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# SELECTION AND USE OF NEST SITES BY BARN OWLS IN NORFOLK, ENGLAND

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ABSTRACT.—Between 1989 and 1993 reproduction was monitored at 96 barn owl (*Tyto alba*) breeding sites in England. Nests were located in tree cavities, buildings, and nest boxes in farm buildings and mature trees. Many of the sites other than nest boxes used by owls were of human origin, but the number of those declined during the course of the study due to deterioration of human-made structures and competition from other species. Nest boxes increased the population density from 15 breeding pairs/100 km² to 27 pairs. Over the study period, pairs using nest boxes produced significantly larger clutches than at other sites, but the number of fledglings was not significantly different among types of nest sites.

KEY WORDS: *barn owl; breeding ecology; England; human-altered habitats; nest boxes;* Tyto alba.

Selección y uso de sitios de nidificación por *Tyto alba* en Norfolk, Inglaterra

RESUMEN.—Entre 1989 y 1993 se monitoreó la reproducción en 96 sitios reproductivos de *Tyto alba*. Los nidos se localizaron en cavidades de árboles, edificios, cajas anideras en construcciones agrícolas y árboles maduros. Mucho de estos sitios, aparte de las cajas anideras, usados por *T. alba* fueron de origen humano, pero el número de ellos declinó durante el curso del estudio debido al deterioro de las estructuras artificiales y a la competencia con otras especies. Las cajas anideras incrementaron la densidad poblacional de 15 parejas reproductivas/100 km² a 27 parejas. En el período de estudio, las parejas que usaron las cajas anideras produjeron nidadas significativamente más grandes que en otros sitios, pero el número de volantones no fue significativamente diferente entre los distintos tipos de sitios.

[Traducción de Ivan Lazo]

The barn owl (*Tyto alba*) is currently classified as vulnerable in northwest Norfolk, England by Shawyer (1987) who recorded a 66% decline to just 82 breeding pairs and a density of 2.9 pairs per 100 km² from the 240 pairs and 8.4 pairs per km² recorded by Blaker (1933). A survey of this area found that 60% of the barn owl population used natural tree cavities for nesting (Johnson 1991). Regional trends in the type of nesting site selected by a barn owl population have been reported in Bunn et al. (1982).

Artificial nesting sites have been readily used by owls and have been widely used in long-term studies of owls (Southern 1959, 1970, Korpimäki and Sulkava 1987, Saurola 1989). By providing nest boxes, the breeding population densities of owls were increased above the levels previously thought to be limited by the availability of natural sites. Lenton (1978) demonstrated that the breeding density of previously rare barn owls in Malaysia could be increased with the provision of nest boxes. On the other hand, the naturalness of results obtained from nest-box studies has been criticized by Møller (1989, 1992).

The primary objectives of this study were to monitor and compare reproductive levels between natural and nest-box breeding sites, and to promote a sustainable expansion of breeding barn owls by extending the range and number of nesting site types.

## METHODS

The study area (10 × 15 km) was intensively farmed in individual units ranging from 300–15 000 ha. Principle crops were winter and spring cereals, sugarbeets, and rough grassland.

Nest sites were located during 1989–90 by methodically searching all possible structures, interviewing landowners, and by following birds to their nest sites. The locations of all potential natural nesting sites were recorded, together with details of their dimensions.

Nest boxes placed in buildings ($N$ = 43) were constructed from 8 mm exterior grade plywood and located in suitably safe and quiet sites on every farm within the study area. Tree-mounted nesting boxes ($N$ = 17) were made from 19 mm exterior grade plywood for increased thermal insulation because this species is known to be sensitive to extreme cold (Johnson 1974). Tree-mounted

Table 1. Reproduction by barn owls at four nest site types in Norfolk, England. Tabular values are percentages or mean ± 1 SD. Numbers of nest types are in parentheses.

| REPRODUCTIVE PARAMETERS | NEST SITE TYPES | | | |
|---|---|---|---|---|
| | TREE BOX (8) | BUILDING BOX (43) | TREE CAVITY (28) | BUILDING (14) |
| Percent of site use | 29.4 | 25.6 | 57.1 | 10.6 |
| Clutch size | 5.4 ± 1.8 | 5.0 ± 1.4 | 4.3 ± 1.3 | 3.9 ± 1.1 |
| Brood size | 4.1 ± 1.7 | 3.7 ± 1.2 | 3.3 ± 1.2 | 2.9 ± 1.4 |
| Fledglings | 4.1 ± 1.7 | 3.1 ± 1.1 | 2.9 ± 1.2 | 2.6 ± 1.3 |
| Fledglings/eggs | 75.0 ± 9.2 | 65.8 ± 21.3 | 66.3 ± 18.5 | 64.9 ± 25.1 |

boxes replicated the darkness found in deeper natural tree cavities by incorporating a baffle to shield the entrance hole from the nesting chamber and increase the protection of birds from weather and predators (Johnson 1990). Tree nest boxes were erected in areas lacking suitable buildings and were mounted on old tree stumps and telegraph poles 3 m above the ground. All boxes were lined with wood chips.

