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## THE EFFECTS OF SUPPLEMENTAL FOOD ON NEST DISPERSION IN BLACK-BILLED MAGPIES<sup>1</sup>

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*Key words:* Magpie; *Pica pica*; supplemental food; nest dispersion; nesting density.

Nest dispersion patterns among bird species range from uniform ("spaced") distributions to clumped. The relative costs and advantages of particular patterns of nest distribution have been examined in several species through the use of conceptual and theoretical models as well as empirical studies (Brown 1964, 1969). In some cases this has been accomplished by examining variability in nest dispersion patterns within a single species at different geographic locations within its range (Lott 1984). These costs and benefits might also be examined in the same population over a period of several years.

Factors which lead to high nest densities are limited nesting habitat (Veen 1977, Burger 1982), variable food resources (Horn 1968), or abundant food resources (Knight 1988). Advantages of high nesting densities or clump nest distributions within an intraspecific population include reduced risks of nest predation through group defense (Veen 1977, Burger 1982) or increased

foraging efficiency (Ward and Zahavi 1973). Competition for resources may be greater in higher density habitats (Fretwell and Lucas 1969, Fretwell 1972) as is the probability of interference from conspecifics (Brown and Brown 1988).

Horn (1968) suggested that when the resources are unpredictable, territory defense should not persist and nests should be clumped, but according to Brown (1969) this might also occur when resources are economically undefendable. Economic undefendability might occur if resources are distributed sparsely and are ephemeral but what if resources are predictable, superabundant and found at a single source such as might be found in many supplementally-fed populations? It might be expected that population density would increase in the vicinity of the supplemented resource, but will territoriality and nest dispersion patterns persist or change?

We examined the influence of food abundance on nest distribution patterns in a discrete population of black-billed magpies (*Pica pica*). Black-billed magpies are a useful species in which to examine the factors that lead to different nest distribution patterns. While magpies in Europe have been described as territorial with nest distributions being uniform or "hyperdispersed" (Birkhead et al. 1986), Knight (1988) suggests that black-billed magpies in North America nest in varying densities. Furthermore, local food resources

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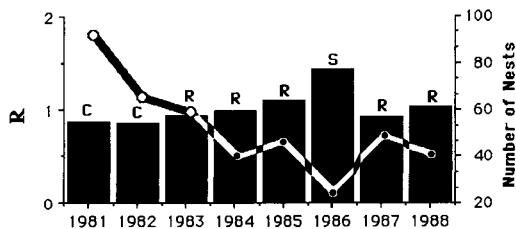


FIGURE 1. The total number of nests within the study area (lines) and nest distribution pattern (boxes) "R" (after Clark and Evans 1954) during the years 1981–1988.  $R < 1$  indicates a clumped nest distribution (C),  $R > 1$  indicates a spaced distribution (S) and  $R = 1$  indicates when years were not significantly different from a random distribution (R).

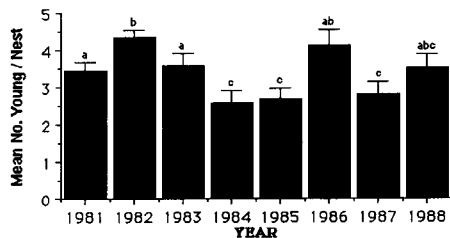


FIGURE 2. Mean fledging success among years ( $\pm$  SE). Letters shared between years are not significantly different (Fisher PLSD,  $P < 0.05$ ).

are known to be important factors determining nesting densities in magpies (Knight 1988).

#### METHODS AND STUDY AREA

Our study area is located about 15 km northwest of Pocatello, Idaho, USA, and consists of a 2.0 km  $\times$  0.5 km zone on each side of the Portneuf River. The actual area of suitable nesting habitat is 0.32 km<sup>2</sup> which we defined as any area containing trees that contained active or previously used magpie nests. This zone is open riparian, with scattered Russian olive (*Elaeagnus angustifolia*) groves, tall willows (*Salix* spp.), Siberian elms (*Ulmus pumilia*) on hillsides, and water birch (*Betula occidentalis*), box elder (*Acer negundo*), and hawthorne (*Crataegus* sp.) along emergent springs. Two commercial trout farms operated within the study area and dead fish and trout feed pellets provided consistent food sources for magpies year round. This food supply was interrupted in 1985 and 1986 when the trout farms closed; both resumed operation in 1987. Magpies made use of the trout farm for foraging, even flying up to 300 m between the nest tree and the site of available food.

