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ARTIFICIAL NEST STRUCTURE DESIGN AND MANAGEMENT IMPLICATIONS FOR THE LESSER KESTREL (*FALCO NAUMANNI*)

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Abstract.—The European population of the lesser kestrel (*Falco naumanni*) has experienced a sharp decrease in recent decades. Because they nest mainly in man-made structures, building deterioration has been an important cause of local declines when roofs collapse and nest sites become limiting. I tested two designs for artificial nest structures to be used in old buildings and a special roof tile that should increase the availability of nest sites in Spain. The first structure was made of wood and fitted under the roofs of buildings. Of 229 structures installed, 41.4% were occupied by 95 pairs of kestrels nesting in buildings. The special roof tile was tested as a nest entrance in deteriorated roofs. Of 94 tile entries installed, 23 were used by 51.1% of all pairs. The second nest structure was ceramic. Of 29 ceramic structures installed, 10 were used by breeding pairs. Although ceramic nesting structures are easy to install nearly anywhere, care must be taken to avoid locations exposed to the sun because ceramic structures can develop high internal temperatures when exposed to direct solar radiation. Both nest structures and the tile entry can be fitted to old and new buildings to prevent roof deterioration and to allow for the establishment of new colonies.

The lesser kestrel (*Falco naumanni*) is a species whose distribution has decreased dramatically in recent decades (Biber 1990). In Spain, the population decreased from about 100 000 pairs in 1960 to less than 50 000 in 1970 and only 5000 in 1988 (González and Merino 1990). Land-use changes in breeding areas are considered the main cause of the decline (Donázar et al. 1993) but lack of nesting places has also become a serious local problem. In Spain, 95% of these small and colonial falcons nest in buildings (González and Merino 1990), so restoration (closing the small holes in the walls or roofs), deterioration and the collapse of old buildings have caused several colonies to disappear (González and Merino 1990, Negro 1991, Tella et al. 1993). Use of artificial nest structures has been recommended to ease the problem caused by the loss of nest sites (Biber 1990, Blanco and González 1992). Use of these structures has been an effective management tool for European and American kestrels (*Falco tinnunculus* and *F. sparverius*) in areas with poor nest-site availability (Hamerstrom et al. 1973, Village 1983). Despite several efforts to install artificial nest structures in Spain, efforts to reestablish lesser kestrels have had only limited success.

This study tested designs for artificial nest structures that would be easy to install. Two kinds of nest structures and a special entrance tile were designed and tested in several nesting colonies of lesser kestrels.

The study took place in Monegros (Aragon) and Catalonia, Spain. In Monegros, about 98% of the kestrels nested under roof tiles in abandoned buildings. In this area, an increasing population of >200 pairs of lesser kestrels is dispersed over more than 30 colonies (Tella et al. 1993). In Catalonia, a reintroduction program was being developed (Pomarol 1993) and a few small colonies had recently been established.

One artificial nest structure was made out of wood and was fitted under the roofs of buildings (Fig. 1; González and Merino 1990). A total of 229 of these structures was tested from 1990–95. Kestrels could go under the roof tiles through cracks and holes in deteriorated tiles. From there, they entered the nest box through a hole that was bored through the reeds and mud used in the construction on roofs. The entry was approximately 40–60 cm in length and the tunnel was not straight to ensure that the bird could not see directly outside from inside the nest structure. Both characteristics are commonly found in natural, lesser kestrel roof nests. To avoid causing roof leaks, 94 special roof tiles commonly used in new buildings for roof ventilation, were tested in 1993–95 as entryways to nest structures (Fig. 2).

The second nest structure was ceramic and made for easy installation in a variety of conditions. A total of 29 of these structures was tested in 1993–95, in two roofless, ruined buildings (Fig. 3). It had a lateral entrance so females could not see directly out and entry was 8 cm in diameter. Several small holes (0.3 cm diam.) were made in the rear to increase ventilation.

Both nest-box designs and entry tiles were installed in buildings used by nesting kestrels so there was a choice between natural and artificial nest sites.

