

EFFECTS OF SUPPLEMENTAL FOOD ON THE BREEDING
BIOLOGY OF THE BLACK-BILLED MAGPIE¹

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Birds may use food as a proximate cue to initiate breeding (Moreau 1950; Lack 1954, 1966; Perrins 1970; Newton 1981). Studies in which food was supplemented in nesting areas have reported changes in timing of nesting, clutch size, egg weight, hatching success, number of fledglings, and fledgling weight (reviewed in Hochachka and Boag 1987 and Arcese and Smith 1988). This experimental approach, however, has not demonstrated an increase in nesting density (Yom-Tov 1974, Högstedt 1981, but see Ewald and Rohwer 1982).

The accidental death of an adult hereford steer (*Bovus* sp.) in eastern Washington enabled me to examine the effects of a single rich pulse of food on initiation of laying, clutch size, and nesting density in the Black-billed Magpie (*Pica pica*). I show that a group of food-enriched magpies nested earlier and in higher densities than magpies which were not supplementally fed.

METHODS AND STUDY AREA

I monitored three groups of nesting magpies between March and June of 1979 through 1981 in Esquatzel Coulee, Franklin County, Washington (Table 1). The study area is described in Knight and Smith (1982). Two of the nesting groups (Russian Olive and Willow) are described in Knight and Fitzner (1985). The third group (Knob Hill) was located in a 0.3-ha stand of willow (*Salix* spp.) trees 3 km from the Russian Olive group and 6 km from the Willow group. Active nests were identified each year and checked until their fate was known. The laying of the first egg was either observed directly or was calculated assuming that magpies lay one egg each day and have an incubation period of 18 days (Erpino 1968, Johnson 1972).

The dead steer weighted approximately 450 kg and died between 1 and 7 March 1981 in the center of the Knob Hill group. The carcass was opened allowing birds access to the food. Enormous numbers of invertebrates, especially blow flies (Calliphoridae), utilized the carcass and were also eaten by magpies. By 22 March there was little food left on the steer for magpies.

RESULTS AND DISCUSSION

Numbers of nesting magpies at the Willow and Russian Olive groups did not change between 1979 and 1981.

The number of nesting pairs at Knob Hill, however, showed a two-fold increase in 1981 (Table 1). In 1982 the number of nesting pairs at Knob Hill declined to a similar number as in 1979 and 1980; I did not check the Willow and Russian Olive groups in 1982.

Ewald and Rohwer (1982) reported an increase in density of nesting Red-winged Blackbirds (*Agelaius phoeniceus*) following food enrichment. Because they removed most of the original males, however, they could not be sure that the increased density was due solely to food manipulation or some other factor, e.g., simultaneous settlement (P. W. Ewald, pers. comm.).

Yom-Tov (1974) and Högstedt (1981) attempted without success to increase nesting densities of Carrion Crows (*Corvus corone*) and Black-billed Magpies, respectively, through the provisioning of additional food. The discrepancies between my study and those of Yom-Tov and Högstedt may reflect differences in the nature of the supplemental food (Ewald and Rohwer 1982). Traditionally, studies that have enriched food on breeding areas have put out small amounts of food at regular time intervals. The dead steer in my study differed in that it represented a single pulse of very abundant food.

Mean laying date for the first egg was significantly earlier at Knob Hill than at the other sites in 1981 (Table 2). Likewise, median laying date was also earlier at Knob Hill than at either the Willow or Russian Olive groups (8 and 13 days, respectively). Mean and median dates of first laying among the three groups did not differ in 1979 or in 1980. Extreme dates for laying in 1981 were 16 March–5 April, 24 March–12 April, and 26 March–8 April for the Knob Hill, Willow, and Russian Olive groups, respectively.

Studies that have added food to nesting areas generally report an earlier onset of laying (table 6 in Arcese and Smith 1988). Högstedt (1981) did not find a significant difference in initiation of nesting dates between supplementally-fed and unfed magpie nests. Similarly, he found only small differences in median dates for onset of laying (between 2 and 2.5 days). When magpies in Edmonton, Alberta were supplementally fed, however, clutch initiation dates were significantly advanced (Hochachka and Boag 1987).

The differences Högstedt and I report may be due to differences in the environmental predictability between our areas. Ewald and Rohwer (1982) hypothesized that variability of food prior to onset of breeding might explain why some species advance laying so markedly while other species do not. Their argument was phrased in terms of interspecific differences but it could be extended to include conspecifics in geographically discrete areas.

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TABLE 1. Number of active magpie nests in three nesting groups during 1979–1982.

Year	Number of active nests in three nesting groups		
	Knob Hill	Russian Olive	Willow
1979	3	6	9
1980	4	6	9
1981	8*	6	9
1982	3	a	a

* Not checked.

* Supplemental food available.

Clutch size did not differ among my three groups in 1981 (Kruskal-Wallis $H = 0.16$, $P > 0.99$). I was unable to compare the number of young that fledged per successful nest in 1981 due to high nest predation at the Russian Olive group; however, there were no differences between the Knob Hill and the Willow groups (Mann-Whitney $U = 31$, $P > 0.20$). For the Knob Hill group, there were no differences in either clutch size or number of young fledged per successful nest during 1981 and the previous 2 years (Mann-Whitney U -test, both P values > 0.05).

