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BREEDING ECOLOGY OF THE PIED AVOCET, *RECURVIROSTRA AVOSETTA* (CHARADRIFORMES, RECURVIROSTIDAE) IN TIFFECH LAKE (SOUK AHRAS, NORTHEASTERN ALGERIA)

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Breeding Ecology of the Pied Avocet, *Recurvirostra avosetta* (Charadriiformes, Recurvirostridae), in Tiffech Lake (Souk Ahras, Northeastern Algeria). Boukrouma, N. — The Pied Avocet (*Recurvirostra avosetta* Linnaeus, 1758) is a sedentary species in Northeastern Algeria, although numbers present increase during spring and summer. Nesting occurs on the dikes and lakes placed at the different pools of the salt pans. In this study, the breeding ecology of the Pied Avocet was studied during the 2017 breeding season in Tiffech lake wetland (868 m in elevation), Northeastern Algeria. The Pied Avocets arrived at Tiffech Lake in early February and usually spent a few days in flocks before dispersing to set up territories. Egg-laying occurred from 11 April to 21 June, with two distinct peaks (last 15 days of April and May) and incubation period was 27.0 days. The present study indicates the expanded, breeding season. Clutch and egg size of this high-elevation population was comparable to lowland counterparts. Hatching success was 85.77 % and mean net productivity was 0.63 chicks per nest. Entire nest failure from human predation and sheep grazing was responsible for most egg losses.

Key words: breeding ecology, pied Avocet, high elevation, hatching success, nest failed.

Introduction

The Pied Avocet (*Recurvirostra avosetta* L.) has a large, breeding distribution throughout the Western Palearctic (Cramp & Simmons, 1983). Extensive studies on the nesting habitat and nest site selection of the species were carried out through their range (Cadbury & Olney, 1978; Hotker, 1998, 2000, 2005; Hotker & Segebaden, 2000), as well as detailed studies about nest site selection (Barati & Nouri, 2009). Different aspects of the breeding ecology of the species were investigated in both natural and semi-natural sites such as dry fishpond (Lengyel, 2006), saline habitats (Chokri & Selmi, 2011), marshes (Cuervo, 2004). In Algeria, there was only one study on some aspects of the breeding ecology of the species in Garaet Gellif (North-East of Algeria) (Saheb et al., 2009). Elevation has huge impacts on the development of bird life history characteristics (Lu, 2005, 2008; Boyle et al., 2015). Some researchers suggested that birds breeding at high altitude may invest less in reproduction (Lu, 2005, 2008; Lu, 2009; Lu et al., 2009, 2010 a, b). Avocets at our study area begin egg laying earlier and have longer breeding period than other populations and our population have high breeding success. Therefore, the objective of this study was to provide baseline information about the breeding ecology of the Pied Avocet in these high elevations.

Material and methods

Study area

The study was conducted at Tiffech Lake Wetland (36°08.513 N, 07°45.417 E), which is located 6 km southwest of Tiffech City, Souk Ahras Province, Northeastern Algeria. It has an area of 110 hectares, located at an altitude of 868 m; 40 % of its territory is covered with emergent vegetation, and the rest is covered with meadow vegetation (with a height of < 30 cm). The emergent vegetation consists of the Common Reed, *Phragmites communis* and Common Rush, *Juncus effuses* (Boukrouma, 2017) (fig.1).

