil) wetland, Southwest of Algeria. Ekológia (Bratislava), Vol. 41, No. 1, p. 70–77, 2022.

The ecological study (phenology and daytime budget) of ruddy shelduck *Tadorna ferruginea* (Anatidae) at Lake Oglat Eddaira (Ain Ben Khlil), Southwest of Algeria, was carried out for three consecutive years from August 2017 to July 2020. While ruddy shelduck has the status of a sedentary species, it was found all year round, persisting at low numbers in mid-summer months (July–August). The numbers of ruddy shelduck began to increase from the first decade of September with the arrival of the wintering and breeding populations. High numbers of ruddy shelduck were mainly recorded between late January and early March. During our monitoring, the balance sheet of the rhythms of daytime activities was dominated by feeding in water and on banks (68%), followed by preening (16.77%), swimming (9.85%,), sleeping (4.67%) and flying (1.22%). Therefore, we can conclude that Oglat Eddaira wetland plays the role of a diurnal grazing ground for this Anatidae.

*Key words*: *Tadorna ferruginea*, phenology, daytime budget, Oglat Eddaira.

## Introduction

The ruddy shelduck *Tadorna ferruginea* (Pallas, 1764) is widely distributed in Southeast Europe and central Asia (Mackinnon et al., 2000, Shurulinkov et al., 2020), overwintering mainly in the Indo-China Peninsula, India, Japan, the Korean Peninsula, Northern Africa (Heinzel et al., 1974) and from the central to south China (Mackinnon et al., 2000). The global population is estimated to be between 170,000 and 220,000 birds (Wetland International, 2017). The species is qualified as 'Near Threatened' in EU27 countries (Birdlife International, 2015). Small isolated populations are present in Morocco, Algeria and Ethiopia (Cramp, Simmons, 1986; Madge, Burn, 1988). As one of the few species that breed erratically over large expanses of arid parts of North Africa, the ruddy shelduck has proved to be a difficult species to study.

Although it is known that North Africa is an important breeding and wintering ground for water birds (Green et al., 2002; Smart et al., 2005; Samraoui et al., 2011; Boulekhssaim et al., 2013). In Algeria, the ruddy shelduck is a flagship species of the wetlands of the high plateaus and the Sahara. It regularly frequents large and shallow bodies of water (Isenman, Mouali, 2002; Boulekhssaim et al., 2006, 2013; Noudjem et al., 2015; Bounab et al., 2017). In order to focus on the ecological role of particular protected wetlands in the maintenance of water bird populations, it is important to report on the ecology (abundance, spatial and temporal distribution and diurnal time budget monitoring) of the ruddy shelduck *T. ferruginea* in such a wetland here, the Oglat Eddaira. The main interest of this research is to understand the ecological requirements of ruddy shelduck and threats to these birds, in order to draw attention to the need for the conservation and management of wetlands for the protection and preservation of breeding and wintering Anatidae.

## Material and methods

### *Study area*

The Oglat Eddaira wetland is a geomorphological depression located in the western part of the city of Ain Ben-Khelil, 30

© The Author(s) 2022. This is an open access article licensed under the Creative Commons Attribution-NonCommercial-NoDerivs License (http://creativecommons.org/licenses/by-nc-nd/3.0/).

km southwest of the capital of the wilaya of Naama and 4 km northwest of the capital of Ain Ben-Khelil commune. It spreads over the western end of the high steppe plains to the southeast of Chott El-Gharbi. It is brackish water body with an area of 200 ha (Fig. 1), located in the middle of the steppe zone and characterised by a low and irregular rainfall of about 200 mm/year. It is fed by runoff from temporary Oued. This seasonal brackish water body, located in the middle of the arid steppe zone, is surrounded by a plant belt made up of *Tamarix gallica* resulting from reforestation carried out 20 years ago. On observing, in places, beaches of much grazed Phragmites. Near the water and along the entire perimeter, there is a very sparse herbaceous vegetation to be noted. It is made up of *Juncus acutus* and *Carex* sp. The width of the belt reaches more than 100 m per location and slows down the advance of the sand dunes which run along the southern part. The lands surrounding the wetland are occupied by the riparian populations settled on the rangelands between El Marfag–El Mesdouria and the cultivated areas along Oued Rokaima. The current status of these areas, however, remains classified as private land and archs. The Oglat Eddaira offers with its variety of natural landscapes and its permanent lake a sample of steppe ecosystem with a global interest due to its floristic diversity (alfa, sagebrush, esparto and halophyte formations, and pistachio of the atlas in the dayates). The wild avifauna frequenting this wetland is mainly composed of ruddy shelduck *T. ferruginea*, common shelduck *Tadorna tadorna*, marbled teal *Marmaronetta angustirostris*, common teal *Anas crecca*, mallard duck *Anas platyrynchos*, northern shoveler *Anas clypeata*, northern pintail *Anas acuta*, common pochard *Aythya ferina*, ferruginous duck *Aythya nyroca*, greater flamingo *Phoenicopterus roseus*, common moorhen *Gallinula chloropus*, booted eagle *Hieraaetus pennatus*, houbara bustard *Chlamydotis undulata*, *white*-backed *stilt Himantopus himantopus* and elegant avocet *Recurvirostra avosetta*.