All sites were monitored at 8-wk intervals throughout the year. The frequency of visits was increased to every 3 wk during the breeding season from March to September at occupied sites. Egg clutch size and initial brood size were determined at all sites. The number of young of fledging age was recorded during visits to band young at 5–6 wk of age.

Data were analyzed for differences in selection of site types and productivity between natural nesting sites and nesting boxes using Chi-square analysis. Because the data for the reproductive efforts were not normally distributed, data on clutch, brood, number of fledglings, and fledgling/egg among the four site types were compared using the Kruskal-Wallis test. Comparisons of clutch, brood, and fledglings/brood produced in natural sites and in all types of boxes were done using the Mann-Whitney $U$-test.

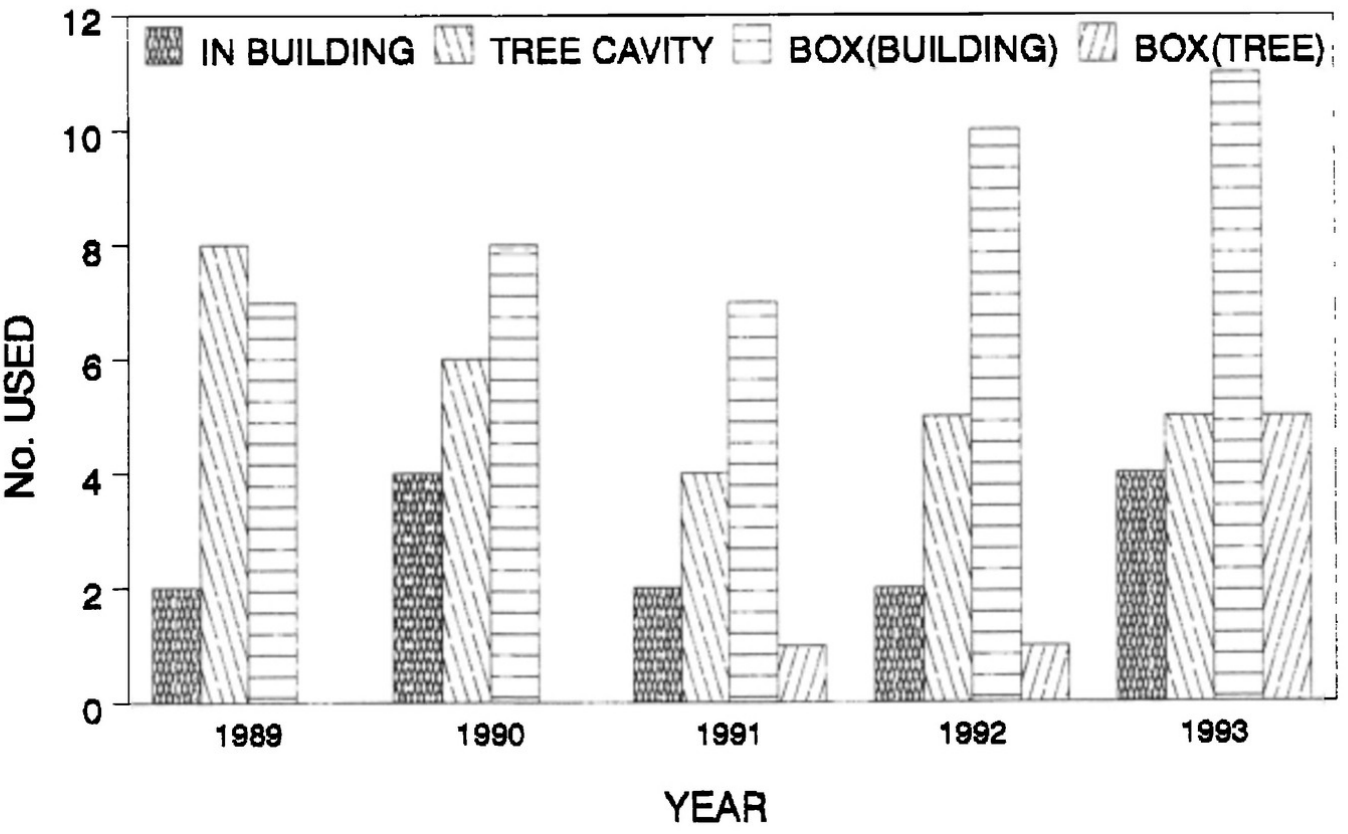


Figure 1. Nest sites available in the study area.