Data collection

The monthly count of Pied Avocets on this lake was conducted from January to July 2017. The water birds also including Pied Avocet were counted by a minimum of two observers. The nests were marked with numbered flag, and nest site characteristics were described (cup depth (cm), distance from the nest to mainland and distance from the nest to the edge of water (cm). Measurements of eggs (length (mm) and width (g)) were made by using a caliper (to nearest 0.1 mm). The egg volumes were calculated using formula (Douglas, 1990): $V = K_v \times L \times W^2$, where $K_v = 0.5236 - (0.5236 \times 2 \times (L/W)/100)$, W = the breadth of egg (mm) and L = the length of egg (mm). Once a nest was located, it was inspected regularly (after every 1–3 days), and at each visit its contents were checked to ascertain its reproductive progress by determining the laying dates, hatching and fledging dates, clutch size, incubation period, fledging duration and nest success. For some clutches, where incubation already had begun or nestlings were hatched, egg-laying dates by back-dating from the reproductive parameters of other completed clutches was estimated. For this purpose, it was assumed that incubation began when the last egg was laid and it was estimated based on a 13-day incubation period (Hatchwell et al., 1996 b). The incubation period was calculated from 23 nests. Laying date was calculated, assumptive a giving frequency of one egg day. The clutch was considered complete when on two consecutive days no additional egg was laid (Lack, 1950). A nest was thought of as hatched if a minimum of one egg showed proof of hatching (one recently hatched chick within the nest or nearby) or proof of imminent hatching (cracked or trained eggshell) or once the date of egg disappearance matched with the date of expected hatching. The nest was thought of abandoned if the female was absent, the eggs were cold, and there has been no proof of female visiting the nest. Eggs that did not hatch were left within the nests. The nesting success was estimated by Mayfield's methodology (Mayfield, 1975).

Statistical analysis

All variables were checked for homoscedasticity using Levene's check and normality using Kolmogorov–Smirnov test. The linear regression used to test for seasonal modification in clutch size associate in incubation period using the Julian date as an independent variable. Statistical analyses were done using the software R(i3864.0.3) with a significance level of $P \leq 0.05$.



Fig.1. General view of Tiffech Lake, Algeria.

Results and discussion

Population status

The local group of Pied Avocets fluctuated from 55 adults at the end of February to 102 in June 2017. Between February and May there has been an increasing trend in the number of birds but they declined in June, disappearing in July. The number of breeding of Pied Avocets was estimated at about 24 pairs.

Nesting site

The overall number of nests in the colony was 26. The maximum number of simultaneously active nests was 23. Nests consisted of shallow approximately circular depression in the ground an average of 0.72 cm deep (0.12–3.1) and 14.5 cm of diameter (10–22). There was neither fragments of vegetation material nor feather at intervals and round the nests, however generally some little recent plants occurred (fig. 2). Nests were placed at a mean distance of 0.85 m to Mainland. Nesting occurred in places with a mean distance of 8.23 m to water edge (table 1). The distance to the water's edge increased as the breeding season progressed ($r^2 = 0.659$, $F_{1,12} = 189.120$, $p < 0.0005$).

Timing of breeding and incubation period

Egg laying took place from 11 April to 21 June, and showed two distinct peaks (second half's of April and May), indicating the existence of two laying wave. The second wave corresponds likely to replacement clutches, as the great majority of colonies initiated all through the first wave, especially large colonies (about 90 % of large colonies), failed due to predation. The mean incubation period for the Pied Avocet was 27.0 days. The incubation periods at the end of the breeding season were longer than in the beginning of the season ($r^2 = 0.895$, $F_{2,62} = 3.682$, $p = 0.023$) (fig. 3).



Fig. 2. Nest of the Pied Avocets with three eggs.

Egg dimensions and clutch size

There was no relationship between egg volume and both laying date ($r^2 = 0.001$, $F_{0,82} = 0.118$, $p = 0.514$) and clutch size ($r^2 = 0.003$, $F_{0,82} = 0.184$, $p = 0.369$). Clutch size varied from one to six eggs, with a mean of 4. Clutch size was five eggs (68 %), while nests with three eggs represented 20 %, and other clutch sizes

Table 1. Nest and egg measurements of the pied Avocets breeding at Barrage Tiffech, Algeria (2017)

No.	Parameter	Mean
1.	Nest diameter, cm	14.5
2.	Cup depth, cm	0.72
3.	Distance from the nest to Mainland, m	0.85
4.	Distance from the nest to the edge of water, m	8.23
5.	Length, mm	48.5
6.	Width, mm	28.9
7.	Mass, g	25.8
8.	Volume, mm ³	29.6

