

SHORT REPORT

Timing of brood emergence in a duck community in Mediterranean Spain

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The majority of overland movements by duck broods occur in the first week after hatching, as they travel between nesting and brood-rearing areas.^{1,2} In this study, we use newly hatched broods falling into a canal when making overland movements to compare the breeding phenology of four duck species in Mediterranean Spain: Marbled Teal *Marmaronetta angustirostris*, Mallard *Anas platyrhynchos*, Red-crested Pochard *Netta rufina* and Pochard *Aythya ferina*. This is one of very few studies of ducks breeding in the Mediterranean region.³

Duck broods making overland movements fall into a 3-km section of a concrete-lined drainage canal (known as the Azarbe del Convenio) at El Hondo Natural Park (38°20'N 00°42'W), a wetland complex in southern Alicante province, eastern Spain.^{4,5} The canal is 4.5 m wide and 2.5 m deep with vertical walls, and ducklings are unable to get out. In 1994 and 1995, the canal was surveyed several times a day by the Consellería de Medi Ambient and the Sociedad Ornitológica *Marmaronetta*, and all broods were rescued.⁴ In 1994, this work did not begin until the last week in May, too late to record most Mallard and Red-crested Pochard broods. In 1995, surveys began at the end of April, and many broods of all four species were recorded.

Although precise data on the age of ducklings rescued were not taken, the great majority of broods were less than eight days old (class Ia⁶). Hence the timing of brood observations is an approximate measure of the emergence of broods from nests, and of brood size at hatching. However, a small number of older

broods were included and some loss of ducklings, or mixing of broods, may have occurred prior to rescue.

Marbled Teal broods observed in 1995 were ascribed to three duckling size-classes: 'small' (less than half adult size, 1–15 days old); 'medium' (at least half but less than three-quarters adult size, 16–27 days); 'large' (at least three-quarters adult size, 28–49 days).⁷ Estimated hatching date was backdated from duckling size, using the following approximate ages for size-classes: 'small' as four days, 'medium' as 22 days, 'large' as 39 days. Marbled Teal broods seen in the field (i.e. not in the canal) in 1995 during regular surveys were ascribed to the same size-classes, and age was estimated in the same way except that 'small' broods were estimated as eight days old, owing to less skew towards newly hatched broods amongst field observations.

Differences between species in observation date of broods in the canal were compared with analysis of variance (ANOVA) and *t* tests, using transformed data to remove differences in heterogeneity between groups. The timing of observations in 1995 differed significantly between species (Table 1; Fig. 1), with Red-crested Pochard having the earliest and Marbled Teal the latest mean date. Tukey HSD tests revealed significant differences in date of observation between Red-crested Pochard and both Pochard ($P < 0.04$), and Marbled Teal ($P < 0.002$). In 1994, Marbled Teal broods ($n = 9$, range 2 Jun–11 July, mean \pm sd = 76.2 \pm 16.8, 1 = 1 April) were found in the canal significantly later than Pochard broods ($n = 19$, range 22 May–15 June, mean = 62.6 \pm 7.1; two-tailed, two-sample *t* test on log-transformed data, $t_{26} = 2.76$, $P < 0.011$).

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Table 1. Size and date of observation for duck broods in drainage canals in Alicante in 1995, compared with body size, egg size and clutch size for each species.

Species	n	Brood size		Date		FM	EM _{exp} (%)	CS	FM (%)
		Range	Mean	Range	Mean ^a				
Red-crested Pochard	11	1-17	5.7 ± 5.9	30 Apr-13 Jun	44.4 ± 13.4	1108	77	9.9 ^b	50
Mallard	17	1-12	5.1 ± 3.9	19 Apr-28 Jun	57.2 ± 18.4	1010	75	8.9 ^b	45
Pochard	39	1-25	5.5 ± 5.6	5 May-24 Jul	63.5 ± 16.5	889	109	8.5	65
Marbled Teal	15	1-18	8.3 ± 5.2	14 May-15 Jul	71.6 ± 19.9	380 ¹⁷	87	11.8 ⁷	93