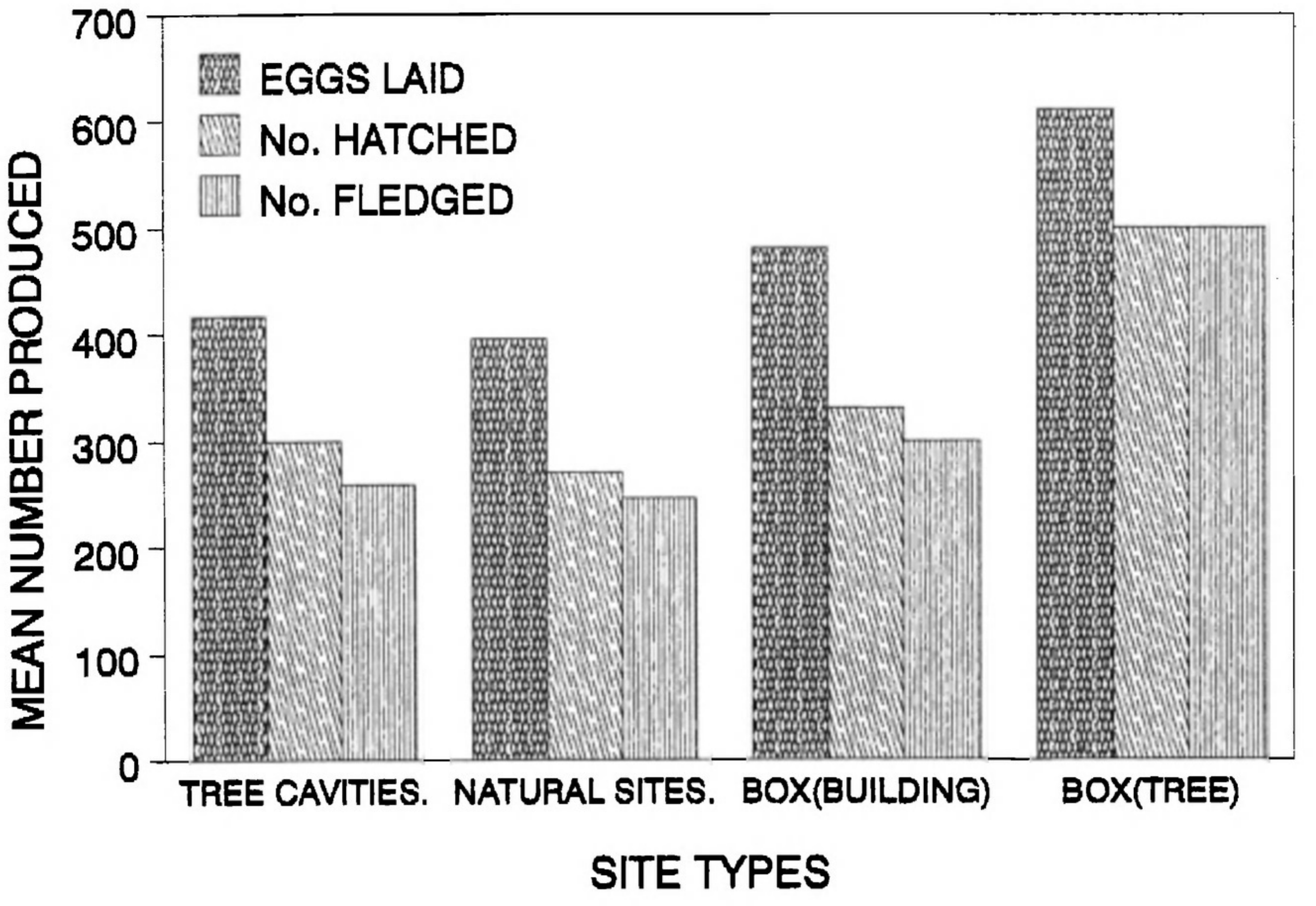


Figure 2. Nest site use by barn owls, 1989–93.