Magpies nested in all the tree species mentioned and all nest trees were numbered with a permanent metal tag. We assumed that habitat structure and nest availability did not change over the course of the study, therefore any changes in dispersion were due to fluctuating food levels. There was a steady decline in nesting density within the study area from 1979 to 1986. This was probably caused by intense nest visitation during the early phases of this study. Data were initially collected in 1979 and every year thereafter; however, only data for the years 1981 to 1988 were used in this analysis because these years represented the most complete data available. Following 1981, human disturbance was kept to a minimum by climbing nest trees less frequently (2–4 times per season).

To examine the effects of local resource abundance on density and nest dispersion we examined the 1985–1986 seasons in which the trout farms ceased operation. If there were an effect due to the loss of this food resource, we expected it to be evident in the 1986 breeding season.

Nests were checked a minimum of three times from

the beginning of the nesting period (early February) until young were fledged (about June 1) to determine nest status. Nesting density was obtained by counting the number of active nests within the entire study area each year. Nearest-neighbor distances between nests were obtained by using an aerial photo of the study area gridded into 50 m squares. Nest dispersal patterns were examined using the approach of Clark and Evans (1954) in which nearest-neighbor distances are used to test the deviation from a random distribution of nests. While density and nearest neighbor distance ("proximity") are correlated with one another, it is possible to experience higher density and at the same time maintain some level of spacing between nests. Thus, the measure of dispersal is independent of density.

#### RESULTS

##### NEST SPACING PATTERNS

In all years except 1986, nests were distributed randomly or in a clumped pattern ( $R$  not significantly different than 1 or  $R < 1$  respectively) when compared with the random model described in Clark and Evans (1954). The highest densities were usually located near the hatchery raceways and open pits where dead fish were often dumped, suggesting that nests clustered at the very rich point sources of food. One other area of high nest density was a grove of trees within 200 m of one of the trout farms. In 1986, the year that the trout farms were closed, the number of nests in the study area was reduced to 25 nests that were uniformly spaced ( $R = 1.47$ ,  $P < 0.5$ ) which suggests a switch to territoriality at a time of reduced food resources (Fig. 1).

##### REPRODUCTIVE SUCCESS

In 1986 the mean number of young fledged per nest was significantly higher than either the previous year (1985) or the year when the trout farms reopened (1987). The increase in the number of young fledged per nest occurred despite, and perhaps as a result of, the loss of supplemental food (Fig. 2). Speculatively, this result may have been due to lower levels of interference from conspecifics at lower densities in the absence of supplemental food resources.

#### DISCUSSION

Our evidence suggests that magpies cluster nests as a response to resource patchiness. When supplemental food became unavailable in 1986 the magpies that continued to nest in the vicinity of the trout farms became

territorial. This trend was reversed when the trout farms were reopened one year later. A flexible social system may be an adaptation to food resources that fluctuate from year to year. Magpies seem to respond to an abundance of food resources by increasing densities, clustering nests about the locations of rich resource patches, and abandoning territorial defense. When disturbance to nests is low this can approach coloniality. In years when resources become unavailable or are found in low levels, magpies respond by spacing nests farther apart suggesting a switch to territoriality.

In years when nesting density decreased and nests were uniformly spaced, the mean number of young fledged per nest tended to increase (Fig. 2). There are several factors such as predation or climate that influence reproductive success that we were unable to measure for or control. Without doing so, we would be unable to conclude that reproductive success was or was not density dependent. Reproductive success does appear to be density dependent for this population of magpies and is also perhaps influenced by nest dispersion. Thus, the interaction between density, nest dispersion and reproductive success should be examined more thoroughly by future studies.

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## INFANTICIDE IN FEMALE TREE SWALLOWS: A ROLE FOR SEXUAL SELECTION<sup>1</sup>

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*Key words:* Sexually selected infanticide; replace-  
ment female; *Tachycineta bicolor*; *Tree Swallows*.

The recognition that infanticide, the killing of conspecific young, can hasten or even create a breeding opportunity for the infanticidal adult, has elevated the behavior from pathological to sexually selected. The

apparent rarity of this behavior in the avian world (Rohwer 1986) has been attributed to the prevalence of monogamy among bird species and therefore a limited substrate upon which sexual selection could act (Mock 1984). However, even in monogamous species, competition for breeding opportunities may be intense due to factors such as biased sex ratios or limited nesting sites. Hence, sexually selected infanticide may be expected and indeed has been shown to occur in monogamous bird species (e.g., Crook and Shields 1985, Goldstein et al. 1986, Freed 1986, Robertson and Stutchbury 1988, Møller 1988, Veiga 1990).

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