FM, mean female body mass (g); EM_{exp} (%), mean egg mass observed as a percentage of egg mass expected (e) from the equation $e = 0.47 b^{0.72}$ where *b* is female body mass (equation calculated for all Anatidae¹¹); CS, mean clutch size; FM (%), total clutch mass as a percentage of FM. Source of data for FM, egg mass and CS is Cramp & Simmons¹⁶ unless otherwise indicated. Means are given ± sd. ^a1 = 1 April. ^bExcludes clutches in the UK which are larger (probably because of domestic genes in the population).¹⁶

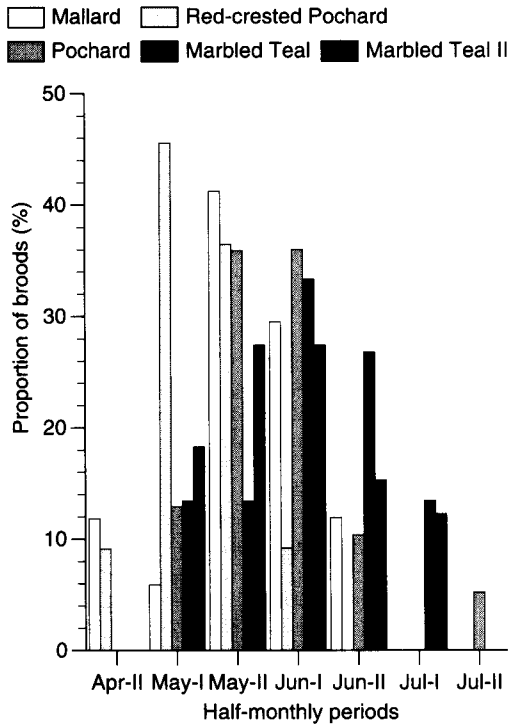


Figure 1. Breeding phenology of Marbled Teal, Mallard, Red-crested Pochard and Pochard in Alicante, 1995. Marbled Teal II refers to estimated hatching dates backdated from duckling size for broods observed in the canal (*n* = 13) or elsewhere (*n* = 20). Other data are for observations of broods in the canal (see Table 1 for sample sizes). Differences in date between species were highly significant (one-way ANOVA on square-root-transformed data, $F_{3,78} = 6.47$, $P < 0.001$).

Hatching date estimated from Marbled Teal broods ascribed to size-classes in 1995 (*n* = 33) had a similar distribution to observation dates of Marbled Teal broods in the canal (Fig. 1), although the average date was slightly earlier (range 10 May-11 July, mean 64.9 ± 18.0). Hence the timing of observations of broods in the canal in Alicante closely reflects the timing of emergence from the nest.

Marbled Teal broods were considerably larger than those of other species, as expected given recorded differences in clutch size (Table 1). Large broods of more than 14 ducklings observed in Marbled Teal, Red-crested Pochard and Pochard were probably a consequence of the nest parasitism common in all three species.^{7,8} However, post-hatch brood amalgamation⁹ also occurs in these species, as illustrated by the field observation of a brood of 17 small and one large Marbled Teal ducklings in El Hondo on 17 June 1995.

A similar pattern for the timing of breeding of these four species has been found in the Marismas del Guadalquivir, 500 km southwest of El Hondo, the one difference being that Mallard nested earlier than Red-crested Pochard in the Marismas.^{3,7} The differences observed between species are compatible with several hypotheses to explain the timing of nesting initiation in ducks,¹⁰ such as the 'laying-delay hypothesis' that nesting may be delayed by the time required by females to pay the energetic costs of egg production. Mallard and Red-crested Pochard breed early and produce relatively small eggs and relatively light

clutches (Table 1). Pochard produce relatively large eggs and have an intermediate clutch mass (Table 1). The Marbled Teal breeds last, and its relative clutch mass is much higher, whereas its relative egg size is intermediate (Table 1). Marbled Teal invest more resources in egg production than the majority of Anatidae.⁷ According to Rohwer,¹¹ only four of 151 Anatid species produce a heavier clutch as a percentage of female mass.

There is an inverse correlation across species between female mass and date of hatching (Table 1), which may also indicate a causal relationship. Larger ducks may have a greater tendency to store fat reserves prior to their arrival on breeding grounds, thus allowing earlier nesting.¹² In other duck communities, there is a trend for larger species to nest sooner.^{13–15} The observed differences between species in phenology could also be explained if each species timed brood emergence to coincide with peak abundance of different food items, or responded to differing functions of changing predation risk over time.¹⁰

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