

Second broods in a Mediterranean cooperatively-breeding corvid: the Azure-winged Magpie

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Received: 10 April 2000; accepted: 2 June 2000.

Abstract. Successful multiple reproductive attempts in the same breeding season are extremely rare among the Corvidae, but are common in cooperatively-breeding species of similar size. The Azure-winged Magpie (*Cyanopica cyanus*) is a cooperatively-breeding corvid species for which there is so far no information from a marked population, to evaluate the presence of multiple broods. We have studied the reproductive biology of a marked population in southwestern Spain for a period of six years. Only in one of these years did we find second broods, and this was associated with a higher than average precipitation level. The results show that in spite of the presence of helpers-at-the-nest, second broods in this species may be constrained by the short duration of favourable breeding conditions in Mediterranean ecosystems, which only allow double broodedness when they are exceptionally favourable.

Key words: Second broods, cooperatively-breeding, Azure-winged Magpie, Mediterranean ecosystems.

Resumen. *Segundas puestas en un córvido mediterráneo con cría cooperativa: el rabilargo.* Las puestas múltiples en una misma estación reproductora son extremadamente raras en la familia Corvidae, sin embargo son comunes en especies de tamaño similar pero con sistema de cría cooperativa. El rabilargo (*Cyanopica cyanus*) es un córvido con cría cooperativa del cual no existe hasta la fecha información sobre una población marcada que permita evaluar la presencia de puestas múltiples. En este trabajo estudiamos la biología reproductiva en una población marcada en el suroeste de España durante un periodo de seis años. Sólo en uno de estos años encontramos segundas puestas, asociadas con un alto nivel de precipitación. Los resultados muestran además que a pesar de la presencia de ayudantes de cría, las segundas puestas pueden estar limitadas por la corta duración de la época favorable para la cría en los ecosistemas Mediterráneos, permitiendo más de una puesta sólo cuando las condiciones son excepcionalmente favorables.

Introduction

The number of successful reproductive attempts in a season is a main component of lifetime reproductive success in birds (e.g. Harvey et al., 1988). Different factors influence the occurrence of multiple broods. Factors favouring multiple broods include short reproductive lifespan, which makes the relative contribution of each breeding season to total success greater than in more long-lived species (Cody, 1971). A correlated feature is small body size, which in turn is associated with higher relative nestling growth rate resulting in shorter nesting periods (Calder, 1984; Reiss, 1989). On the other hand, constraints include the short duration of the favourable season, especially in temperate and cold climates (Cody, 1971). As a consequence, the number of broods per season is higher among small passerines and in tropical environments.

However, other factors contribute to generate variability such as food availability (Perrins, 1965; Cody, 1971) and the presence of helpers at the nest (e.g. Brown, 1987; Stacey & Koenig, 1990).

The Azure-winged Magpie *Cyanopica cyanus* is a large passerine although small among corvids (Cramp & Perrins, 1994). Its breeding system is colonial and the presence of helpers at the nest has been reported (Hosono, 1983; Cruz, 1988). Records of second broods in Corvidae of the Western Palearctic are extremely rare (Cramp & Perrins, 1994). The Azure-winged Magpie is considered to produce only one brood per year (Snow & Perrins, 1998) and only one case of second brood has been reported for captive Chinese birds (Porter, 1941 in Cramp & Perrins, 1994). Unlike other breeding data, information on the number of broods per season is scarce among birds since this information necessitates marked populations. Here we report the occurrence of