### *Sampling*

The phenology and diurnal behaviour of ruddy shelduck *T. ferruginea* were studied at Lake Oglat Eddaira (Ain Ben Khlil) for three consecutive years from August 2017 to July 2020. Birds were counted weekly; individual counting is possible when a ruddy shelduck group is near to observation points (within 200 m) and counts less than 200 individuals, and a visual estimation is made otherwise (Blondel, 1975; Houhamdi, 2002). During the same campaign, regular monitoring of diurnal activity rhythms of the ruddy shelduck *T. ferruginea* was done. It was carried out every hour from 8 am to 5 pm during all the observation times on 80%–100% of the individuals present in the site using the scan method, *instantaneous scan sampling*, which is very suitable for this type of terrain (large, open and little disturbed) (Altmann, 1974) and was corrected and improved by Baldassare et al. (1988) and Losito et al. (1989). Thus, once a week, from August 2007 to July 2020, we carried out scans of the majority of individuals whose behaviours were easy to observe (Houhamdi, Samraoui, 2001, 2003, 2007; Amorabda et al., 2015; Merzoug et al., 2015; Charchar et al., 2019). The activities measured are: sleep, feeding in the water and on the banks, grooming, swimming and flying. The data were then analysed using a multivariate correspondence analysis (with XL-Stat software) to describe the relationships between the different activities.

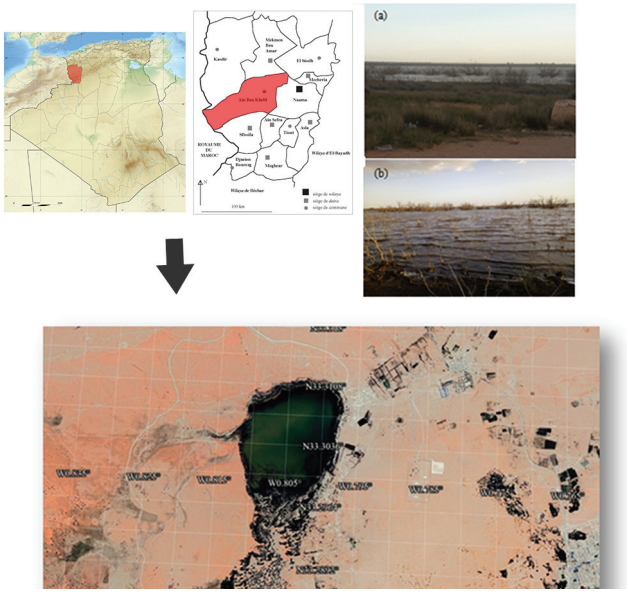



**Fig. 1.** General views of Oglat Eddaira (Ain Ben Khlil) wetland: (a) oriental sector, (b) western sector (photos taken on 29 March 2019 by Houhamdi M.); (c) location map of Oglat Eddaira (Ain Ben Khlil) wetland.

## Results and discussion

### *Evolution of population (bird number)*

Ruddy shelduck exhibited similar abundance trends between 2017/2018, 2018/2019 and 2019/2020 within the study area. The species was found all year round, persisting at low numbers in mid-summer months (July–August), with a population ranging from 59 to 91 individuals. The numbers of ruddy shelduck began to increase from the first decade of September with the arrival of the wintering and breeding populations. High numbers of ruddy shelduck were mainly recorded between late January and early March (Fig. 2), confirming the results obtained in previous studies in Saharan wetland (Nouidjem et al., 2012; Bensaci et al., 2012, 2013). During the study period, the numbers of ruddy shelduck peaked at 234 birds in the last decade of January 2018 and 256 and 264 birds for 2019 and 2020, respectively, in the first decade of March (Fig. 2). This increase in number is observed among all wintering and breeding Anatidae birds of Mediterranean wetlands (Tamisier, Dehorter, 1999; Houhamdi, 2002; Houhamdi, Samraoui, 2002). This species is often solitary. It is mainly observed as small groups and rarely associated with other bird species. The birds occupy the banks and edges (muddy places) of lakes, but during the mid-days, they cross the lake without stopping. The ruddy shelduck, which is a species sensitive to variation in water depth, does not change its number according to variation in water depth in this region, unlike the ones in the wetlands in the arid and semi-arid regions of Algeria (Nouidjem et al., 2015; Bounab et al., 2017). The ruddy shelduck is an often solitary species and does not mix too much with other Anatidae

