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Effects of Red-crested Pochard nest parasitism on Mallards.—Although nest parasitism (i.e., a female laying eggs in the nests of others) has been recorded in many waterfowl species (e.g., Weller 1959, Bezzel 1961, Eadie et al. 1988, Rohwer and Freeman 1989), only a few studies have been conducted on this aspect of the breeding biology of ducks (e.g., Weller 1959, Joyner 1976, Sugden 1980, Talent et al. 1981, Amat 1985a). Despite this, it is still not clear to what extent nest parasitism is detrimental to the host. Here I document the effects of nest parasitism by Red-crested Pochards (*Netta rufina*) on Mallards (*Anas platyrhynchos*) and discuss my findings in relation to those of Talent et al. (1981), who studied nest parasitism of Mallards by Redheads (*Aythya americana*).

Study site and methods.—I conducted field work in the marshes of the Guadalquivir (SW Spain) during 1977–1978 and 1984–1989. For a description of the area and methods see Amat (1982, 1985a, b). In these marshes, the nesting season of Mallard is longer than that of the Red-crested Pochard (Amat 1982). The latter species nests mainly on old watercourses which are covered by *Arthrocnemum glaucum* and *Juncus subulatus*. This habitat type is also used by nesting Mallards, mainly during the peak nesting season of the Red-crested Pochard (Amat 1982, 1985b).

Nests were considered intraspecifically parasitized when: (1) more than one egg was laid per day, (2) eggs were added after incubation started, and/or (3) nests contained more than 14 eggs (e.g., Morse and Wight 1969).

In most studies of nest parasitism among ducks, mean clutch sizes of parasitized and unparasitized nests were compared when analyzing the effects of nest parasitism on the host, and some of these studies concluded that clutch sizes of hosts were reduced in parasitized nests (Weller 1959, Joyner 1976, Sugden 1980, Talent et al. 1981, Stoudt 1982, Bouffard 1983). However, laying dates were not controlled for, and this might have led to incorrect conclusions (Amat 1987). The clutch size of Mallards in my study site decreases throughout the nesting season (Amat 1982). Early nesting Mallards (i.e., those with larger clutches) cannot be parasitized by Red-crested Pochards, because the latter species initiates its nesting season later. Thus, it would be inappropriate to include all Mallard nests in the comparisons. Therefore, I restricted the comparison to nests located on the old watercourses (or <10 m from them), because this habitat type was used by Mallards coinciding with the nesting season of Red-crested Pochards, and also because all parasitized Mallard nests were found on this habitat type or very close to it.

Results.—On the old watercourses, Mallard nests (N = 62) were parasitized by conspecifics (1.6%), Red-crested Pochards (30.7%), and Common Moorhen (*Gallinula chloropus*) (1.6%). Furthermore, I found 4.8% of Mallard nests simultaneously were parasitized by Red-crested Pochards and Common Pochards (*Aythya ferina*), and an additional 6.5% simultaneously parasitized by conspecifics and Red-crested Pochards. Only nests exclusively parasitized by Red-crested Pochards are considered in this study.

The fate of nests was similar in parasitized and unparasitized nests (Table 1, $G = 1.77$, $P > 0.05$). The clutch size of Mallards was larger in parasitized than in unparasitized nests (Table 1, $t = 2.38$, $P < 0.05$). The frequency of parasitism in 1988 (50% of 24 nests) was greater than in remaining years combined (24.1% of 29 nests; $G = 3.84$, $P = 0.05$). Water levels were higher in 1988 than in the other years, and this was associated with larger Mallard clutches. Mean (±SD) clutch sizes in parasitized (10.9 ± 3.0, N = 11) and unparasitized nests (9.4 ± 2.0, N = 7) were similar in 1988 ($t = 1.08$, $P > 0.05$). Also, during the remaining years, clutch sizes in parasitized (7.8 ± 0.8, N = 5) and unparasitized nests (7.2 ± 1.9, N = 15) were similar ($t = 0.64$, $P > 0.05$).