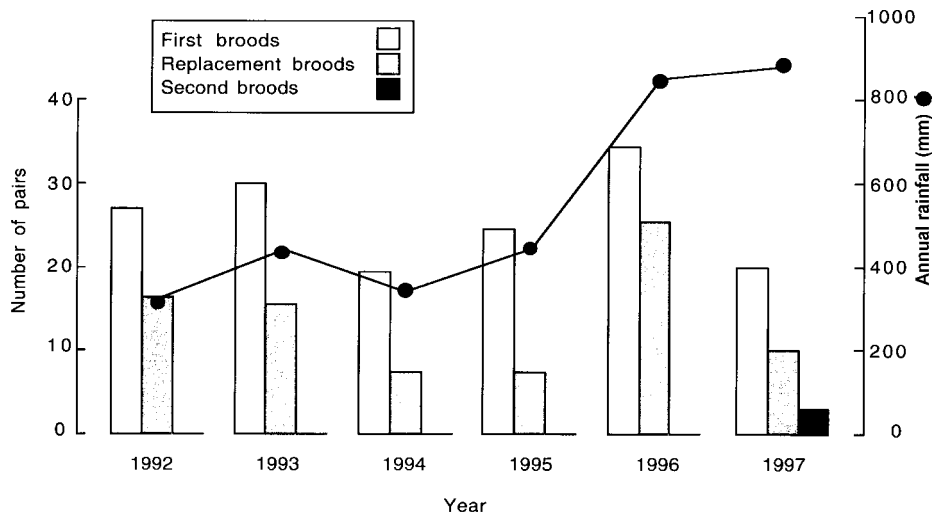


Figure 1.- Number of pairs attempting first-, replacement- and second broods (left scale) together with the cumulative annual rainfall in the area (right scale) during the years of study.

second broods in a marked population of Azure-winged Magpie in south-west Spain (*C. c. cooki*), whose breeding biology was studied for six years.

Methods

Since 1992, Azure-winged Magpies in this population have been captured and marked with metal and coloured plastic bands. Data presented here refer to the 1992-1997 period. The study area is 22 km north the city of Badajoz (39° 03' N, 6° 48' W), in the middle of the species' Iberian distribution (Sacarrao, 1967). The predominant habitat is a dehesa (open holm oak *Quercus ilex* woodland) (Sacarrao, 1972). The climate is typically Mediterranean, with dry-hot summers and mild-wet winters. Azure-winged Magpies in this area breed between late March and early July, typically producing a single brood which may be replaced in the case of failure (González, 1996). At the beginning of the nesting period (late March or early April depending on year) every tree in the area was inspected and, if containing a nest, marked. Field work lasted until the last chicks fledged, usually in early July. The whole area was searched for nests at least during one day per week, and different portions of the area were searched every two days, in a way that any tree in the whole area was inspected at least twice a week. Every nest found was monitored from a hidden position during one hour every two days, by using a telescope. The nest content was also inspected every two days. Nests with at least one egg found before 1 May were considered as a pair's first clutch. We assumed that nests with eggs found for the first time after 1 May likely represented replacement clutches even though no previous clutch of the pair had been found. Nests in which at least one egg was laid in the same season while offspring from a previous brood were still alive, were considered second broods.

Results

From 1992 to 1997 an average of 25.7 ± 5.8 SD pairs producing first clutches were monitored every year (Figure 1). Second broods were started only in 1997. Yearly rainfall changed dramatically during the study period. Between 1992 and 1995 there was a drought period, with on average only 387 ± 54 SD mm of rain per year. By contrast, 1996 and 1997 were much wetter, with a mean rainfall of 731 ± 54 SD mm per year. In 1996, predation affected 76.7% of the first clutches laid in the colony ($n=30$) versus 40.0% in 1997 ($N=20$) ($\chi^2=5.380$, d.f.=1, $p=0.020$). The three pairs laying second clutches in 1997, started their first clutches very early in the season, with clutches hatching between 15 and 20 April, the former being the earliest record for the entire colony in 1997. The mean number of young fledgling from the first clutches of these three pairs (4.00 ± 1.00 SD, $n=3$) did not differ from that of the other nests from which young fledged successfully (4.50 ± 1.05 SD, $n=6$; $t=0.683$, d.f.=7, $p=0.517$). Of the second clutches, one successfully fledged 2 chicks (no. 2), while the other two failed. One was depredated during the incubating phase (no. 12) and the other during the nestling period (no. 13). The pair that suffered predation on eggs (no. 12) made a new attempt but the clutch was again depredated during incubation. Interbrood interval was variable, and ranged from 12 (pair 12) to 27 days (pair 13).

