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Breeding ecology of the northern shoveller (*Spatula clypeata*) in Tiffech Lake (Souk Ahras, Northeastern Algeria)

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Breeding ecology of the northern shoveller (*Spatula clypeata*) in Tiffech Lake (Souk Ahras, North-eastern Algeria). – Acta Mus. Siles. Sci. Natur., 71: 97-104, 2022.

Abstract: The breeding behavior of Northern Shoveler (*Spatula clypeata*) was studied from January 2019 to March 2021 in Tiffech lake, an artificial wetland, in Souk Ahras Province, Northeastern Algeria. On this ecosystem, egg-laying occurred from earlier January to mid-March. In this study, there was a positive correlation between the egg-laying period and the number of active nests. The mean incubation period was 36.0 days. Clutches started later in the season and had a shorter incubation duration than early clutches. Hatching success amounted to 79.2% (n= 52 nests) and hatching success from eggs 37.6. In this study we measured water depth to control differences in habitats availability for the species, we speculate that differences in food abundance, water depth, and behavioral strategies during the breeding season collectively influence the selection of breeding habitat.

Key words: Northern Shoveler, Tiffech lake, Northeastern Algeria, Egg-laying period, Water depth.

Introduction

The preferences of waterfowl regarding breeding sites vary according to several factors such as food availability (Safine & Lindberg 2008) , breeding sites (Holopainen *et al*. 2015), intra, and interspecific competition, predation, parasitism, water depth, and anthropic activities. Knowledge of the breeding site selection is a key factor that reliably explains occupation over time (Bialas *et al*. 2019). Nest site selection may be reflected in the shape of preferred habitats in the immediate surroundings of the nest and may affect reproductive output (Janiszewski *et al*. 2013; Lack 1950). Therefore, understanding how water birds select nesting sites is of particular importance (Loucif *et al*. 2021). The quality of the habitat inevitably changes over time, thus, adaptability to these changes is a key issue in conservation biology (Tobolka *et al*. 2018). Anthropogenic changes in the environment generally influence nest site selection (Tryjanowski *et al*. 2000); however, for some bird species, natural events such as flooding, windstorms, and heavy rains affect not only breeding success but also the reoccupation rate (Tobolka *et al*. 2018).

The Northern Shoveler (*Anas clypeata*) is a widely distributed duck species in Africa, Asia, and Europe (Webster *et al*. 2002; Norris *et al*. 2004). Many studies have focused on the wintering habitat used by this species and not so much attention was paid to the breeding habitat selection for this species in Algeria (Loucif *et al*. 2021). Herein we present new data regarding habitat selection during the breeding season.

Addressing these aspects of the breeding biology of the Northern Shoveler duck is expected to contribute to better conservation strategies in order to increase species population in its breeding range. In order to facilitate conservation management of breeding biology of this species in Algeria wetlands, the current study was carried out to understand the influence of wetland characteristics on nesting site selection and reproduction parameters of this species at Tiffech lake an important wetland in Northeastern Algeria.

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Materials and methods

Study area

The study area was located at Tiffech lake (36°08. 513 N, 07°45. 417 E), northeast of Algeria. The area extension is 110 ha, with elevation ranging from 824 to 868m a. s. l. (Fig. 1). The region belongs to a sub humid climate, with an average annual temperature of 14.1°C and annual precipitation of 1.300 mm. There is a clear separation between the rainy and dry seasons.

The rainy season is from November to the following March when the water level reaches 24.6 m. The dry season usually lasts from April to July in the following year, with the water level fluctuating between 6 and 14 m (Boukrouma *et al*. 2018).