Because high temperatures can be reached inside ceramic pots exposed to the sun (Tella et al. 1994), three changes were made to ceramic nest structures to determine how the thickness and color of construction materials can affect internal temperatures that develop within these pots. In one case, the ceramic nest structure was made with thin walls (0.5 cm in thickness). In a second case the structure was made with thick walls (1.0 cm in thickness) and in the third case, the ceramic structure

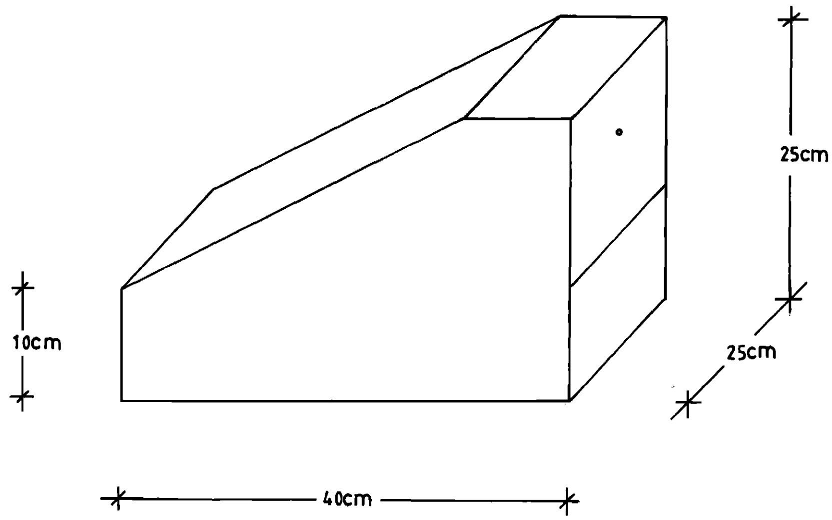

Figure 1. Wooden nest structure installed under tile roofs for nesting lesser kestrels.

was whitewashed. All three types of ceramic kestrel boxes were installed on the same roof and a maximum/minimum thermometer was placed in each. Over a 26-d period in July 1994, maximum daily temperatures were recorded inside these ceramic pots and wooden nest boxes, natural cavities under roof tiles, as well as outside in the shade. Data were analyzed using ANOVA and differences between means was determined with a LSD test.

Forty-one percent of the 229 wooden structures were occupied by 95 known breeding kestrel pairs (Table 1).

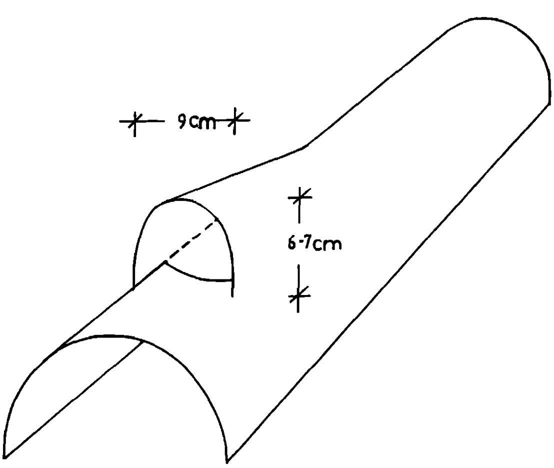

Figure 2. Special tile used as an artificial entrance for the lesser kestrel.

The spotless starling (*Sturnus unicolor*) also used these structures as did a similar species, the European starling (*S. vulgaris*), which has been found to be a regular breeder in many different designs for nest structures (Gauthier 1988). Little owls (*Athene noctua*), jackdaws (*Corvus monedula*), stock doves (*Columba oenas*), dormice (*Elyomis quercinus*) and rats (*Rattus rattus*) also used the structures sporadically.

A total of 94 tiles were fitted in the roofs of buildings used by four colonies of breeding lesser kestrels. Fifty-four were installed in combination with wooden nest structures and 40 were placed over natural cavities. Twenty-three pairs (51.1%) of the 45 known pairs nesting in these buildings chose these tiles as the entrance to their nests and starlings and little owls also used them sporadically.

Twenty-nine ceramic nest structures were located in two colonies. Ten (28.5%) of the 35 known breeding pairs in these colonies nested in the ceramic structures. The only other species to use this type of structure were the spotless starling, house sparrow (*Passer domesticus*) and scops owl (*Otus scops*).

Thin-walled ceramic nest structures developed significantly higher mean temperatures (41.3 ± 3.2°C, $P < 0.05$) than thick-walled ceramic structures (39.1 ± 3.5°C), whitewashed ceramic structures (34.9 ± 2.3°C), natural cavities (37.0 ± 2.5°C) and wooden nest boxes under roofs (33.3 ± 1.6°C). Temperatures in wooden nest boxes installed under roofs also varied less than did temperatures in ceramic structures ($P < 0.05$).

