J. Raptor Res. 30(2):70–73

POSSIBLE SECOND CLUTCHES IN A MEDITERRANEAN MONTANE POPULATION OF THE EURASIAN KESTREL (*FALCO TINNUNCULUS*)

JUAN A. FARGALLO
Departamento de Ecología Evolutiva, Museo Nacional de Ciencias Naturales, C.S.I.C., J. Gutiérrez Abascal 2, E-28006 Madrid, Spain

GUILLERMO BLANCO
Departamento de Biología Animal, Universidad de Alcalá de Henares, Alcalá de Henares, 28871 Madrid, Spain

EDUARDO SOTO-LARGO
Pza. Mariano de Cavia 1, 28007 Madrid, Spain

ABSTRACT.—Three of eleven Eurasian kestrel (*Falco tinnunculus*) pairs from a montane population in central Spain began possible second clutches after chicks of the first had fledged. The mean-laying date of first clutches for double-brooded pairs was earlier than single-brooded pairs and double-brooded pairs laid larger first clutches and fledged more young than single-brooded pairs. Overall, second clutches were less productive. The low latitude and high availability of prey in this study area may explain the occurrence of the second breeding attempts in this species.

KEY WORDS: Falco tinnunculus; *Eurasian kestrel; second clutch; Mediterranean.*

RESUMEN.—Tres de once parejas de Cernícalo Vulgar (*Falco tinnunculus*) en una población montana de España central, iniciaron una presumible segunda puesta tras haber volado los pollos de la primera. Se observó un descenso de la productividad de los cernicalos a medida que avanzó la estación reproductora. La fecha de puesta de las consideradas parejas con dobles puestas fue más temprana que la de las parejas que sólo hicieron una. En las primeras puestas de la parejas que presumiblemente pusieron dos veces, el número de huevos y el de pollos volados fue mayor que en las que sólo hicieron una puesta. Las consideradas segundas puestas fueron menos productivas que el resto de las puestas. La baja latitud junto con la gran abundancia y constante disponibilidad de presas en nuestro área de estudio podría ser la causa de segundas puestas en esta especie.

[Traducción de Juan Fargallo]

Most diurnal raptors outside the tropics raise only one brood per year; however, in some species, some pairs occasionally raise two broods in the same year (Newton 1979). Second clutches have been noted in rodent-eating raptors, such as the American kestrel (*Falco sparverius*) (Toland 1985), white-tailed kite (*Elanus leucurus*) and black-shouldered kite (*E. caeruleus*) (Newton 1979). The breeding cycle of the Eurasian kestrel (*F. tinnunculus*) has been well documented in central and northern Europe (e.g., Cavé 1968, Newton 1979, Village 1990, Palokangas et al. 1992, Cramp & Simmons 1980). No long-term study of the breeding biology of this species has ever documented second clutches in breeding pairs (Cavé 1968, Meijer et al. 1990, Daan et al. 1990, Village 1990) and only one case of a second brood in free-living kestrels has ever been recorded in Spain (Sánchez 1990). In captive kestrels, Meijer (1989) and Meijer et al. (1992) found second clutches under conditions of manipulated photoperiod. Here, we report three instances of possible second breeding attempts in the same year by Eurasian kestrels in a montane area of central Spain.

STUDY AREA AND METHODS

The study was conducted in the Campo Azálvaro region of central Spain (40°40'N, 4°20'W), an extensive grassland area located on the northern slopes of Sierra de Malagón at 1300 m elevation. All nests were checked for occupancy by kestrels and laying dates, clutch sizes, and numbers of young hatched and fledged were recorded. No adult kestrels were banded or color-marked so

adults could not be individually identified. The possible double clutches we are reporting are based on the isolation of individual pairs within the study area and associated field observations that lead us to believe that second breeding attempts were being made by the same females. All nestlings in nest boxes were banded at 15–20 days of age.

RESULTS AND DISCUSSION

Of the 44 kestrel nest sites we observed in the study area in 1993 and 1994, 29 (66%) were in old carrion crow (*Corvus corone*) nests (20 in trees and 9 on metal utility structures), 9 (21%) were in holes of buildings, and 6 (13%) in nest boxes. Three breeding attempts in nest boxes (nests A, B and C) were presumed to be the second breeding attempts of females in the same season. In one case (nest A), the female attempted to breed a second time in the same nest box, and in the two other cases the females moved only 150 m away to the next available nest box. The closest neighboring, breeding females were 1.5–2.5 km away. American kestrels lay their second clutches either in alternative nest sites close to the original nest, or in the same nest if alternative sites are not available (Toland 1985). All three of these females were the first to initiate clutches in the study area. We could not individually identify these females but all three were observed delivering prey to banded fledglings that remained in family groups on top of the nest boxes and these same banded fledglings were observed standing on the tops of boxes while females incubated inside. Because female Eurasian kestrels are aggressive toward intruding conspecific females during the breeding season (Wiklund and Village 1992), it seemed unlikely that other females had both initiated breeding attempts and had adopted fledglings and associated parental feeding behavior.