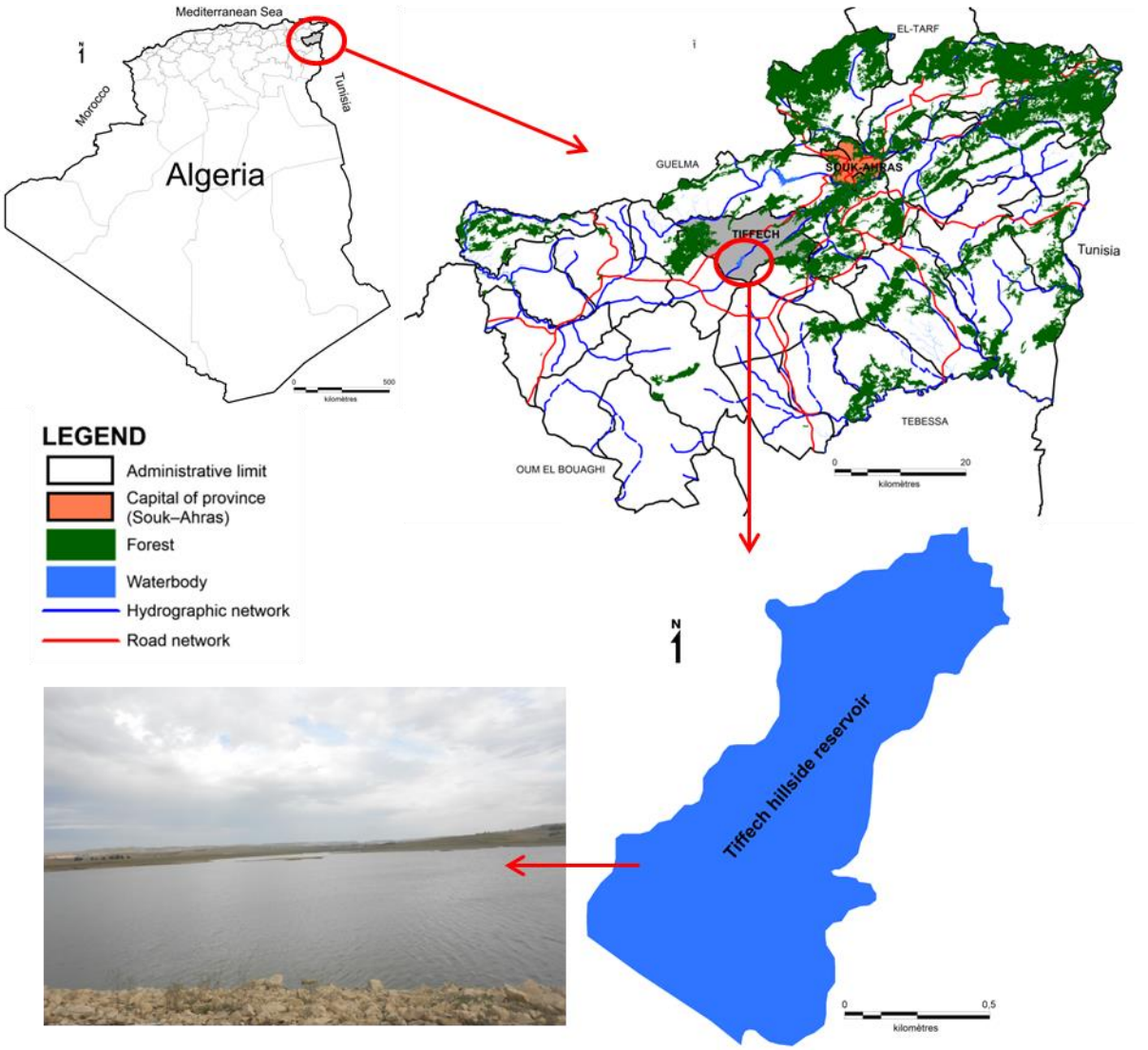


Fig 1: Geographical location of the study area (Touarfia 2022)

Nest monitoring

Surveys were carried out between early January 2019 to early March 2021. Surveys were conducted every two days from 08:00 to 12:00 and 13:30 to 18:30. Nests characteristics (external-internal diameters and water depth) were measured using a meter reel. Selection for water depth was modeled as a quadratic function (e.g., Bancroft *et al*. 2002; Russell *et al*. 2002) because wading birds do not use habitat with highly negative (below ground) or large values of depth.

Nest contents were monitored weekly and nesting success was assessed. Hatching rate was assessed until 20 days after hatching almost all the eggs were hatched. Eggs were also marked, weighed with a Pesola spring scale (Baar, Switzerland) and their length (mm) and width (mm) were measured with vernier calipers to the nearest 0.1mm. Egg volume was calculated as follows: Volume (cc) = (0.476 × length × width 2)/1000 (Gounter 1992).

The date when the first egg of a clutch was laid was considered as the laying date of a nest (Janiszewski *et al*. 2013). When nests were first recorded during incubation, the first egg was inferred from hatching dates assuming an incubation period of 22-23 days. Hatching success was estimated by the number of hatched eggs observed during the last survey before the nest was terminated. We recorded nest status as: (1) successful nests: if at least one hatched egg, (2) abandoned nests, when no activity is observed (the eggs were cold), or the egg disappeared before the expected hatching date, and (3) predated nests (eggs and chicks).

Statistical analysis

Descriptive statistics, given as arithmetic mean, standard error of the mean (SD), and (minimum-maximum), summarized each measured parameter collected during the surveys. Variables that did not meet the assumption of normality were transformed (square rooted) to meet parametric test requirements. The influence of water depth on the breeding of Northern Shoveller has been analyzed using Pearson correlation tests. All statistical tests were realized using the statistical software R (R core Team, 2016) out in the "Rcmdr" package.