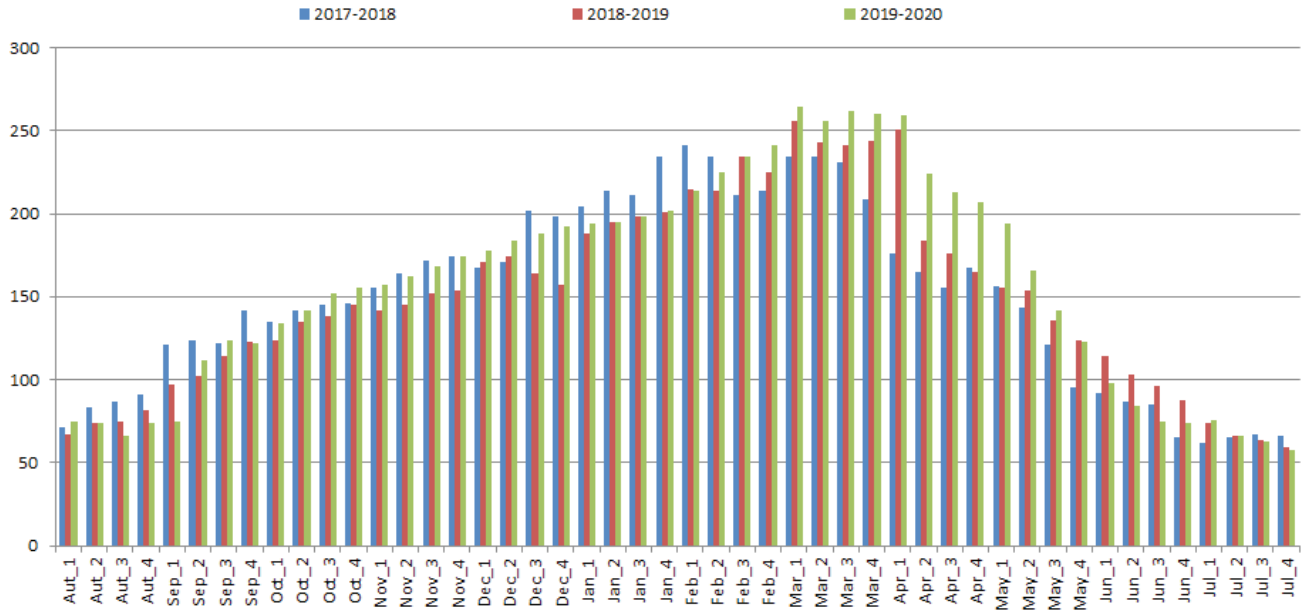



**Fig. 2.** Evolution of the abundance of ruddy shelduck *Tadorna ferruginea* at Oglat Eddaira (Ain Ben Khlil) in 2017/2018 (blue), 2018/2019 (red) and 2019/2020 (green).
Notes: 01 – first week of the month; 02 –second week of the month; 03 – third week of the month; 04 – fourth week of the month.

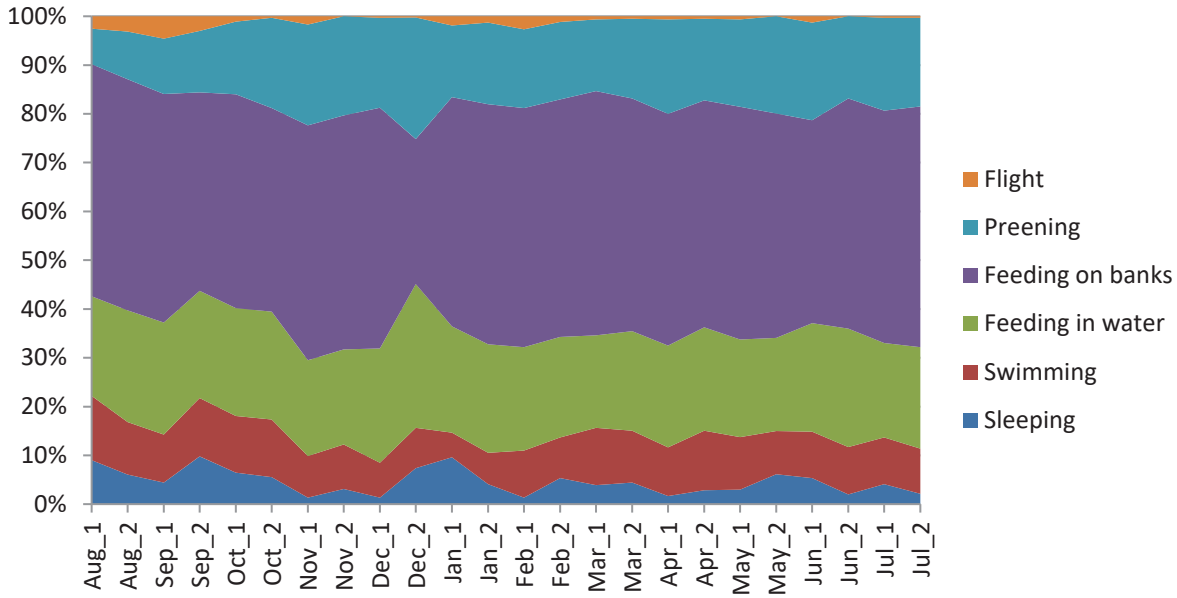



**Fig. 3.** Balance sheet of diurnal rhythm activities of ruddy shelduck *Tadorna ferruginea* at Oglat Eddaira (Ain Ben Khlil) in 2017/2018, 2018/2019 and 2019/2020.

species on the site, except with the mallard duck if it is present in the site. The mallard duck is rare in the region.

### *Study of diurnal behaviour*

After 3 years of weekly monitoring of diurnal behaviour of ruddy shelduck from 8 am to 5 pm at the lake of Oglat Eddaira (Ain Ben Khlil), the obtained results showed that the budget time was dominated by feeding activity (feeding on banks and feeding in water), which gave a value more than 68%. The second diurnal activity was preening activity with 16.77%, followed by swimming (9.85%), sleeping activity (4.67%) and, finally, flying activity which showed the lowest value of the budget time (1.22%) (Fig. 3).

