Breeding biology of Redshanks *Tringa totanus* in the Ebro Delta, NE Spain

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One of the main breeding populations of Redshanks in Spain is in the delta of the Ebro in Catalonia. The breeding biology of this population has not previously been studied. Between 1996 and 1999, the number and size of eggs, laying dates and nest-site selection, as well as the number of pairs were recorded. Number and size of the eggs were similar to other European populations. No significant differences were found in egg-volume between years. Laying took place between the end of April and the beginning of June. The mean laying date was 19 May. 90% of the nests were hidden among vegetation and 56% of these were among *Sarcocornia perennis* or *Arthrocnemum* sp. bushes.

Most Redshanks in the Ebro Delta breed in just one area of saltwater marshes (Canalot, Punta de la Banya). The conservation of this area is therefore important for the species' survival in this Mediterranean wetland.

INTRODUCTION

The Redshank *Tringa totanus* is a scarce breeding wader in Spain. One of its largest populations is found in Catalonia (Valle & Scarton 1996, Purroy & Sánchez 1997), where the only confirmed breeding site is the Ebro Delta (Muntaner *et al.* 1983). There, the number of pairs has varied from 12 (found during an almost total census in 1979), to 82 (in 1997) (Martínez Vilalta 1992, 1997/1998). Despite the importance of this population, the only information on its breeding biology concerns a single nest with three eggs found by Maluquer & Pons (1961) on Illa de Buda.

Here, I present data on egg-size, clutch-size, breeding phenology, habitat selection and abundance of Redshanks in the area of highest density in the Ebro Delta.

STUDY AREA AND METHODS

Data were collected on breeding Redshanks in two areas in the Ebro Delta: Punta de la Banya and Punta del Fangar. At Punta de la Banya, the population breeds mainly in the Canalot, an area formed by a group of islets covered by fruticose and therophytic halophilous vegetation (Curcó *et al.* 1995/1996). These islets are surrounded by seawater most of the year. The depth is usually less than 20 cm at high tide. The substrate is clayish, but at the highest parts of the islets it is sandy. At Punta del Fangar, Redshank pairs occupied a sandy islet, with psammophilic vegetation in the highest parts and halophilous plants in the lowest.

Data on breeding biology were gathered between the end of April and the beginning of July from 1996 to 1999. Although the area was visited each year from the end of February, nesting behaviour was observed only from the end of April. Most nests were found after observing the adult fleeing from a vegetated area and, later, searching exhaustively at that spot. Clutch-size, maximum length (L) and width (W) of eggs (to the nearest 0.01 mm), and the type of vegetation at the location were recorded for most of the nests. The volume (V in cm^3) of the eggs was calculated by applying the regression $V = 0.37698*L*W^2 + 3.283$, L and W in cm (Väisänen 1977). This made it possible to compare them to the results obtained by Väisänen (1977) for Europe-wide samples covering 17 sites.

In some cases, the same nest was visited repeatedly, in order to check that the clutch was complete and to determine the incubation period. The date on which the clutch was started is defined as the day when the first egg was laid. This date was determined for those nests found before the clutch was completed and was calculated from the mean incubation time for nests where newborn chicks were found.

To compare the volume of the eggs between years, analysis of variance was used with the mean value for each clutch as the dependent variable. Before analysis, the homocedasticity and normality of the samples was confirmed (Sokal & Rolf 1995). To describe habitat selection, the plant species where the nest was located were noted as well as the extent of their cover. Two categories of plant cover, determined from a top view of the nest, were used: exposed, when <25%; and hidden, when >25% (Amat *et al.* 1999).

RESULTS

Clutches

During the four years, a total of 35 nests were found at Punta de la Banya, with a mean clutch-size of 3.8 eggs (Table 1). The only nest at Punta del Fangar was found in 1998 and contained four eggs.

For biometric analysis, only the nests found at Punta de la Banya are considered. In clutches of three and four eggs,

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Table 1. Number of nests of Redshank according clutch size and year at the Ebro Delta.

Clutch Size	1996	1997	1998	1999	Total (%)
3	1	2	–	4	7 (19.4)
4	3	9	9	7	28 (77.8)
5	–	1	–	–	1 (2.8)
Total nests	4	12	9	11	36
Mean clutch-size	3.75	3.91	4	3.64	3.83

the size of the eggs was less variable within clutches than among them (ANOVA, $F_{5,12} = 5.751$, $p<0.001$ for clutches of three eggs; $F_{22,6} = 3.541$, $p<0.001$ for clutches of four eggs). Considering each nest as a unit, it was found that egg-volume did not vary between years (ANOVA $F_{3,26} = 1.935$, $p=0.15$; Table 2). In none of these years was a significant difference in egg-volume found between clutches of three and four eggs ($F_{1,27} = 0.133$, $p=0.91$).