TABLE 1
CHARACTERISTICS OF PARASITIZED AND UNPARASITIZED MALLARD NESTS

	Parasitized	Unparasitized
Fate		
Deserted	1[a]	4
Predated	6	5
Hatched	10	13
Clutch size	9.9 ± 2.9 (16)[b]	7.9 ± 2.2 (22)
Eggs outside nest	1.1 ± 1.9 (12)[c]	0.3 ± 0.8 (13)
Percent of eggs with dead embryo	10.5 (95)[d]	6.3 (95)
Percent of infertile eggs	8.4 (95)	3.2 (95)

[a] Number of nests.
[b] Mean ± SD (number of nests).
[c] Mallard eggs.
[d] Number of Mallard eggs in successful nests.

The mean number of Red-crested Pochard eggs in parasitized Mallard nests was 3.3 ± 1.3 (N = 16). On average, 0.6 ± 1.0 Red-crested Pochard eggs were displaced outside parasitized nests. Although more Mallard eggs were displaced outside the nest bowl in parasitized than in unparasitized nests, the difference was not significant (Table 1, $t = 1.61$, $P > 0.05$). The proportions of Mallard eggs with dead embryos were similar in parasitized and unparasitized successful nests (Table 1, $G = 1.10$, $P > 0.05$). Also, similar proportions of infertile Mallard eggs were found in both nest types (Table 1, $G = 2.50$, $P > 0.05$). However, when considering all factors that negatively affected hatching success (displacement outside the nest, breakage, infertility and dead embryo), fewer Mallard eggs hatched in parasitized (76.0% of 100) than in unparasitized nests (86.9% of 99; $G = 3.93$, $P < 0.05$).

Discussion.—In 1988 Mallard clutches were larger probably because of higher water levels (see Krapu et al. 1983). In addition, in this year there was greater proportion of Mallard nests parasitized by Red-crested Pochards. The clutch size of Mallards was larger in the parasitized than in unparasitized nests which I studied. However, when the data of 1988 were separated from the comparisons, there were no differences in clutch sizes between parasitized and unparasitized nests. In other studies in which laying dates between parasitized and unparasitized nests did not differ, clutch sizes were also similar in both types of nest (Heusmann et al. 1980, Amat 1985a). Talent et al. (1981) found larger clutches in unparasitized Mallard nests than in nests parasitized by Redheads, and following Weller's (1959) hypothesis, concluded that Redhead nest parasitism could have suppressed ovulation in Mallard hens. However, Talent et al. (1981) did not control for effect of laying date on clutch size; thus, their conclusion might be incorrect. Perhaps, the effects of nest parasitism on hosts have been overemphasized, because clutch sizes in parasitized nests may not have been reduced (Amat, unpubl. data). Factors known to cause variations in clutch sizes in waterfowl should therefore be controlled when making comparisons between parasitized and unparasitized nests, for the deposition of parasitic eggs can yet be implicated as an influence on reduced host clutches in parasitized nests.

In other studies it was found that the proportion of eggs with dead embryos was greater in parasitized than in unparasitized successful nests (Amat 1985a, Davies and Baggott 1989), but I did not observe this in the present study. The number of eggs deposited by Red-crested Pochards in Mallard nests was similar to that deposited by Redheads in nests of the same host species (Talent et al. 1981). When Red-crested Pochards and Redheads each parasitized

other duck species, the number of host eggs displaced outside the nest bowl was significantly greater in parasitized than in unparasitized nests (Weller 1959, Joyner 1976, Sugden 1980, Amat 1985a), but this was not evident when each parasitic species deposited their eggs in Mallard nests. However, as Talent et al. (1981) also found, egg success was lower in parasitized Mallard nests, which resulted from a combination of factors, of which egg displacement seemed to be the most important. As clutch size was not reduced, I conclude that the effects of Red-crested Pochard nest parasitism on Mallards, although adverse, were not as detrimental as Talent et al. (1981) implied when the same host species was parasitized by Redheads.

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