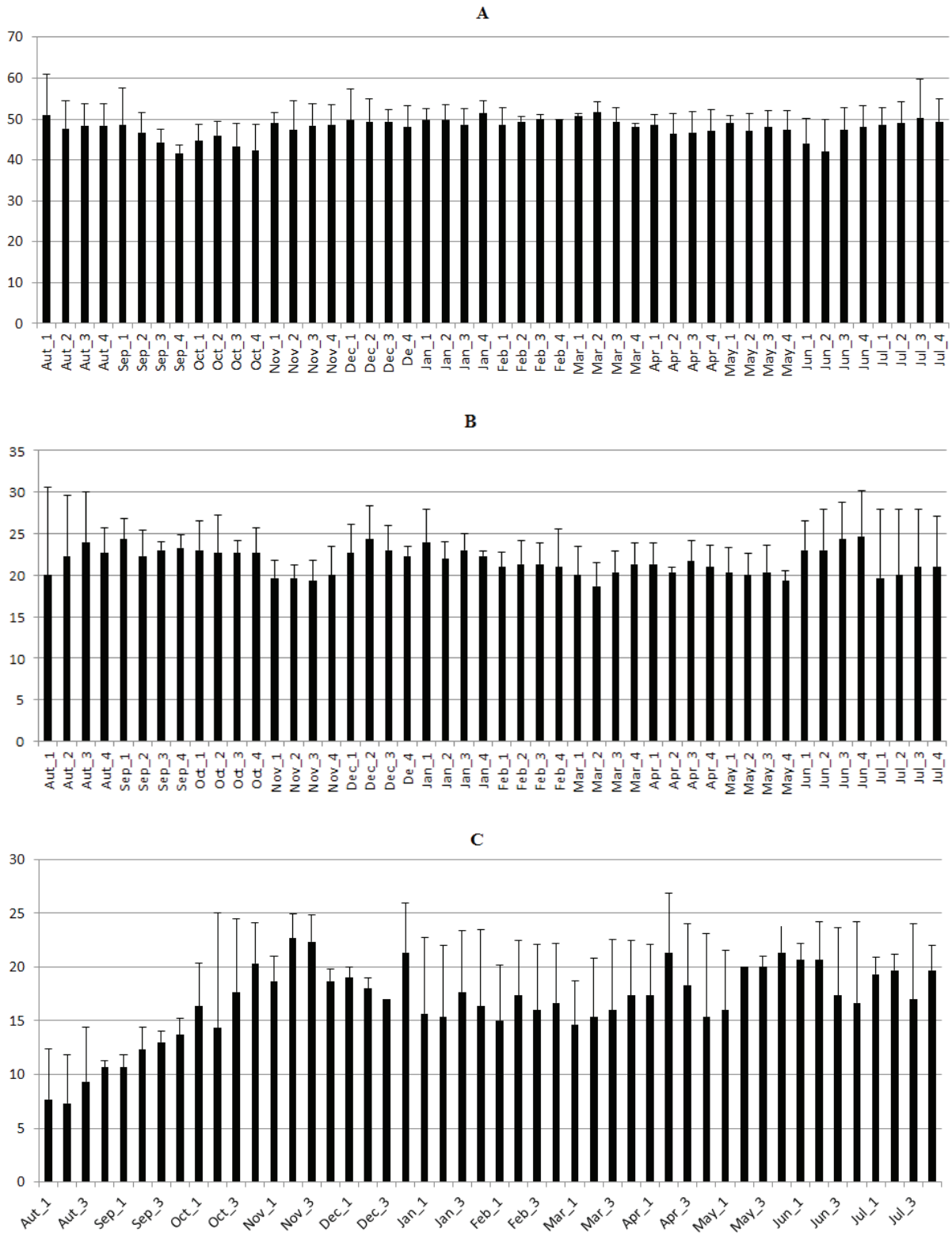



**Fig. 4.** Evolution of diurnal activity patterns of ruddy shelduck *Tadorna ferruginea* at Oglat Eddaira (Ain Ben Khlil) wetland during 2017/2018, 2018/2019 and 2019/2020. A: feeding on banks; B: feeding in water; C: preening.
Notes: 01 – first week of the month; 02 – second week of the month; 03 – third week of the month; 04 – fourth week of the month.