The three clutches contained one (nest A), four (nest B) and three eggs (nest C), and all three clutches were incubated. Eggs hatched in only one clutch (nest C) which successfully fledged three young. The mean laying date of the first clutches of these three females (29 March) was significantly earlier than for females that attempted to breed only once (10 May) (Mann-Whitney test: $U = 2.35$, $N = 11$, $P = 0.01$) with a difference in median laying dates of 41 days. The laying date of the latest clutch laid by females breeding only once was 27 May. Laying dates of second clutches were 16 June (nest A), 12 June (nest B), and 8 June (nest C). These dates were significantly later than females that laid only once (Mann-Whitney test: $U = 2.3$, $N = 11$, $P = 0.01$). Females laying twice had significantly larger first clutches (6, 6 and 6 eggs) than females that laid only once ($\bar{x} = 4.5 \pm 0.9$, ±SD, $N = 8$; Mann-Whitney test: $U = 2.13$, $N = 11$, $P = 0.03$). The average number of chicks hatched per clutch was smaller in females that laid once ($\bar{x} = 4.0 \pm 1.4$, ±SD, $N = 6$) than in the first broods of females that laid twice (6, 6 and 5), but the difference was only marginally significant (Mann-Whitney test: $U = 1.58$, $N = 9$, $P = 0.1$), probably due to the small sample size. Late clutches (1, 3, and 4) and broods (0, 3, 0) of females breeding twice were smaller than those of females breeding only once but, again, the difference was only marginally significant (Mann-Whitney test: $U = 1.79$, $N = 11$, $P = 0.07$, and $U = 1.83$, $N = 9$, $P = 0.06$, respectively). Females nesting twice averaged a greater number of young fledged (6, 6 and 5) from their first nesting attempts than females that bred only once ($\bar{x} = 3.8 \pm 1.1$, ±SD, $N = 6$; Mann-Whitney test: $U = 1.98$, $N = 9$, $P = 0.04$). Likewise, fledging success of the first brood of females breeding twice was also higher (100, 100 and 83%) than the average fledging success of females that bred only once ($\bar{x} = 80.6 \pm 11.2$, ±SD, $N = 6$). Again, this difference was only marginally significant (t-test: $t = 1.73$, $N = 9$, $P = 0.1$).

In species previously documented to breed more than once in a single season, an early initiation of breeding allows pairs to make a second breeding attempt, while single-brooded pairs delay the onset of breeding until conditions allow them to lay their optimal clutch size (Lack 1954, Klomp 1970, Perrins 1970). This is consistent with our finding that only those females we presumed to have bred twice laid clutches earlier than 1 May and no second clutches were laid by females whose first clutches were laid in May. Sánchez (1990) has also reported that in Spain, Eurasian kestrels typically lay their clutches in May.

In captive and wild, double-brooded American kestrels (Bird and Laguë 1982, Toland 1985) and Eurasian kestrels (Meijer 1989, Palokangas et al. 1992), there is a seasonal decline in clutch size with increasing laying date. When all clutches in our study were considered, we found a similar seasonal decline in clutch size ($r = -0.80$, $F = 22.43$, $df = 1,10$, $R^2 = 65.1$, $P < 0.001$; Fig. 1). These data suggest there may be a seasonal decline in Eurasian kestrel productivity.

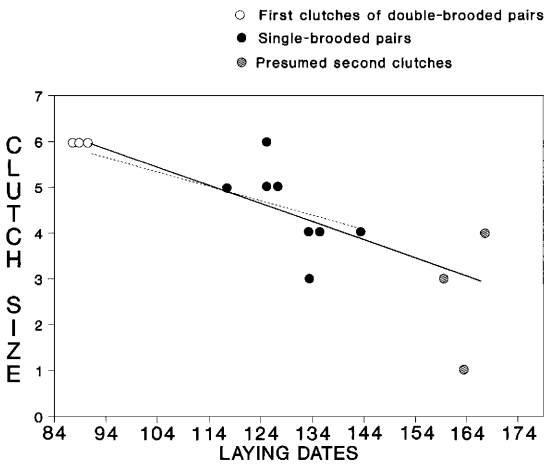

Figure 1. Relationship between clutch size and laying date (1 = 1 January) in clutches (first clutches only dashed line and second clutches only solid line) of Eurasian kestrels in Spain.