Two of the pairs starting a second brood consisted of birds aged three or more, whereas the third pair (no. 12) consisted of an adult male and a 1-year old female. Two pairs were assisted by helpers both at first and second broods. Pair 2 had the same two helpers at both broods. Pair 13, however, had two helpers at their first brood which were replaced by two new helpers plus one juvenile from the first brood, i.e. a two-months-old full sibling, demonstrating that helping

behaviour in the Azure-winged Magpie may start as early as at two months of age. Offspring from the first brood of the pair without helpers and with a one-year-old female (no. 12), died soon after fledgling while their parents were attempting to raise a second brood. This suggests that helping may be important for the survival of fledglings, although the age and previous experience of the parents may play a role.

Discussion

Our data indicate that second broods are rare in this species. Many species with cooperative breeding produce more than one brood per year (Brown, 1987). The assistance of helpers may reduce parental effort, and pairs with helpers may increase their success mainly because they can produce more clutches per season (Rowley, 1965; Brown & Brown, 1981; Brown, 1987; Emlen, 1981). The presence of helpers may reduce the time between successive clutches and helpers may provision and care for the fledglings while the female is initiating a new breeding attempt (Stacey & Koenig, 1990). However, one of the pairs that laid a second clutch in our population, was not assisted by helpers and its interbrood interval was shorter than that of the pairs with helpers. This suggests that helping may not be crucial for the parental decision to re-nest, although it may be important for the survival of fledglings from the previous brood.

Even among species with helpers, second clutches are strongly constrained in environments where the favourable season is short. Brown (1987) reviewed the number of broods per season in communally breeding species. Most multibrooded species are tropical or subtropical and have long breeding seasons. Among species with shorter reproductive seasons, environmental factors are crucial in allowing multiple broods. Rainfall appears to be determinant for species inhabiting dry environments. For instance in *Malurus splendens*, the number of successful breeding attempts per season may vary from none to three depending on food availability which is in turn largely determined by rainfall (Ligon & Ligon, 1990). Arabian Babblers *Turdoides squamices* may produce up to three broods after years of heavy rainfall, although in normal dry years they produce a single brood or do not reproduce at all (Zahavi, 1990). Galápagos Mockingbirds *Nesomimus parvulus* produce up to six clutches per female in years with heavy rainfall (Curry & Grant, 1990).

Rainfall is a major environmental constraint on productivity in Mediterranean ecosystems (Herrera, 1980; Olea et al., 1991). Our data suggest that the occurrence of second broods was possible due to higher rainfall in two favourable years after a period of drought. However, in the first rainy year no second broods were found. One possible explanation is that rainfall did not improve the physical condition of parents until the following year. On the other hand, in 1996 predation

was exceptionally high. Most pairs replaced lost clutches and hence fledging date was delayed. Consequently the available time for a second clutch was shorter than in 1997. Therefore, our results suggest that in spite of the presence of helpers-at-the-nest, the following factors may influence the low frequency of second broods in the Azure-winged Magpie: (1) the long duration of the nesting period, over 20 days for egg laying and incubation plus 14-16 days for chick development (over 35 days in total); (2) the short duration of conditions favourable for breeding (less than 90 days between April and June), a typical feature of Mediterranean ecosystems; (3) the very high predation level (Cruz et al., 1990), which makes replacement clutches very common and reduces the chances of an early successful brood that would allow the parents to engage in a new reproductive attempt during the current season.

Acknowledgements. We are grateful to A. M. Pitarch and personnel of Valdesequera estate for permission and facilities, as well as to those students that collaborated at different stages of field work.

