Short notes

CLUTCHES OF RUFOUS BUSH CHATS *CERCOTRICHAS GALACTOTES* PARASITISED BY CUCKOOS *CUCULUS CANORUS* CONTAIN LARGER EGGS

FERNANDO ALVAREZ

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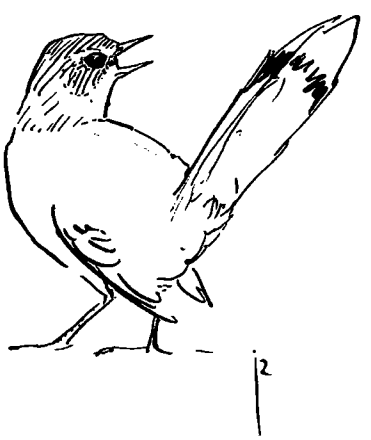
In southern Spain clutches of Rufous Bush Chats *Cercotrichas galactotes* that were parasitised by Cuckoos *Cuculus canorus* contained larger eggs than non-parasitised ones. Three alternative hypotheses are given that can explain this result. The first states that as a result of the larger size difference with the Cuckoo's egg, parasitism in smaller egg clutches is more easily detected by the host, which then ejects the Cuckoo's egg. Such incidence of parasitism would thus go easily unnoticed to the human observer. Yet, this hypothesis was rejected, since it is known that Rufous Bush Chats readily accept Cuckoo egg models larger than their own. The second hypothesis states that the observed higher average size of eggs in parasitised nests could be due to the removal of one of the smaller eggs of the host (it appeared that Cuckoos removed only one egg of the host), resulting in an increase of the average egg size of the remaining clutch. This hypothesis was tested by comparing average egg size of parasitised clutches with that of unparasitised clutches, but excluding the smallest egg in the clutch, and could not be rejected. As smaller eggs hatch earlier, eliminating smaller eggs would perhaps withdraw competition for food of the early-born Cuckoo chick with early born Rufous Bush Chat nestlings. The third hypothesis, which could not be rejected either, is that Cuckoos choose to parasitise host pairs of superior parental quality in the benefit of the Cuckoo chick. Superior quality is then related with large egg size.

Key words: *Cuculus canorus* - *Cercotrichas galactotes* - egg size - parasitism

Estación Biológica de Doñana, C.S.I.C., Apartado postal 1056, E-41080 Sevilla, Spain, E-mail: alvarez@ebd.csic.es



Each gens of Cuckoo *Cuculus canorus* parasitises preferentially a bird species whose eggs are similar in size (Baker 1942) and slightly smaller than their own (Lack 1968). In southern Spain one such gens regularly parasitises the Rufous Bush Chat *Cercotrichas galactotes* and certain adaptations and counter-adaptations have been described (Alvarez 1993, 1994a, b, c, 1996, 1999; in press, Palomino *et al.* 1998a, b). Egg size within a population of Rufous Bush Chat varies (Alvarez 1994a), and I have tried to determine whether there is any relationship between host egg size and incidence of parasitism by the Cuckoo.

The study area (about one thousand ha) is an agricultural vineyard area, located in southern Spain, 20 km south-east of Seville (37º9'N, 2º14'W), at 12m above sea level. It is interspersed with small patches of gardens, orchards, green-

Table 1. Clutch size (minimum - maximum, median, and quartile range) and egg mass (minimum - maximum, mean ± SD) in parasitised (Cuckoo egg excluded from the count) and non-parasitised Rufous Bush Chat nests.

	Clutch size Min - max	Median	Quartile range	Egg mass (g) Min - max	mean ± SD	*n*
Non-parasitised	1–5	3	1	2.35–3.12	2.71 ± 0.22	52
Parasitised	1-4	2	1	2.38–3.45	2.83 ± 0.30	38

houses and few remnants of natural vegetation. All nests were built 0.7-1.2m above the ground on vineyard stocks. Observations were carried out from May to July 1992 to 1997. Density of Rufous Bush Chat breeding pairs in the study area was about 0.5 ha^{-1}. The number of Cuckoo females in the study area varied yearly from about five to more than seven, and the proportion of parasitised nests from 27% to 35%. A total of 90 nests were found. For each nest it was noted at least every two days whether or not it was parasitised by the Cuckoo. Length L and breadth B of each egg in each clutch was measured, and fresh egg mass was calculated from $c \cdot LB^2$, where $c = 0.52$ had been determined empirically (Hoyt 1979).

In 38 parasitised and 52 non-parasitised Rufous Bush Chat nests, average fresh egg mass did conform with the normal distribution ($P > 0.20$; Kolmogorov-Smirnov test), whereas clutch size did not ($P < 0.05$). Average egg mass was affected neither by the year nor by the month of study (year: non-parasitised: $F_{5,46} = 0.08$, $P = 0.99$; parasitised: $F_{5,32} = 1.00$, $P = 0.43$; month: non-parasitised: $F_{2,49} = 0.43$, $P = 0.65$; parasitised: $F_{2,35} = 0.15$, $P = 0.86$; one-way ANOVA). Comparison of the size of clutches in non-parasitised and parasitised nests (Cuckoo egg of parasitised nests excluded from the count, Table 1) showed the former to be significantly larger ($G = 36.15$, $df = 2$, $P < 0.001$). When the comparison was made between non-parasitised clutches and number of Rufous Bush Chat eggs in parasitised clutches plus one, the difference was non-significant ($G = 0.92$, $df = 2$, $P > 0.3$). When adding two to the size of parasitised clutches, the latter were larger than the non-parasitised clutches ($G = 30.76$, $df = 2$, $P < 0.001$).