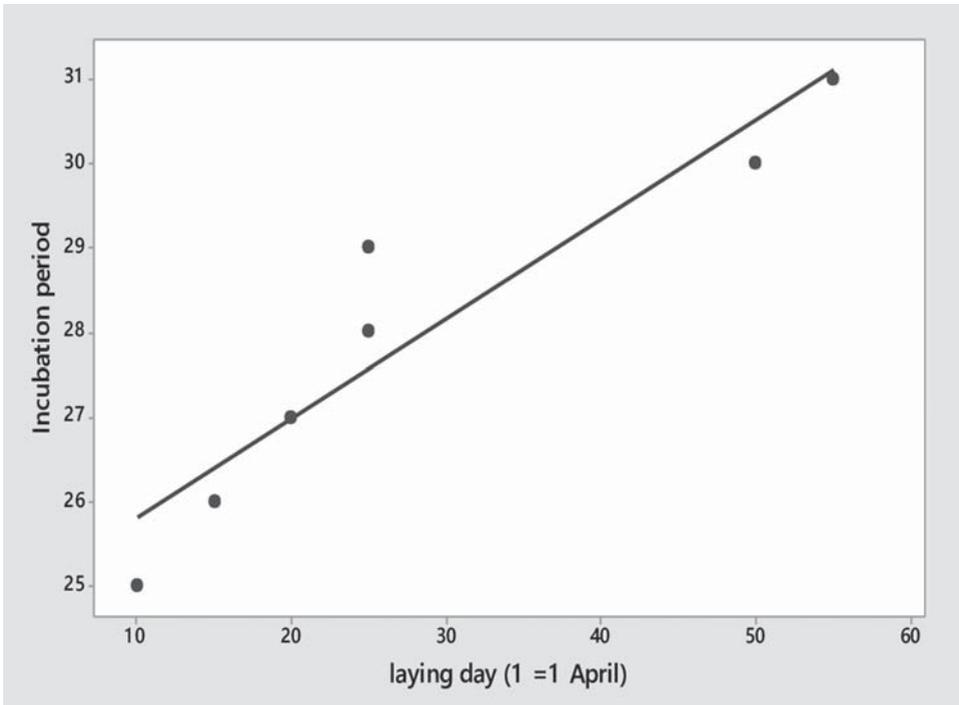


Fig. 3. Distribution of egg laying dates in Pied Avocet colony at Tifféch Lake during the 2017 breeding season (N 23).

did not exceed 12% in frequency. Clutch size increases significantly with the progress of the breeding season ($r^2 = 0.950$, $F_{0.62} = 1.88$, $p = 0.000$) (fig. 4).