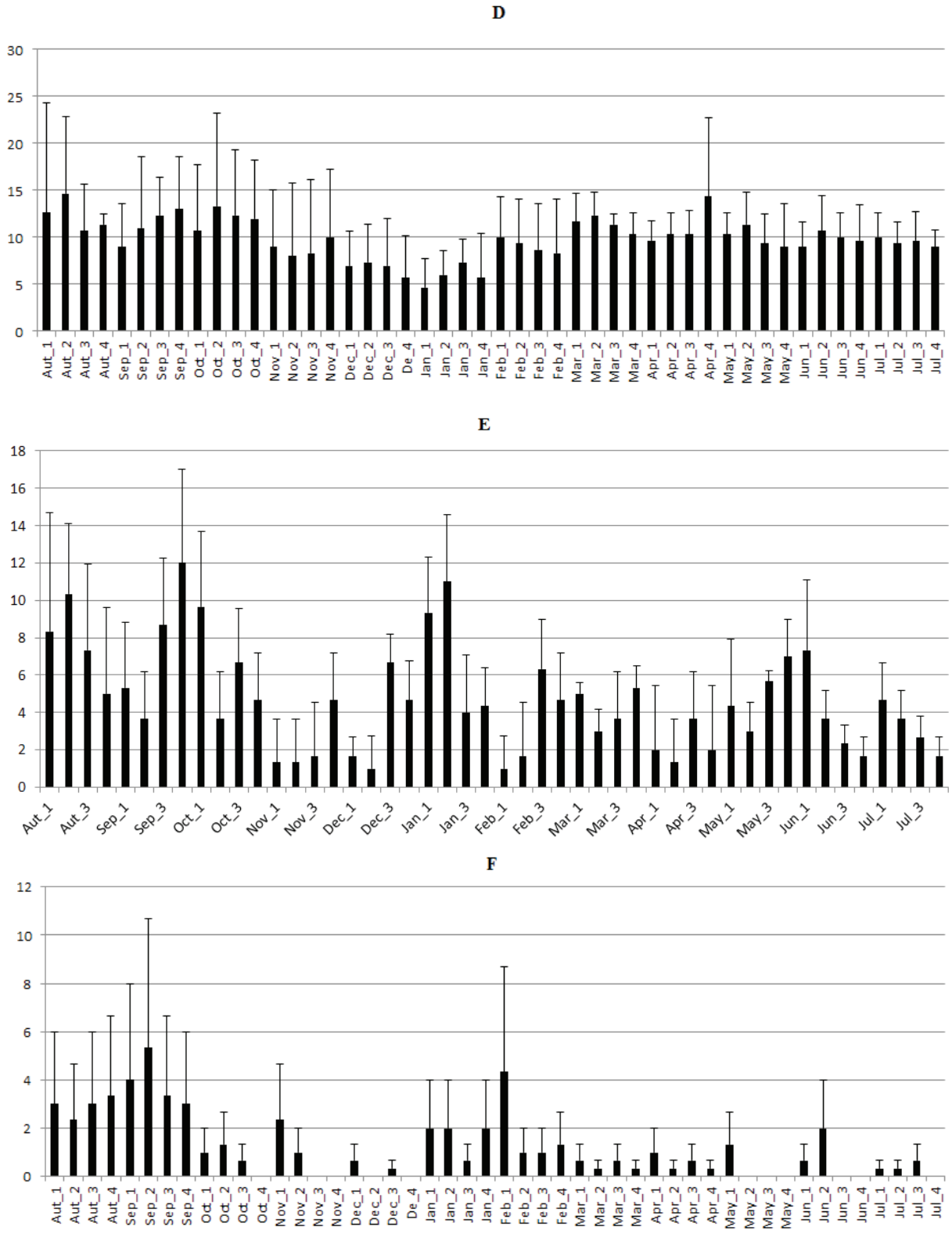



**Fig. 4.** Evolution of diurnal activity patterns of ruddy shelduck *Tadorna ferruginea* at Oglat Eddaira (Ain Ben Khlil) wetland during 2017/2018, 2018/2019 and 2019/2020. C: preening; D: swimming; E: sleeping; F: flight.
Notes: 01 – first week of the month; 02 – second week of the month; 03 – third week of the month; 04 – fourth week of the month.

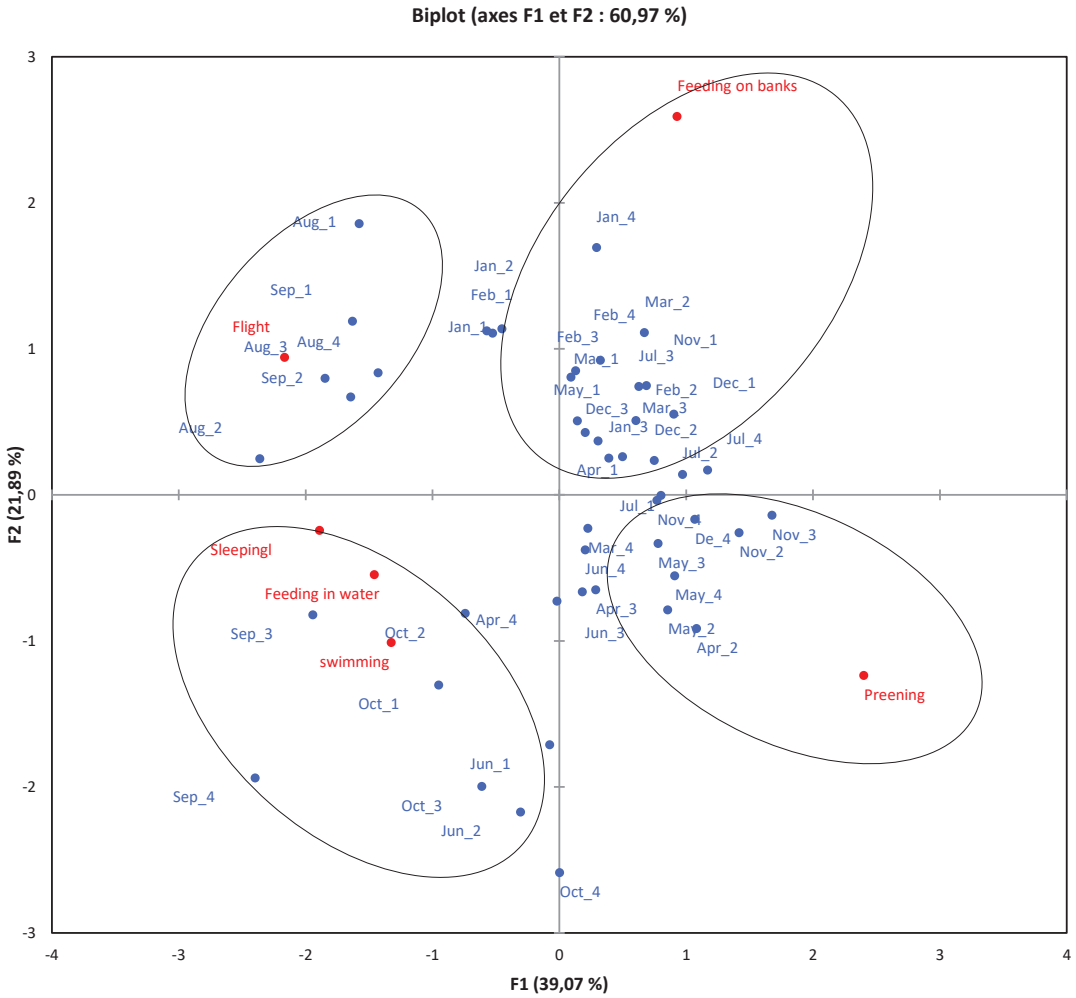



**Fig. 5.** Analysis (CA) factorial plan 1 × 2 of diurnal rhythms of activities of ruddy shelduck *Tadorna ferruginea* at Oglat Eddaira (Ain Ben Khlil) wetland during 2017/2018, 2018/2019 and 2019/2020.
Notes: 01 – first week of the month; 02 – second week of the month; 03 – third week of the month; 04 – fourth week of the month.