This result clearly demonstrates that, when parasitising a nest of Rufous Bush Chats, the Cuckoos apparently take only one egg. In this respect, Cuckoos behave in the study area similarly as in England (1.2 eggs removed from clutches of Reed Warbler *Acrocephalus scirpaceus*, Wyllie 1981) and Norway (1.5 eggs from clutches of Meadow Pipits *Anthus pratensis*, Moksnes & Røskaft 1987), and do not remove two eggs, as previously reported (Congreve 1927).

Egg removal by the Cuckoo did not reduce the probability of detection by Meadow Pipits (Moksnes & Røskaft 1989). If this also holds for Rufous Bush Chats, removal of one of the host eggs most probably has the function of maintaining the optimal clutch size, in order to increase the hatching probability of the eggs (Davies & Brooke 1988, Lerkelund *et al.* 1993). A comparison of average egg mass revealed that parasitised clutches contain larger eggs than non-parasitised ones ($t_{88} = 2.26$, $P = 0.03$; Table 1). Female Rufous Bush Chats with smaller eggs could eject Cuckoo eggs more easily than those females with clutches of larger eggs, perhaps because of the formers eggs being more dissimilar to Cuckoo eggs (Palomino *et al.* 1998a). As a result, incidence of parasitism on smaller-eggs clutches would go unnoticed to us. Since Rufous Bush Chats readily accept Cuckoo egg models larger than their own (Alvarez *in press*), for the moment we discard this possibility.

The observed higher average size of eggs in parasitised nests could also be due to the removal of one of the smaller eggs of the host, resulting in an increase of the average egg size of the remaining clutch. The Cuckoo might also actively choose to parasitise nests of Rufous Bush Chat pairs with heavier eggs. The first hypothesis was tested

by comparing average egg size of parasitised clutches (Cuckoo egg excluded) with that of unparasitised clutches, but excluding the smallest egg in the clutch. Since average egg mass was not significantly different ($t_{79} = 1.10$, $P = 0.27$), the hypothesis is supported. It might result from the easier grasping of smaller eggs by the Cuckoo. As smaller eggs hatch earlier (Rahn & Ar 1974), eliminating smaller eggs would perhaps withdraw competition for food of the early-born Cuckoo chick (pers. obs.) with early born Rufous Bush Chat nestlings. Selection by the Cuckoos of clutches with larger eggs is the other most likely alternative. Cuckoos could choose to parasitise host pairs of superior parental quality in the benefit of the Cuckoo chick (as the Great Spotted Cuckoo *Clamator glandarius* does with respect to Magpies *Pica pica*, Soler *et al.* 1995). The cues for high parental quality could be song frequency, nest location, general activity, or some other, which would be correlated with the observed large egg size. Larger eggs in parasitised clutches, if due to host selection by the Cuckoo, could be related to higher hatching success (Wiebe & Bortolotti 1995) or higher offspring fitness (Montevecci 1976;Verbeek 1988; Williams 1994) of larger-eggs clutches. Potential female hosts laying larger eggs could also be more able to obtain food for egg formation (experienced females, or in better body condition, Wiebe & Bortolotti 1995; Viñuela 1997) and perhaps also for feeding the Cuckoo chick.

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SAMENVATTING

In Zuid-Spanje bleken door de Koekoek *Cuculus canorus* geparasiteerde legsels van de Rosse Waaierstaart *Cercotrichas galactotes* grotere eieren te bevatten dan niet-geparasiteerde legsels. Voor dit verschijnsel konden wij drie verklaringen bedenken. Ten eerste zou het kunnen zijn dat een gastheer met kleine eieren eerder het grotere Koekoeksei ontdekt en het vervolgens verwijdert. De onderzoeker ziet zo'n geval van parasitisme gemakkelijk over het hoofd. Het is echter uit andere studies bekend dat de Rosse Waaierstaart modellen van Koekoekseieren die veel groter zijn dan normaal, nog gemakkelijk accepteert. Deze mogelijke verklaring werd dus verworpen. De tweede mogelijkheid is dat het waargenomen verschil het gevolg is van het feit dat de Koekoek altijd een van de kleinere eieren van de gastheer eruit gooit. Kleinere eieren komen eerder uit en het Koekoeksjong dat als eerste uitkomt heeft zo minder vlug met een concurrent te maken. Deze hypothese werd getest door de gemiddelde eigrootte van geparasiteerde legsels te vergelijken met niet-geparasiteerde legsels, maar nu zonder het kleinste ei van dat laatste legsel mee te tellen. Er bleek geen verschil in gemiddelde eigrootte meer te zijn en deze verklaring bleef dus overeind. De derde verklaring is dat Koekoeken het liefst ouders van hoge kwaliteit zouden parasiteren, hetgeen het Koekoeksjong ten goede zou komen. Kwaliteit als ouder zou dan gekoppeld zijn aan het leggen van grotere eieren. Ook deze verklaring bleef overeind.

(JvdM)

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