Wooden nest structures were easy to check from inside buildings minimizing disturbance to colonies. Unfortu-

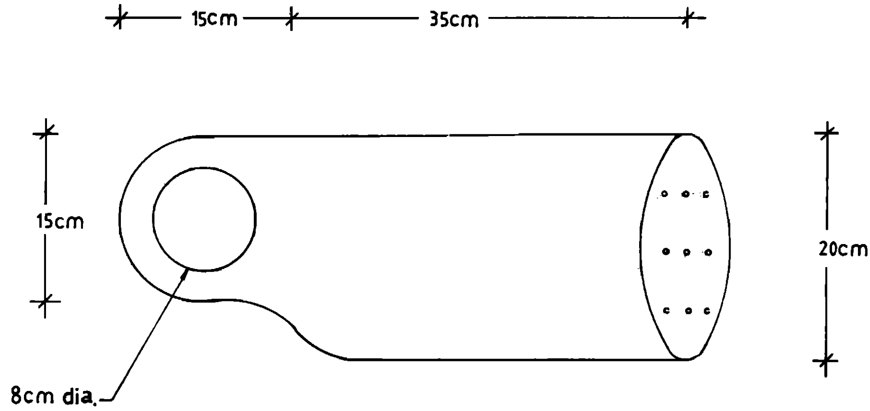

Figure 3. Ceramic nest structure used for nesting lesser kestrels.

nately, they could not be used in all buildings, particularly in ruins with no roofs or in buildings where it was not possible to reach spaces under roofs.

Different materials have been used in constructing artificial nest structures (Soulliere et al. 1992), but few designs have incorporated ceramic materials (Bernal 1991). Ceramic nest structures have the advantage of being easy to install in any building (they are simply attached with concrete) and they do not deteriorate easily. However, they have a drawback in their potential to develop high internal temperatures. Temperatures as high as 49°C was reached inside ceramic structures during this study and temperatures as high as 55°C have been reported by Tella et al. (1994). Temperature extremes are not only lethal to chicks but also eggs (Webb 1987). Varnishing ceramic structures causes even higher temperatures to be reached (Bernal 1991). My results showed that only ceramic nest structures with thick and white-washed walls should be used in places exposed to sun.

Table 1. Use artificial nest structures by lesser kestrels in Spain.

YEAR	# OF COLONIES	# OF NEST STRUCTURES	# OF NEST STRUCTURES OCCUPIED	% OF PAIRS NESTING IN BOXES
1990	1	10	8	30.7%
1991	4	48	19	21.8%
1992	4	48	26	31.7%
1993	8	65	33	35.8%
1994	2	29	5	38.4%
1995	2	29	4	36.3%
TOTAL	21	229	95	30.5%

To prevent further declines of the lesser kestrel in Spain, reconstruction of buildings supporting breeding colonies of lesser kestrels should be done outside the breeding season and the holes or cavities in walls of these buildings that are suitable for nesting kestrels should not be closed, as has already been proposed by González and Merino (1990) and Biber (1990). If holes must be repaired, nest structures similar to those I tested should be used, even in new buildings, to provide lesser kestrels with the opportunity to nest and recolonize previously occupied areas. Use of special roof tiles as access openings to nests also makes it possible to equip roofs with artificial cavities for lesser kestrel colonies without causing harm to buildings. A simple solution would be to subsidize the use of these tiles in new constructions in appropiate areas.

RESUMEN.—Las poblaciones de cernícalo primilla han padecido una fuerte regresión en las ultimas décadas. Debido a que esta rapaz nidifica principalmente en edificios, la escasez de lugares de nidificación motivado por las reconstrucciones o el deterioro de estos, son una causa local importante de desaparición. Dos tipos de cajas-nido y una teja especial han sido recientemente probados con éxito. El primero fue hecho de madera, y fue colocado bajo el tejado. De 229 cajas instaladas, el 41.4% fueron usadas por el 30.5% de las parejas nidificantes en esas colonias. Para evitar el deterioramiento del tejado, se probó una teja especial que sirviera de entrada al nido. De 94 tejas, 23 fueron utilizadas por el 51.1% de las parejas. La segunda caja nido fue hecha de cerámica. De 29, 10 fueron utilizadas por el 28.5% de las parejas. Aunque esta puede ser utilizada en cualquier sitio, se debe tener cuidado por las altas temperaturas que se pueden alcanzar en su interior. Todos estos nidos artificiales pueden ser colocados tanto en edificios nuevos

como viejos, evitando el deterioro de estos y favoreciendo el establecimiento de nuevas colonias.

[Traducción del Autor]

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