Results

Characteristics of nests and eggs

During my search for active nests (containing at least one egg), 52 nests were located. The nests and egg's characteristics are listed in (Table 1). There was neither fresh plant material nor feathers within and around the nests, but sometimes a few small dry plants were observed.

Table 1: Nest characteristics and egg measurements of the Northern Shoveller in Tiffech lake, Souk Ahras, north-east Algeria

Nest characteristics [unit]	Min	Max	Mean ± S.D.
External diameter of nest (cm)	19.1 ± 0.02	29.1 ± 0.02	27.1 ± 0.02
Internal diameter of nest (cm)	09.1 ± 0.02	25.1 ± 0.02	18.5 ± 0.02
Water depth (m)	1.14 ± 0. 1	3.85±0.1	3.85±0.1
Nest depth [cm]	2.2 ± 0.1	4.2 ± 0.1	2.85 ± 0.1
Clutch size	0.1 ± 0.2	3.8 ± 0.2	2.9 ± 0.2 (225)
Egg length (mm)	28.5 ± 1.1	41.9 ± 1.1	48.9 ± 1.1
Egg width (mm)	28.0±1.6	25.0–1.6	26.0 ± 1.6
Egg volume (cm^3)	29.0±4.7	113.0–4.7	71.3 ± 4.7
Egg weight (g)	89.9 ± 5.8	48.9 ± 5.8	68.9 ± 5.8

Nesting chronology

The first pairs were observed on 2 January and the number of pairs increased in the following weeks until the beginning of June. The egg-laying period lasted 60 days; it began on 2 January and ended on 11 March but 50% of eggs were laid between 15 January and 22 February. There was a positive correlation between the egg-laying period and the number of active nests (Pearson correlation: $r^2= 0.582, F_{1,42}=1.369, P<0.001$) (Fig. 2).

The mean incubation period for the Northern Shoveler was 36.0 ± 1.0 (35-60 days, $n = 52$). Clutches started later in the season had shorter incubation duration than early clutches did (linear regression: $r^2 = 0.386$, $F_{1,42} = 6.756$, $p = 0.030$) (Fig. 3), whereas, there was no evident influence of clutch size (linear regression: $r2 = 0.0$, $F_{1,42} = 0.0$, $p = 2.0$) and eggs volume (linear regression: $r^2 = 0.002$, $F_{1,42} = 0.034$, $p = 0.896$) on the incubation period.

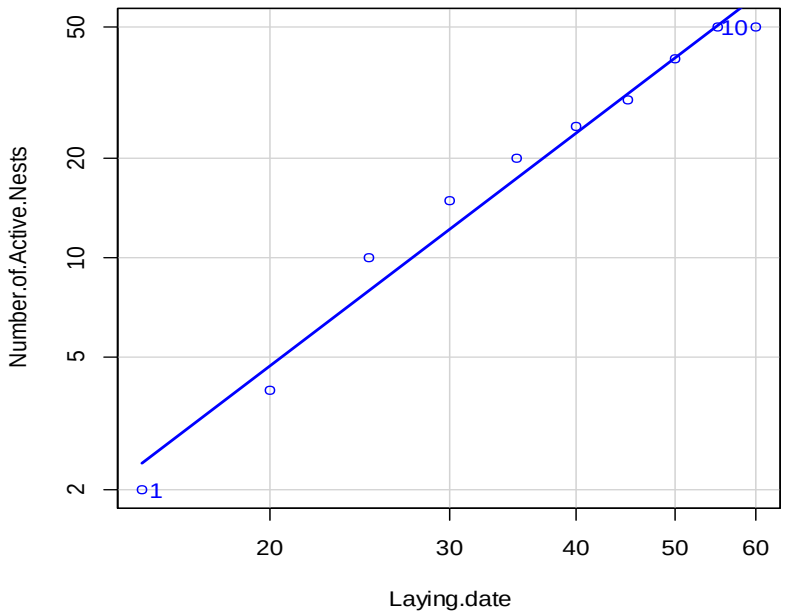


Fig 2: Correlation between egg laying date and number of active nests of the northern shoveller at Tiffech lake, northeast Algeria.