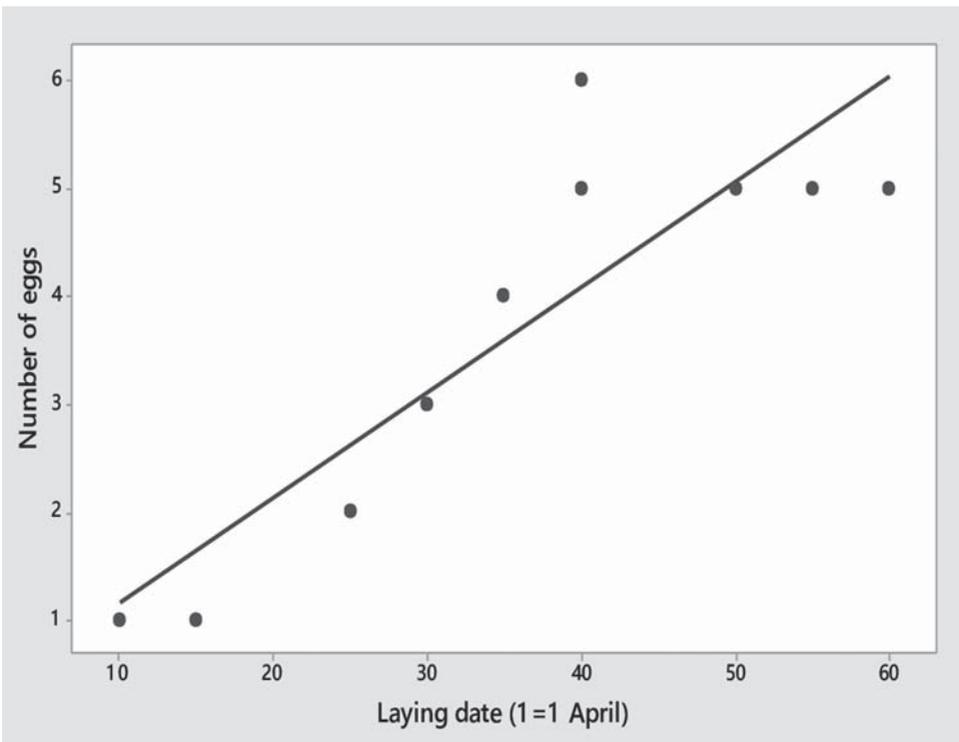


Fig. 4. Seasonal change of clutch size (N 23).

Breeding success

The hatching rate was 85.77 % with mean net productivity of 0.63 chicks per nesting attempt. The number of hatchlings did not vary as breeding season progressed. Total nest failures during incubation were 14.23 %. Hatching success did not vary significantly according to egg laying dates. The distance to the water's edge did not influence hatching success.

Discussion and conclusion

The number of Avocets varied during the study period and the drop in the number in early June coincided with the completely dry of the wetland, following a lack of precipitation in spring of 2017. The other factor affecting negatively the water table was the using of the water stock in agriculture activities around the lake. The mean clutch size, egg volume and incubation period on Tiffech lake agree with the range recorded in Pied Avocet populations in Hungary (Lengy, 2006), Tunisia (Chokri & Selmi, 2011) and Iran (Barati & Nouri, 2009). The seasonal grow in incubation period was not primarily due to climatic conditions. But instead, Avocets seemed to follow a strategy of increasing development time for late clutches in this high -elevation habitat. The start of the breeding season is influenced by weather conditions, food availability and altitude (Durant et al., 2007; Bensouilah et al., 2014; Bensouilah, 2015).

In present study late start of egg laying and the long-laying period may be a different strategy employed by this species as an adaptation to local conditions. New evidence shows the thigh-elevation species have a longer breeding period than birds at a low altitude (Lu et al., 2008; Boyle et al., 2015; Hille & Cooper, 2014). The Pied Avocets are known to incur high rate of clutches loss owing to predation and flooding, which are the main causes of breeding failure in many ground nesting species (Hotker & Segebade, 2000). Hatching success in this investigation was higher than in other Pied Avocets populations, 81 % in the Iberian Peninsula (Nogueira et al., 1996), 42–77 % on the Wadden Sea coast of Schleswig-Holstein, Germany (Hotker & Segebade, 2000).

In the present research, most failures in nesting tries came from drain of water and resulting increasing accessibility of nests. Some nests were abandoned for unknown reasons. The nest failures took place in the late periods of breeding season mainly because of increasing accessibility and consequent destruction of nests. The chick survival was low and mortality among chicks was frequently observed. Cuervo (2004) have reported that there are only two factors that appeared to affect hatching success to any degree were laying date and colony size, although in present study there was non-significant decline in hatching success as the season progressed (Arroyo, 2000). Regarding nest site characteristics, breeding pairs seem nest close to each other like other Avocet populations (Cuervo, 2004; Lengyl, 2006). The average distance to the edge of water are in the line with other studies, which suggest that low distance to the edge of water may provide high accessibility to food resources. (Barati & Nouri, 2009; Chokri & Selmi, 2011). The Pied Avocets nested in sparse and dense vegetation (Cuervo, 2004; Barati & Nouri, 2009). The present investigation contradicts these findings which show vegetation cover and in open habitats. Therefore, nest in exposed sites facilitate the early detection of predators.

The breeding biology of the Pied Avocets population in Tiffech Lake shows that this ecosystem can offer good-quality environmental conditions leading to high hatching success. This study should be followed by further investigations on all aspects of the species' breeding biology at Tiffech Lake and elsewhere in Algeria. These should cover the complete range of habitats and locations used by the species to identify the factors that influence hatching and fledging success. It will be especially valuable to establish whether high hatching success is generally characteristic of in land colonies. If this proves to be the case, conservation efforts might be focused on such colonies to enhance the status of the species in Algeria as a whole.

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