Feeding is an essential activity for all Anatidae species (Tamisier, Dehorter, 1999; Houhamdi, 2002; Houhamdi, Samraoui, 2002; Boulekhssaim et al., 2006; Charchar et al., 2016). At the lake of Oglat Eddaira (Ain Ben Khlil), ruddy shelduck was foraging in different ways, either by filtering the mud from the water or walking on the banks or by swimming in deep regions (25–45 cm) (Khafou et al., 2013). Its diet depends mainly on Crustaceans such as Hydrobia and Artemia (Chadenas, 2003). Thus, during the study period and far from the breeding season, ruddy shelduck birds spent most of their time foraging (Figures). These birds eat differently during the day. Unlike the results obtained by Boulekhssaim et al. (2013), Khafou (2014), Nuidjem (2014) and Bounab (2018) at the wetlands of Sahara, high plateaus of eastern Algeria and wetlands of Morocco, most of this activity was observed on banks along the day (47.88%) in this wetland. The evolution rate of this activity showed a stable pattern, where the maximum rate was recorded during mid-March (51.33%) and the minimum rate during the following month (42%) in June (Fig. 4A). In water, this activity was observed with an average rate equivalent to 21.69% (Fig. 4B). This activity is often observed at mid-day (11 am and 3 pm), where most birds are gathered in the water body and start to eat; its rates vary little and display a more or less stable graph. The maximum rate recorded is around 24.33%–24.66% during mid-November and end of June.

Preening activity and maintenance of the plumage are observed mainly in water and rarely on the banks. At Oglat Eddaira, ruddy shelduck exhibited an average rate of preening of around 16.67% (Fig. 3). The graph of this activity shows remarkable variation during the study period, with increases and decreases observed throughout our period of monitoring. The maximum recorded for this activity was 22.66% at the end of November (Fig. 4C). It should be noted that during daytime, the highest rates were observed during the early mornings. These rates gradually decreased during the course of the day.

Swimming is often accompanied with other activities such as feeding, sleeping and courtship. But it occurs mainly when changing location and to avoid drift induced by wind and waves,

where it manifests in a collective manner (Tamisier, Dehorter, 1999). The maximum rate recorded for this activity was around 14.66% during mid-August (Fig. 4D). The graph shows a gradual decrease over time between August and January, and then it returns to show an increase again between the end of January until the end of April (Figure). Rates appear to increase towards the end of the wintering season. Overall, ruddy shelduck exhibited a general rate of swimming estimated at 9.85% (Fig. 4C). This activity is often observed at mid-day associated with the activity of swimming.

Unlike other Anatidae, where sleeping is an essential activity (Tamisier, Dehorter, 1999; Houhamdi, 2001, 2003, 2007; Houhamdi et al., 2008, 2009; Merzoug et al., 2014; Charchar et al., 2016, 2019; Bouchaala et al., 2017), this activity occupied the fifth position in the diurnal budget time of ruddy shelduck at Oglat Eddaira with a rate of 4.67%. The evolution rates of this activity over time and throughout the study period show a sawtooth pace, exhibiting several peaks (Fig. 4E), the maximum of which was recorded during the start of the study during the month of September (12%). In general, this activity was observed much more during the mid-day and showed decreasing rates during the day. This activity was observed preferentially in water.

The flight was found with the lowest rate (1.22%) in this diurnal time budget. Its evolution over time showed a variable pace. The first period noted between August and December was characterised by rates ranging from 0% to 5.33%, where we recorded the maximum rate, or 5.33% during mid-September, and the second period noted between December and July showed rates varying between 0% and 4.33%, with the maximum recorded at the beginning of February (Fig. 4F). This activity was mainly observed during early mornings. These flights mainly concerned changing place and grouping flights of birds in water body. The flights observed in the afternoons were often caused by disturbances (humans and animals) or occurred following the flight of other birds belonging to other avian species, mainly Anatidae, which are known for their fierce character, between August and September. It often occurred as a result of disturbances by diurnal raptors or after the flight of another species of Anatidae.

This study on the daytime activities of ruddy shelduck at Oglat Eddaira showed a significant difference compared to the studies reported by Boulekhssaim et al. (2013), Khafou (2014), Nuidjem (2014) and Bounab (2018) at the wetlands of Sahara, high plateaus of eastern Algeria and wetlands of Morocco, where ruddy shelduck allocates an important part of its daytime budget to sleeping and resting. These variations in the rates of diurnal activity are explained by differences in local conditions, including food availability and distribution, abiotic factors such as water temperature (thermoregulation) and biotic factors such as predation and intra and interspecific competition.

### *Multivariate statistical treatment of diurnal activity rhythms*

The correspondence analysis represents 60.97% of the information (Fig. 5) and shows that the diurnal behaviour of the ruddy shelduck at Oglat Eddaira (Ain Ben Khlil) wetland is subdivided into more or less distinct four groups:

The first group represented by the dominant activity which is riverbank feeding, recorded with high rates during our monitoring, generally characterises the period between January to July (Fig. 5). During this period, the water level of the lake, where the bird allocates most of its time to eating on banks, rises as a result of rain. These results corroborate with the results of subsequent studies carried out by Nouidjem (2014), Khaffou (2014) and Bounab (2018) and confirm the sensitivity of ruddy shelduck to deep water.