## RESULTS AND DISCUSSION

Site use and reproductive data are shown in Table 1. Tree cavities were used at a higher rate than non-box sites in buildings ($P = 0.06$). The combined data for nest boxes versus all other types showed no significant difference in selection relative to availability ($\chi^2 = 0.3$, NS). Tree boxes produced more eggs, but not significantly more fledglings than other site types (Kruskal-Wallis, $H = 9.6$, $P = 0.02$ for clutch; $H = 6.3$, $P > 0.08$ for brood and fledglings).

Significant differences were found in the clutch and brood sizes and the numbers of young produced between nest boxes and other sites, but productivity of fledglings in relation to clutch sizes was comparable between natural and artificial sites, (Mann-Whitney $U = 802$, $P < 0.04$ for the first three, but $U = 1005$, NS for productivity). Therefore, box sites apparently do produce a greater reproductive effort, but not necessarily a greater reward. Overall, productivity of fledged young (number of young fledged/number of eggs laid) in this study was 66.6% (SD = 20.3), which compares favorably with an average of 62.5% (SD = 14.8) for 11 other species of cavity-nesting owls (F.R. Gelbach pers. comm.).

My early survey results (Johnson 1991) showed a 58% use of large tree cavities and only 31% use of buildings by breeding owls in comparison to a national trend of 64.6% nesting in buildings and 24% in trees (Shawyer 1987). Within the study area, the three pairs nesting in buildings used lofts in derelict houses or abandoned military buildings. These findings are in line with other studies in the East Anglian region. Cayford (1992) also found a high proportion of nest sites in tree cavities; only buildings with lofts or nest boxes were used as breeding sites. Such features and natural sites were scarce in the area prior to this study (Fig. 1). Tree cavities were used in ash (*Fraxinus excelsior*; $N = 5$), oak (*Quercus robur*; $N = 5$), elm (*Ulmus procera*; $N = 3$), and beech (*Fagus sylvatica*; $N = 1$). The low annual rainfall in the region ($\bar{x} = 65$ cm compared to 100–300 cm nation-