Of 14 food supplementation studies, only five reported increases in clutch sizes (Arcese and Smith 1988). Evidence for increased clutch size in supplementally-fed magpie populations is equivocal. Supplementally-fed magpies in Sweden showed a larger clutch size in 1 of 2 years (Högstedt 1981); whereas, there were no significant clutch size differences in Canada (Hochachka and Boag 1987).

Hochachka and Boag (1987) have proposed a design for food supplementation experiments to determine the critical period of food shortage. My results suggest that the amount and frequency of supplemented food (i.e., a single rich pulse vs. smaller amounts placed out at regular intervals) might be a variable of interest in future experiments.

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TABLE 2. Median and mean laying dates for three groups of nesting magpies during 1979–1981. Only Knob Hill (1981) had supplemental food.

Year	Onset of laying*							
	Median			Median test	$\bar{x} \pm SD$ (n)			Kruskal-Wallis test
	Knob Hill	Russian Olive	Willow		Knob Hill	Russian Olive	Willow	
1979	20	21	19	$\chi^2 = 1.25$ $P > 0.50$	19.0 ± 5.6 (3)	20.8 ± 3.8 (6)	18.1 ± 3.3 (9)	$H = 2.19$, $P > 0.10$
1980	18	19	20	$\chi^2 = 2.7$ $P > 0.25$	18.0 ± 5.9 (4)	18.8 ± 1.7 (6)	21.1 ± 5.5 (9)	$H = 1.99$, $P > 0.25$
1981	9	17	22	$\chi^2 = 6.9$ $P < 0.05$	13.9 ± 7.2 (8)	17.7 ± 6.3 (6)	19.6 ± 6.3 (9)	$H = 7.21$, $P < 0.01$

* Dates are transformed on a scale from day 1 = 15 March.

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COLD TOLERANCE OF EUROPEAN BLACKBIRD EMBRYOS AND NESTLINGS¹

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Key words: Thermal tolerance; incubation; *Turdus merula*; embryos; nestlings.

In a review of the thermal tolerance of avian embryos, Webb (Condor 89:879–898, 1987) found few published data on the effects on embryos of limited duration exposure to low temperatures. In particular, Webb commented on the lack of studies on common birds, nesting in relatively benign thermal environments, and suggested that the American Robin, *Turdus migratorius*, would be a suitable species on which to collect baseline data on avian thermal tolerance. I report here some field observations of the cold tolerance of embryos and nestlings of the congeneric and ecologically similar European Blackbird, *Turdus merula*. The observations were made in the University Botanic Garden, Cambridge, England (52°12'N, 0°7'E), during 1987. Air temperature records were taken from the Botanic Garden weather station; the times given are GMT.

A reproductively experienced female blackbird laid a clutch of four eggs that were expected to hatch on 20 May, assuming a typical incubation pattern and incubation period of 13–14 days. At 07:30 on 20 May three eggs were present; by 17:35 only two remained. They were not then examined, but the following day at 07:25 they were both pipped yet cold to the touch. When checked at 09:20, 13:20, and 15:10 that day they were still cold and no nearer hatching. The female had apparently deserted the eggs after the loss of the other two, so that they had been at temperatures between 5.8 and 12.4°C for at least 8 hr, assuming that they were completely shaded (the nest was in an evergreen hedge and it was a mostly cloudy day). At 15:10 I removed and marked the eggs, rewarmed them under an infrared lamp, and placed them in the nest of another blackbird pair whose nestlings were due to hatch. Next morning both eggs had hatched. One nestling was left in this new nest where it grew well for 4 days, but

disappeared before I banded the remaining nestlings at 8 days. The second nestling (which was marked at hatching and color-banded when 8 days old) was raised by other host parents. It grew well, fledged at a normal age, and was last seen 14 days after fledging, shortly before young become independent. Snow (*Ibis* 100:1–30, 1958) records a mean period of dependence of 20 days; range 15–25.

Blackbird nestlings may also be able to tolerate short periods of hypothermia. At one poorly constructed nest I found a nestling, that had hatched that day, lying on the ground at 17:50 on 18 May, completely cold to the touch. The maximum temperature that day was 12.0°C; it had been a wet and completely cloudy day. The nestling was quite still, so it appeared dead, but it revived when rewarmed. I replaced it in the nest, where it grew well for 2 days but had disappeared, along with another nestling, when the brood was measured at 4 days. The remaining two nestlings were deserted, suggesting that the nestling's disappearance may have been due to a poor breeding attempt by this first-year pair, not to irreversible damage when the nestling was cold.

In both cases reported the young would have died if I had not intervened, but I have recorded cold, pipped eggs and cool nestlings which have been rewarmed by their parents. Such records constituted less than 1% of my visits to nests (of the 322 nests which survived at least until the end of hatching; each nest was visited one to 12 times).

Thus the blackbird, which does not seem to nest in an unusually difficult thermal environment in Cambridge, has embryos and apparently nestlings that are tolerant of chilling below 12°C for several hours. Perhaps any species nesting in a temperate climate needs to have embryos tolerant of cooling for at least short periods, although the nominate race of the blackbird breeds as far north as 63° in Finland (Cramp, *Handbook of birds of Europe, the Middle East and North Africa*. Vol. 5. Oxford Univ. Press, Oxford, 1988), so may be especially tolerant for a passerine breeding in England. In the blackbird both sexes feed the nestlings but only the female incubates and broods, and the male

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