The second group is represented by preening. During the month of November, it generally characterises new arrivals to the lake that have to change their damaged feathers after a long migration. Between the months of May and June and in sunny days, the bird is observed to be carefully preening its feather on the shores of the lake.

The third group comprises feeding in water, sleeping and swimming (Fig. 5). These three activities are recorded during the months of October–September, during wintering period, which is characterised by arrival of the migratory population, where feeding and sleeping in water represents the best means of recovery and conservation of energy, and during April–June period of reproduction when the bird begins to seek its partner and construct its nest. These activities are also observed during the mid-day period.

Finally, the last group represented by flight was observed with low rates during our monitoring. This activity also characterises the first arrivals at the lake (August–September), where we observed positioning flights or group changes.

The correspondence analysis also shows that the feeding activity is associated with swimming. This allows birds to feed on the surface of water in areas cleared of all vegetation and away from other ducks occupying the same areas of the wetland (Fig. 5).

## Conclusion

Like all water bodies in the region (Sahara), Oglat Eddaira (Ain Ben Khlil) is a very suitable diurnal grazing ground for rudy shelduck and for many other species of Anatidae. This diurnal fattening is noted at the beginning of the mornings on the banks of the lake and as the day passes on, the ruddy shelduck *T. ferruginea* enters water and continues to feed either by tilting or dipping its head or only its beak.

These results, collected over three consecutive years of monitoring, however, provide new information concerning the diurnal behaviour of Anatidae. But we believe that it would be preferable to determine the ecological role and functioning of this continental aquatic ecosystem over several years (wintering and reproduction) and bring together the work on all species of Anatidae as it is necessary for handing over and/or restoring this wetland.

## References

Amor Abda, W., Merzoug, S., Belhamra, M. & Houhamdi M. (2015). Phenology and diurnal behaviour of the Northern Shoveler *Anas clypeata*in the Guerbes- Sanhadja wetland complex (north-eastern Algeria). *Zoology and Ecology*, 25(1), 19–25. DOI: 10.1080/21658005.2014.994361.

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* (pp. 23–26). Minneapolis: University of Minnesota Press.

Bensaci, E., Saheb, M., Cherief-Bouteraa, N., Cherief, A., Qninba, A. & Houhamdi M. (2012). Un second cas de nidification de la Mouette rieuse *Chroicocephalus ridibundus* en Algérie. *Alauda,* 80(2), 153–154.

Bensaci, E., Saheb, M., Nouidjem, Y., Bouzegag, A. & Houhamdi M. (2013). Biodiversité de l'avifaune aquatique des zones humides sahariennes: Cas d'Oued Righ (Algérie). *Physio Géo*, 7, 31–42. DOI: 10.4000/physio-geo.3198.

Bird Life International (2015). *European Red list assessment*. Ruddy Shelduck (*Tadorna ferruginea* Pallas, 1764). http://www.birdlife.org.

Blondel, J. (1975). Analysis of populations of water birds. Element of ecological diagnosis. I: Progressive sampling method frequency (EFP). *Rev. Ecol.-Terre Vie*, 29, 533–589.

Bouchaala, L., Charchar, N., Boukhemza, M. & Houhamdi M. (2017). Behavior and phenology of Wigeon *Anas penelope* in the Garaet of Hadj-Tahar (Skikda, Northeast of Algeria), Algeria. *Journal of Entomology and Zoology Studies*, 5(2), 361–364.

Boulkhssaim, M., Houhamdi, M. & Samraoui B. (2006). Status and diurnal behavior of the Shelduck *Tadorna tadorna* in the Hauts Plateaux, northeast Algeria. *Wildfowl,* 56, 65–78.

Bounab, C. (2018). *Phénologie et structure des Tadornes (Tadorne de Belon et Tadorne casarca) dans le Chott El-Hodna (wilaya de M'sila, Algérie)*. Thèse de Doctorat, Université Djillali Liabes de Sidi Bel abbes, Algeria.

Chadenas, C**.** (2003). *L'homme et l'oiseau sur les littoraux d'Europe occidentale: Appropriation de l'espace et enjeux territoriaux: vers une gestion durable*. Thèse Doctorat, Université de Nantes, France.

Charchar, N., Boucaala, L., Belhamra, M. & Houhamdi M. (2016). Diurnal time budget of wintering Teal *Anas crecca crecca* (Anatidae) at GaraetHadj-Tahar (Skikda) Northeast Algeria. *Journal of Entomology and Zoology Studies*, 5(1), 540–545.

Charchar, N., Bouchaâla, L. & Houhamdi M. (2019). Phenology and diurnal behavior of marbled duck *Marmaronetta angustirostris* in the ecocomplex of wetlands of Guerbes Sahhadja North-east of Algeria. *Ecol. Mediterr.*, 45(2), 35–43. DOI: 10.3406/ecmed.2019.2087.

Cramp, S. & Simmons K.E.L. (1986). *Handbook of the birds of Europe, the Middle East and North Africa.Vol. 1: Ostrich to ducks*. Oxford: Oxford University Press.

Green, A.J., El Hamzaoui, M., El Agbani, M.A. & Franchimont J. (2002). The conservation status of Moroccan wetlands with particular reference to waterbirds and to changes since 1978. *Biol. Conserv.,* 104, 71–82. DOI: 10.1016/S0006-3207(01)00155-0.

Heinzel, H., Fitter, R.S.R. & Parslow J.L.F. (1974). *The Birds of Britain and Europe: with North Africa and the Middle East*. London: Collins.