References

- Brown, J.L., 1987. *Helping and Communal Breeding in Birds. Ecology and Evolution*. Edited by J.R. Krebs and T. Clutton-Brock. Princeton, New Jersey: Princeton University Press.
- Brown, J.L. & Brown, E.R., 1981. Kin selection and individual fitness in babblers. In: *Natural Selection and Social Behavior* (ed. R.D. Alexander and D.W. Tinkle) pp. 244-256. New York: Chiron Press.
- Calder, W.A., 1984. *Size, function and life history*. Cambridge, Mass: Harvard University Press.
- Cody, M.L., 1971. Ecological Aspects of Reproduction. In: *Avian Biology. Vol. I* (ed. D.S. Farner, J.R. King and K.C. Parkes) pp 461-512. New York: Academic Press.
- Cramp, S. & Perrins, C.M., 1994. *Handbook of the Birds of Europe the Middle East and North Africa. Vol VIII*. Oxford: Oxford University Press.
- Cruz, C., 1988. Contribución al conocimiento de la biología del rabilargo (*Cyanopica cyanus* Pall., 1776) PhD. Thesis, University of Extremadura.
- Cruz, C., De Lope, F & Da Silva, E., 1990. Exito reproductor del rabilargo (*Cyanopica cyanea* Pall.) en Extremadura. *Ardeola* 37(2):179-195.
- Curry, R.L. & Grant, P.R., 1990. Galápagos mockingbirds: territorial cooperative breeding in a climatically variable environment. In: *Cooperative breeding in birds. Long-Term Studies of Ecology and Behavior* (ed. P. Stacey & W. Koenig) pp 289-331. Cambridge: Cambridge University Press.
- Emlen, S.T., 1981. Altruism, kinship, and reciprocity in the white-fronted bee-eater. In: *Natural Selection and Social Behavior* (ed. R.D. Alexander & D.W. Tinkle) pp. 217-230. New York: Chiron Press.
- González, B., 1996. Comportamiento reproductivo del rabilargo (*Cyanopica cyanus*). PhD. Thesis, University of Sevilla.
- Herrera, C.M., 1980. Composición y estructura de dos comunidades mediterráneas de paseriformes. *Doñana Acta Vertebrata*, 7(4):1-340.
- Harvey, P.H., Stenning, M.J. & Campbell, B., 1988. Factors Influencing Reproductive Success in the Pied Flycatcher.

- In: *Reproductive success. Studies of Individual Variation in Contrasting Breeding Systems* (ed. T.H. Clutton-Brock) pp. 189-200. Chicago: University of Chicago Press.
- Hosono, T., 1983. [A study of the life history of the Blue Magpie. II. Breeding helpers and nest-parasitism by cuckoos]. *J. Yamashina Inst. Ornithol.*, 15:63-71.
- Ligon, J.D. & Ligon, S.H., 1990. Green Woodhoopoes: life history traits and sociality. In: *Cooperative breeding in birds. Long-Term Studies of Ecology and Behavior* (ed. P. Stacey & W. Koenig) pp 31-65. Cambridge: Cambridge University Press.
- Olea, L., Paredes, J. & Verdasco, M.P., 1991. Características y producción de los pastos de las dehesas del S.O. de la Península Ibérica. *Pastos*, 20-21:131-156.
- Perrins, C.M., 1965. Population fluctuations and clutch size in the Great Tit, *Parus major*. *J. Anim. Ecol.* 34: 601-647.
- Reiss, M.J., 1989. *The allometry of growth and reproduction*. Cambridge: Cambridge University Press.
- Rowley, I.C.R., 1965. The life history of the superb blue wren. *Emu*, 64:251-97.
- Sacarrao, G.F., 1967. Remarques sur la variation Geographique de la Pie-bleue, *Cyanopica cyanus* (Pall.) dans la Peninsula Iberique, specialment an Portugal. *Arq. Mus. Bocage*, I (12): 241-248.
- Sacarrao, G.F., 1972. Contribution a l'etude de la distribution de *Cyanopica cyanus cooki* BP (Aves-Corvidae) dans la Peninsule Iberique. *Arq. Mus. Bocage*, 3:347-354.
- Stacey, P.B. & Koenig, W.D., 1990. *Cooperative breeding in birds. Long-Term Studies of Ecology and Behavior* (ed. P. Stacey & W. Koenig). Cambridge: Cambridge University Press.
- Zahavi, A., 1990. Arabian babblers: the quest for social status in a cooperative breeder. In: *Cooperative breeding in birds. Long-Term Studies of Ecology and Behavior* (ed. P. Stacey & W. Koenig) pp 105-130. Cambridge: Cambridge University Press.