In birds of prey, the duration of the breeding season is associated with latitude. The proportion of replacement clutches of large diurnal raptors, with longer breeding cycles and of second clutches of small diurnal raptors with short breeding cycles, is less frequent in the northern portions of their ranges (Newton 1979). An inverse correlation between vole (*Microtus* spp.) abundance and the laying date of Eurasian kestrels has been well documented (Cavé 1968, Dijkstra et al. 1982), and there appears to be a shorter postfledging dependence period (16 days on average) in Eurasian kestrels in Mediterranean regions with a high abundance of prey (Bustamante 1994). We believe that the combination of latitudinal effects and high vole abundance in montane regions of the Mediterranean (Veiga 1982, 1985, 1986), allows an early initiation of breeding in Eurasian kestrels followed by a second breeding attempt in pairs with high-quality territories.

ACKNOWLEDGMENTS

We express our gratitude to Juan Moreno for the support in this work, and to Jaime Potti, H. Pietiäinen, J. Bustamante, G. Bortolotti and an anonymous referee for helpful comments on a previous manuscript. The Junta de Castilla y León gave us permission to ring nestlings, while the landowners (Finat family) allowed us to work on their property.

LITERATURE CITED

BIRD, D.M. AND P.C. LAGUË. 1982. Influence of forced renesting, seasonal date of laying and female characteristics on clutch size and egg traits of captive American kestrels. *Can. J. Zool.* 60:71–79.

BUSTAMANTE, J. 1994. Behavior of colonial common kestrels (*Falco tinnunculus*) during the post-fledging dependence period in southwestern Spain. *J. Raptor Res* 28:79–83.

CAVÉ, A.J. 1968. The breeding of the kestrel, *Falco tinnunculus* L., in the reclaimed area Oostelijk Flevoland. *Neth. J. Zool.* 18:313–407.

CRAMP, S. AND K.E.L. SIMMONS. 1980. The birds of the Western Palearctic. Vol. 2. Oxford Univ. Press, Oxford, U.K.

DAAN, S., C. DIJKSTRA AND J.M. TINBERGEN. 1990. Family planning in the kestrel *Falco tinnunculus*: the ultimate control of covariation of laying date and clutch size. *Behaviour* 114:83–116.

DIJKSTRA, C., L. VUURSTEEN, S. DAAN AND D. MASMAN. 1982. Clutch size and laying date in the kestrel *Falco tinnunculus*: effect of supplementary food. *Ibis* 124: 210–214.

KLOMP, H. 1970. The determination of clutch size in birds. *Ardea* 58:1–124.

LACK, D. 1954. The natural regulation of animal numbers. Clanderon Press, Oxford, U.K.

MEIJER, T. 1989. Photoperiodic control of reproduction and moult in the kestrel, *Falco tinnunculus*. *J. Biol Rhythms* 4:351–364.

———, S. DAAN AND M. HALL. 1990. Family planning in the kestrel *Falco tinnunculus*: the proximate control of covariation of laying date and clutch size. *Behaviour* 114:117–136.

———, C. DEERENBERG, S. DAAN AND C. DIJKSTRA. 1992. Egg-laying and photorefractoriness in the European kestrel *Falco tinnunculus*. *Ornis Scand.* 23:405–410.

NEWTON, I. 1979. Population ecology of raptors. T. & A.D. Poyser, Berkhamsted, U.K.

PALOKANGAS, P., R.V. ALATALO AND E. KORPIMAKI. 1992. Female choice in the kestrel under different availability of mating options. *Anim. Behav.* 43:659–665.

PERRINS, C.M. 1970. The timings of birds' breeding seasons. *Ibis* 112:242–255.

SÁNCHEZ, A. 1990. Noticiario Ornitológico. *Ardeola* 37· 335.

TOLAND, B.R. 1985. Double brooding by American kestrels in central Missouri. *Condor* 87:434–436.

VEIGA, J.P. 1982. Ecología de las rapaces de un ecosistema mediterráneo de montaña. Aproximación a su estructura comunitaria. Ph.D. dissertation, Univ Complutense, Madrid, Spain.

———. 1985. Crecimiento de los pollos de *Falco tinnunculus* en el centro de España, aspectos energéticos y ecológicos. *Ardeola* 32:187–201.

———. 1986. Interannual fluctuations of three microtine populations in mediterranean environments: the effect of the rainfall. *Mammalia* 50:114–116.

VILLAGE, A. 1990. The kestrel. T. & A.D. Poyser, Berkhamsted, U.K.

WIKLUND, C.G. AND A. VILLAGE. 1992. Sexual and seasonal variation in territorial behaviour of kestrels, *Falco tinnunculus*. *Anim. Behav.* 43:823–830.

Received 18 July 1995; accepted 1 January 1996