Breeding phenology

In 1997, three nests were followed from the time that the eggs were laid until they hatched. These showed an incubation period of 24.7 days (SD = 2.1).

At 11 of the 36 nests found, it was possible to determine the laying date. Five of them were found before the clutch was complete; in the other six, the laying date was calculated by subtracting the incubating period of 25 days from the date that newborn chicks were found in the nest. Laying took place from 27 April to 8 June, and the mean laying date was 19 May (SD = 15.7).

Habitat selection

The nests were found on shallow islets covered by halophilous and/or psammophilous vegetation. Of the 36 nests, 20 (56%) were found among tufts of *Sarcorcornia perennis* or *Arthrocnemum* sp.; 8 (22%) among *Schoenus nigricans*; 1 (3%) among *Atriplex portulacoides*; 1 (3%) among *Suaeda vera*; and for 6 nests (17%) the habitat was not noted. Of the nests where vegetation was noted, 27 (90%) fell in the category "hidden" and only 3 (10%) were found in exposed sites.

Partial census of the breeding population in 1999

During June 1999, a census was carried out of the population that breeds in the Canalot area of Punta de la Banya where 66 pairs were found. In addition, at least one pair bred at Punta del Fangar.

DISCUSSION

Although the breeding population of Redshanks in the Ebro Delta is one of the most important in Spain (Valle & Scarton 1996; Purroy & Sanchez 1997), there has been no previous study of its reproductive biology.

The clutch-size most frequently found was four, similar to that reported in other studies (Dement'ev & Gladkov 1969; Cramp & Simmons 1983; Valle & D'Este 1994). The range in clutch-size, of 3–5 eggs, was also the same as that found by Fjeldsa (1977) and Cramp & Simmons (1983). Egg-size was within the normal range reported for this species (42–48 × 29–33 mm; Cramp & Simmons 1983). Egg-volume in the Ebro Delta was similar to that recorded by Väisänen (1977) for clutches in Spain (V = 20.09 SD = 0.92, n = 9; t = 1.358, $p>0.05$). The incubation period was also within the normal range of 22–25 days found in the former USSR (Dement'ev & Gladkov 1969) and 22–29 days in Europe (Cramp & Simmons 1983).

According to Väisänen (1977), the mean laying date in Spain is 30 April (n = 9; though the origin of the sample is not given), which is 19 days earlier than that found in the Ebro Delta population. Although the date given by Väisänen supports the idea that southern European populations breed earlier than central and northern ones, the laying date in the Ebro Delta resembles that of the populations of southern Scandinavia (see Figure 14 in Väisänen 1977). I have no explanation for this.

The census carried out in 1999 was incomplete, since only the Canalot area of Punta de la Banya was counted. However, it is likely this included most of the breeding population because this area supported 97% of the total number in the 1992 census and 89% in 1997 (Martínez Vilalta 1992, 1997/1998). There were only a few pairs in other parts of the Ebro Delta, such as Illa de Buda, La Tancada, Punta del Fangar and L'Encanyissada.

The Redshank is a scarce breeding species in the Ebro Delta and most of its population is limited to a small area of the Punta de la Banya. There, the habitat occupied comprises

Table 2. Biometrics of Redshank eggs at the Punta de la Banya, Ebro Delta, Spain (Mean ± SD; n = number of clutches).

Year	Volume (cm^3)	Length (mm)	Width (mm)	n
1996	19.558 ± 1.523	44.87 ± 066	30.99 ± 1.23	2
1997	19.961 ± 0.825	44.49 ± 1.13	31.52 ± 0.54	10
1998	19.930 ± 0.510	45.03 ± 0.95	31.31 ± 0.32	7
1999	19.305 ± 0.507	44.01 ± 0.88	31.07 ± 0.31	11
All years	19.687 ± 0.728	44.47 ± 1.02	31.27 ± 0.49	30

a group of small islands covered by a halophilous plant community. This used to be the most widespread habitat in the Ebro Delta before a major transformation of the landscape into rice-fields, which started at the beginning of the 20th century (Curcó *et al.* 1995/1996). The preservation of this remnant is vital if the Redshank is to be retained as a breeding species in this important Mediterranean wetland.

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