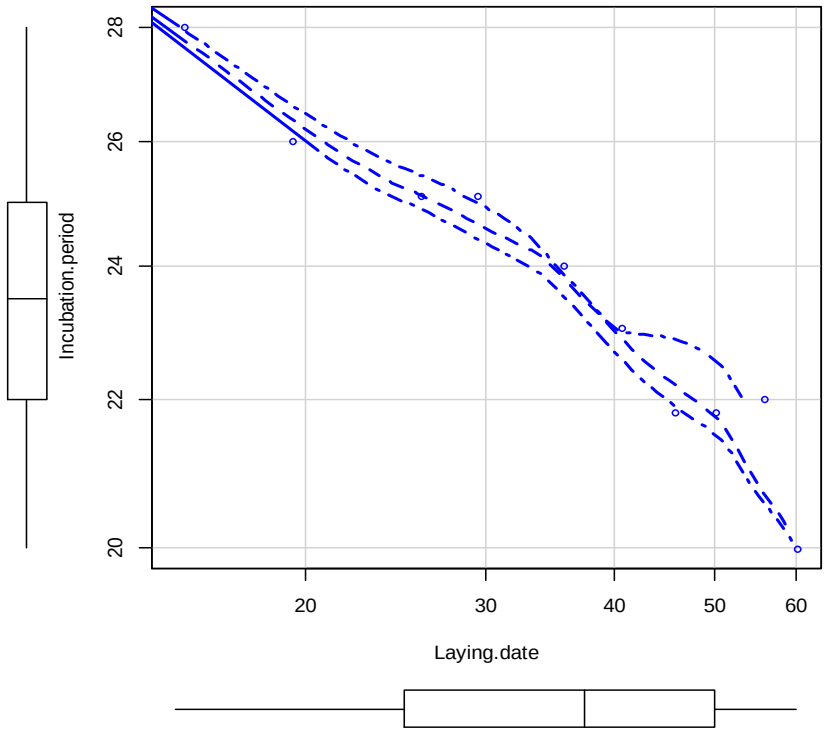


Fig 3: Correlation between egg-laying date and incubation period of the northern shoveller at Tiffech lake, northeast Algeria.

Distribution of the clutch size

Mean clutch size, hatching success, and chick productivity of Northern Shoveler are shown in Table 2. It ranged from 1 to 6 eggs/nest during the breeding season. There was also no apparent trade-off between clutch size and mean egg volume (Pearson correlation: r^2= 0.286, $F_{1,42}$ = 0.143, P>0.001).

The average number of eggs hatched per nest varied according to the nest location. Hatching success was 68.2%, breeding success from the egg was 37.6 %, and 52.7% of breeding success was from hatching (Table 2).

Influence of nest site parameters on clutch size

The Pearson correlation test revealed that water depth presented a significant effect on the variation in clutch size recorded per nest (Pearson correlation: r^2= 0.472, $F_{1,42}$=1.562, P<0.001) (Fig. 4).

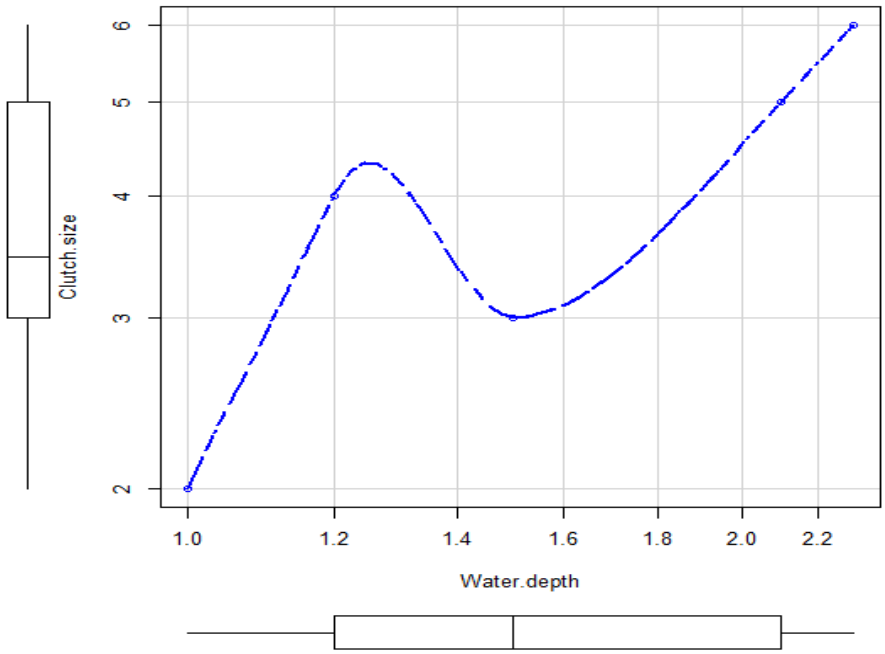


Fig 4: Correlation between water depth and clutch size of the northern shoveller at Tiffech lake, northeast Algeria

Nesting success

The 52 active nests determined that (79.2%) were successful and the remaining (20.8%) failed with 10% of which were deserted, 5.8% predated, 5% were found empty for unknown reasons.