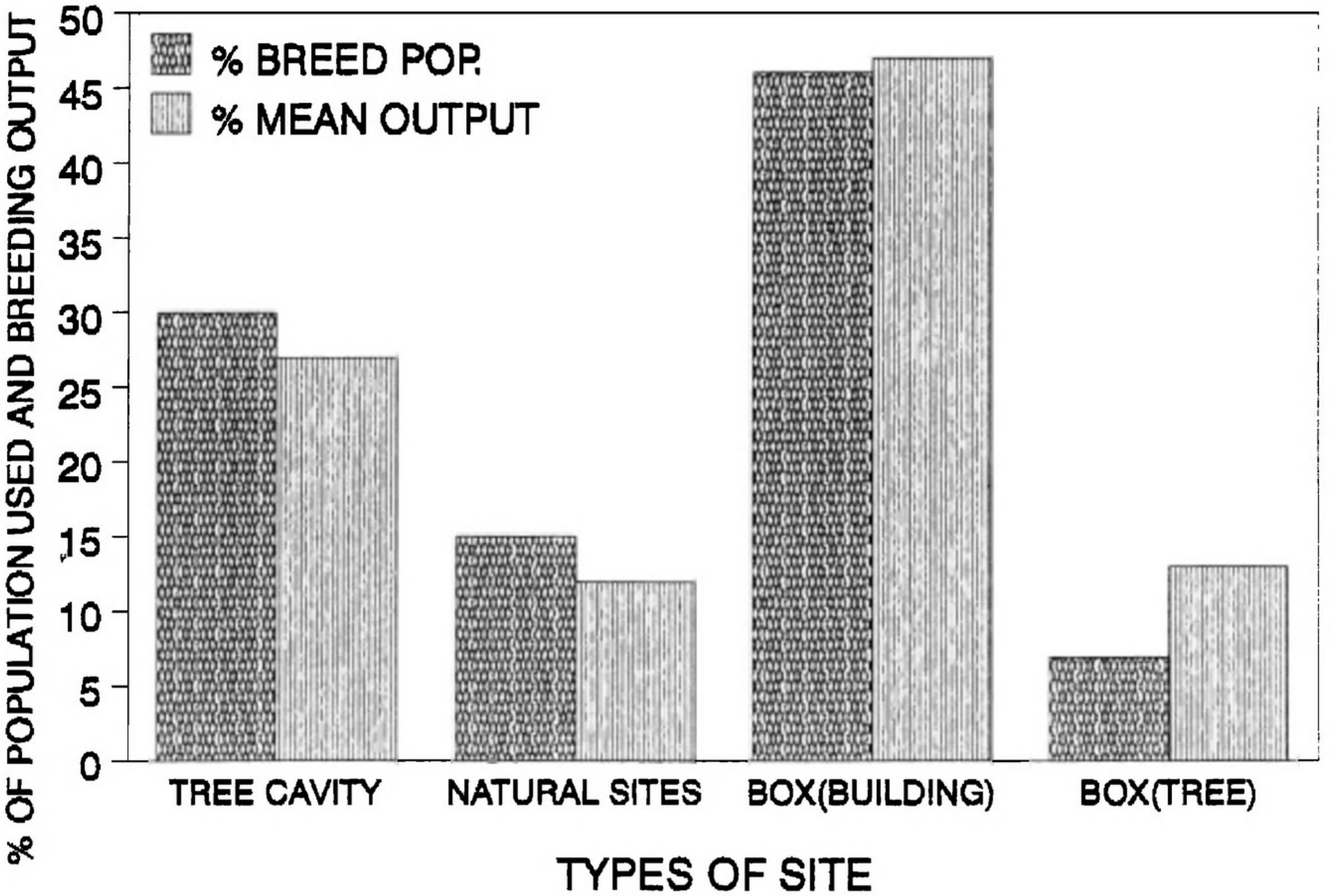


Figure 3. Reproductive performance by barn owls in four types of nest sites.

ally) is thought to be a critical factor allowing such open structures to be used successfully (Shawyer 1987). The loss of elms to disease across the region has significantly reduced the availability of tree cavities. Osbourne and Krebs (1981) estimated a loss of over 11 million trees nationally, which has increased competition among other cavity-nesting species.

The tawny owl (*Strix aluco*), often viewed as a nest-site competitor with the barn owl (Shawyer 1987), only used one box during this study. Whereas, the jackdaw (*Corvus monedula*) proved to be a major competitor for tree cavities and tree nest boxes requiring the annual removal of jackdaw nest material which would otherwise restrict access by barn owls.

Predation by a stoat (*Mustela erminea*) caused the permanent desertion of one nest box in a building, and deliberate human disturbance in buildings caused the loss of clutches during incubation.

The widespread felling of decaying trees has had the greatest impact on the density of suitable natural breeding sites during this study. The observed trend for nesting barn owls was an increased use of nest boxes and a decline in the availability of natural tree cavities (Fig. 2). Eleven (25%) of the 43 nest boxes erected in buildings were used, together with five (41%) of the 17 tree boxes, increasing the breeding population density within the study area from 23 to 41 pairs, an increase of 178% during the 5 yr of the study. Much like the situation described by Lenton (1978), the increased barn owl population recorded in my study is attributable to the wider availability of good quality nest sites. Nesting sites were apparently a limiting factor on the population and without the provision of nest boxes the deterioration of natural sites available would have reduced the density of breeding pairs.

Data for all site types clearly show a reduction in brood size from the number of eggs laid (Fig. 3 and Table 1). This was attributable to the common occurrence of infertile eggs in clutches. A further reduction between hatching and fledging was recorded for all sites except tree boxes. Partial brood mortality is often a symptom of poor food supply to the brood (Southern 1959) but was attributable to predation in three present cases.

Taylor and Massheder (1992) using data from southwest Scotland, modeled a population that required a mean reproductive output of 3.2 young per pair to maintain a population and 3.5 young per pair to produce a sustained population growth. If applicable to this study area, only the pairs using nest boxes were achieving this level.

To safeguard this threatened species, nest boxes need to be correctly located and maintained in order to increase the potential breeding density determined by foraging area and prey density. For the mid- to long-term future in this area, conservationists must protect and enhance the remaining habitat and restrict tree felling across the region. A revival of historic tree management, particularly pollarding, would stimulate the growth of trees with widened trunk diameters and provide spacious natural cavities in time. Within this intensively human-manipulated environment, a comparison between "natural" and man-made structures is not valid. Many natural structures are in unnatural locations, only the quality of the structure and surrounding environment varies and perhaps directly influences the nesting success and density of the breeding barn owl population. Only species that build their own nests can locate in optimum foraging conditions. By selecting nest boxes in trees or buildings barn owls are adapting to an adequate substitute for losses of natural sites and show reproductive output equivalent to that of other sites.

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