Houhamdi, M. (2002). *Ecology of avian populations of Lac des Oiseaux (oriental Numidia)*. Doctoral thesis, University of Badji Mokhtar, Annaba, (Algeria).

Houhamdi, M., Maazi, M.C., Seddik, S., Bouaguel, L., Bougoudjil, S. & Saheb M. (2009). Status and ecology of the White-headed duck *Oxyura leucocephala* in the wetlands of the high plains of eastern Algeria. *Aves,* 1, 129–148.

Houhamdi, M. & Samrauoi B. (2001). Diurnal behavior of common teal *Anas crecca* at lac des Oiseaux, northest Algeria. *Ardeola,* 55(1), 59–69.

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

Houhamdi, M. & Samraoui B. (2003). Diurnal behavior of wintering Wigeon *Anas penelope* at Lac des Oiseaux, Northeast Algeria. *Wildfowl,* 54, 51–62.

Houhamdi, M. & Samraoui B. (2007). Diurnal and nocturnal behaviour of ferruginous duck *Aythya nyroca* at Lac des Oiseaux, Northeast Algeria. *Ostrich – Journal of African Ornithology*, 78(2), 510.

Isenmann, P. & Moali A. (2000). *Les oiseaux d'Algérie/ Birds of Algeria*. Paris: SEOF.

Khaffou, M. (2014). *Biologie et écologie du Tadorne casarca Tadorna ferruginea (Pallas, 1764) dans la Zone Humide d'Aguelmam Sidi Ali (Site Ramsar – Moyen Atlas – Maroc) en vue d'une Gestion Durable du Site*. Thèse de Doctorat, Université Moulay Ismail, Maroc.

Khaffou, M., Chahlaoui, A.K. & Samih M. (2013). Les habitats utilisés par le Tadorne casarca (*Tadorna ferruginea)* dans la zone humide d'Aguelmam Sidi Ali – Site Ramsar – Moyen Atlas – Morroco. *International Journal of Biological and Chemical Sciences*, 7(2), 598–606. DOI: 10.4314/ijbcs.v7i2.16.

Losito, M.P., Mirarchi, E. & Baldassare G.A. (1989). New techniques for timing activity studies of avian flocks in view-restricted habitats. *J. Field Ornithol.,* 60, 388–396.

Luo, Z.K., Wen, H.Z., Ying, H., Xing, Y.L., Wen, L. & Zhen J.L. (2013). Seasonal dynamics and habitat selection of Ruddy Shelduck (*Tadorna ferruginea*) (Anseriformes: Anatidae) in Alpine Wetland Ecosystem of Southwest China. *Acta Zool. Bulg.,* 65(4), 469–478.

Mackinnon, J., Phillipps, K. & He F.Q. (2000). *A field guide to the birds of China*. Changsha: Hunan Education Press.

Madge, S. & Burn S. (1988). *Wildfowl*. London: Christopher Helm.

Merzoug, S.E., Amor Abda, W., Belhamra, M. & Houhamdi M. (2014). Eco-ethology of the wintering ferruginous duck *Aythya nyroca* (Anatidae) in Garaet Hadj Tahar (Guerbes-Sanhadja, Northeast of Algeria). *Zoology and Ecology,* 4, 297–304. DOI: 10.1080/21658005.2014.953800.

Migoya, R., Baldassarre, G.A. & Losito M.P. (1994). Diurnal activity budgets and habitat functions of northern Pintail *Anas acuta* wintering in Sinaloa, Mexico. *Wildfowl,* 45, 134–146.

Nouidjem, Y. (2014). *Stationnement et étude écologique du Tadorne casarca, Tadorna ferruginea dans les écosystèmes aquatiques de la Vallée d'Oued Righ (Sahara Algérien)*. Thèse de Doctorat, Université d'Oum El-Bouaghi, Oum El-Bouaghi, Algeria.

Nouidjem, Y., Saheb, M., Bensaci, E., Bouzegag, A., Guergueb, Y. & Houhamdi M. (2015). Habitat use and distribution of the Ruddy Shelduck *Tadorna ferruginea* in the wetland complex of Oued Righ (Algerian Sahara). *Zoology and Ecology,* 25(1), 26–33. DOI: 10.1080/21658005.2014.997995.

Nouidjem, Y., Saheb, M., Mayache, B., Bensaci, E., Bouzegag, A. & Maazi M.C. (2012). Le Tadorne casarca *Tadorna ferruginea* dans la Vallée de Oued Righ (Sahara Algérien). *Alauda,* 80(4), 301–306.

Samraoui, F., Alfarhan, A.H., Al-Rasheid, K.A.S. & Samraoui B. (2011). An appraisal of the status and distribution of waterbirds of Algeria: indicators of global changes? *Ardeola,* 58, 137–163. DOI: 10.13157/arla.58.1.2011.137.

Shurulinkov, P., Daskalova, G., Popov, K., Dalakchieva, S., Tzonev, R., Dimchev, I. & Ralev A. (2020). Recent changes in the presence status and numbers of ruddy shelduck (*Tadorna ferruginea*) in the Eastern Balkans. *Historia Naturalis Bulgarica,* 41, 41–49. DOI : 10.48027/hnb.41.06001.

Smart, M., Essghaier, M., Etayeh, K., Hamza, A., Azafzaf, H., Baccetti, N., Defos du Rau, P. & Dlensi H. (2005). Wetlands and wintering waterbirds in Libya, January 2005 and 2006. *Wildfowl,* 56, 172–191.

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

Wetlands International (2017). *Waterbird population estimates*. wpe.http://wpe.wetlands. org.