Table 2: Breeding parameters of the Northern Shoveler in Tiffech lake, Souk Ahras, northeast Algeria

Parameters	Min	Max	Mean ± S.D.
Hatching success (%)	22.7	82.6	68.2 (182)
Breeding success from egg (%)	23.1	42.3	37.6 (46)
Breeding success from hatching (%)	19.8	72.6	52.7 (46)
Chick productivity	0.1 ± 0.7	2.6 ± 0.7	0.5 ± 0.7 (46)

Discussion

This is the first study focused on the breeding ecology of the Northern Shoveler in Tiffech lake, northeastern Algeria. Our results indicate that the species nests in sites that confer it to avoid predation by selecting habitats with height depth water and alternatively sites that have a good view of the surrounding area. The study findings were also close to those reported by Janiszewski *et al*. (2013) and Ross *et al*. (2016) in central Poland. Water depth is an important predictor of differential habitat selection in ducks (Gawlik 2002; Beerens 2011) and of relative reproductive success (Frederick and Spalding, 1994). The greater range of water depths used by shovelers could be explained by a combination of factors, including morphological adaptations (Powell 1987), broad diet (Smith1997), lower habitat specificity (Beerens 2008), and greater physiological tolerance (Herring 2008). The species showed higher selectivity for water depth during a good year than in a poor year, exercising a higher degree of specialization when conditions were more favorable and prey availability was high.

Results of nest diameter and egg dimensions were similar to those obtained by Ankney & Afton (1998) in southern Manitoba.

We recorded that the first eggs were laid in early January. This is later than the 10 October recorded in Marshes of Rochefort, France and earlier than the 18 February found in southern Manitoba. (Ankney & Afton 1988). Food supply, competition, nesting conditions, predation pressure, and climatic conditions are the factors known to influence the breeding time (Beerens 2008; Figuerola 2007). Anthony & Conover (2015), have reported that Shovelers may be breeding in winter, because these individuals may endure immediate costs of wintering in colder areas to benefit from early arrival or arrival in better condition to breeding grounds in the spring, generally to establish a territory (Yerkes *et al*. 2008). Previous research supports this hypothesis as shovelers have high breeding site territoriality (Olson & Trost 2012) making it important to reach breeding areas earlier in the spring than conspecifics to secure the best territories. All other factors being equal, shovelers that have shorter migration distances should arrive at the breeding grounds with higher lipid levels than shovelers with longer migration distances (Deceuninck *et al*. 1998). It is also reported that the beginning of the breeding season varies with latitude and altitude. It starts early in southern latitudes (Gil-Delgado & Catalá 1989) and late in high altitudes (Chabi & Isenmann 1997). Moreover, the breeding season in this study is markedly longer than that recorded in Marshes of Rochefort, France (Deceuninck *et al*. 1998). It may be speculated that the longer-laying period may be a different strategy employed by this population as an adaptation to local conditions, which is consistent with the reproductive restriction hypothesis at high altitudes of Bears *et al*. (2009).

One of our key findings is that number of active nests increase along with the growth of laying day. This finding support results obtained by Hebert & Wassennar (2001) of northern shoveller colony breeding in western Canada. The mean clutch sizes recorded in our study are within the range of those obtained by Hobaugh & Teer (1981). Our study revealed that there is no correlation between egg volume and clutch size in the northern shoveller.

Hatching success of northern shoveller at Tiffech lake was markedly higher (79.2%) than that reported by Loucif *et al*. (2021) (52,5%) in Lake Tonga, northeastern Algeria. Our findings showed that the Chick productivity of the northern shoveller was positively related to the water depth. Russell *et al*. 2002 reported that water depth can limit heat stress by minimizing exposure to the predator. Nest predation was significantly less during the incubation stage than in the nestling stage. Our results confirm the predictions of the parental activity hypothesis (Skutch 1949; Varela & Juana 1986), which states that nests may suffer higher predation rates during the nestling stage because of increased parental activity that brings adults far from the nest in search for food.

Conclusion

The present study shows that nest site selection and breeding success of the northern shoveller are influenced by water depth. This suggests that this species does not easily occupy any sites and thus confirms certain selective needs. Also, results show that water depth has a positive influence on clutch size and chick productivity in the northern shoveller. Although Tiffech lake wetland, is an important breeding area for the northern shoveller.

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