

CHANGES IN HOUSE SPARROW POPULATION SIZE, BREEDING SUCCESS AND BREEDING PATTERN ON LUNDY

By

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ABSTRACT

Since 1995, house sparrows (*Passer domesticus*) on Lundy have been under intensive and systematic investigation for doctoral research projects. During this period, the population of house sparrows has undergone some notable changes. Since the introduction of a group of house sparrows from the mainland in 2000, following the unexpected population crash in 1997, the population has grown remarkably. The year 2004 saw the largest population size, the largest number of breeding individuals, and the earliest start of breeding, but this year also suffered from the poorest breeding performance in terms of the number of fledglings produced per pair. This paper presents the observed changes in the Lundy house sparrow population since 1995 and discusses possible causes for the changes.

Keywords: *House sparrows, Population change, Breeding success, Breeding patterns, Domestic chickens.*

INTRODUCTION

Recent decades have seen an unprecedented decline in house sparrows (*Passer domesticus*) populations in Britain and in many other western European countries (Gibbons, 1993; Krebs *et al.*, 1999; Siriwardena *et al.*, 2002). Although this dramatic decline has provoked much debate and speculation by the public, as well as by academics, the actual causes remain unclear. For example, Hole *et al.* (2002) suggested that the decline in house sparrow populations in rural areas in southern England was due to agricultural intensification which had reduced winter food supply resulting in local extinctions. Although their evidence seems valid, their study did not provide all of the answers to the observed decline in house sparrows. For example, it does not solve the mystery of the disappearance of house sparrows in some urban areas. The opposite trend observed in the house sparrow population (an increase) on Lundy in recent years is reported in this paper. Interesting observations on changes in breeding success and breeding patterns are also reported and the possible factors that may be causing these changes are discussed.

METHODS

Study species

House sparrows are a sexually dimorphic species in which the males possess a melanin-based black patch on the throat and chest, which shows a large variation in size; females lack this black patch (Summers-Smith, 1963). House sparrows live in flocks throughout the year. They are socially monogamous birds (although frequently unfaithful to their partner, or genetically promiscuous: Wetton *et al.*, 1992) with multiple breeding episodes within each season. Both males and females share incubation and provisioning (Cramp & Perrins, 1994). It takes approximately 14-16 days for eggs to hatch after the first egg is laid and another 16-20 days before the chicks fledge from the nest. In Great Britain, each pair normally produces one to three clutches in a season, but at lower latitudes some pairs will attempt four clutches within a season (Summers-Smith 1963).

Brief history of house sparrows on Lundy

The first house sparrows on Lundy are thought to have emigrated from the mainland to the island. Natural migration of house sparrows from the mainland to Lundy is rare (the minimum distance is 19 km) because of their sedentary nature and flight ability not suited for a long continuous distance (Summers-Smith, 1963). The estimated rate of natural migration between 1944 and 1978 was three birds every four years (Griffith *et al.*, 1999a). Although it is likely that house sparrows inhabited Lundy for hundreds, if not thousands, of years, the first published record was reported by Loyd (1922) who observed five breeding pairs in 1922. Wynne-Edwards and Harrison (1932) reported that 22 pairs were present in 1930. However, during the 1940's and 1960's, house sparrows were effectively absent from the island because they were actively controlled to protect stored winter grain (Lundy Field Society Annual Reports, 1947-1970). In 1972 a group of breeding pairs were again observed and, after a gradual population increase, numbers stabilised between 35-50 breeding pairs in recent years (Lundy Field Society Annual Reports, 1973-1996).

In 1990, I.P.F. Owens initiated a formal study of house sparrows on the island as part of a project led by Professor Terry Burke (previously at the University of Leicester but now at the University of Sheffield), erecting approximately 80 nestboxes (by 1994, over 95% of breeding occurred in the nestboxes: Griffith *et al.*, 1999a). Since then, the population has been subject to intensive research programs by three postgraduate students: S. C. Griffith between 1995 and 1997 (Griffith, 1998), N. Ockendon between 2000 and 2002 (Ockendon, 2003), and S. Nakagawa (the author) from 2003 to present. In the winter of 1996-97 an unexpected population crash occurred when many sparrows died, apparently from consuming grain laced with Difenacoum, intended for controlling the number of rats on the island, even though the bait was placed in 'bird proof' containers. Although the bait types were quickly changed once the problem was identified, only 15 breeding pairs were observed in

the 1997 breeding season. In 2000, N. Ockendon introduced 49 house sparrows from Morthen, a small village in South Yorkshire (53.24.16⁰N, 1.14.58⁰W) (under English Nature licence). Twenty-nine birds (19 males, 9 females) settled on the island and, at the time of introduction, 44 adult native birds (24 males, 20 females) were present. Since the introduction of the mainland house sparrows, the population has continued to rise. It should also be noted that in 1995 S. C. Griffith introduced a flock of 15 chicks to the island in order to maintain a food supply for sparrows during winters. Chicken food is a crucially important food source for sparrows during the winter, when much of the adult and juvenile mortality occurs (S.C. Griffith, *personal communication*). Chicken feathers are found in almost all of the house sparrow nests, acting as heat insulation.

General observation protocols

During the breeding seasons of 1995, 1996, and 2000 to 2004, all nestboxes (80-90 between 1995-2003 and 114 in 2004) were checked regularly to record dates for the first egg of each clutch, the number of hatchlings, and the number of fledglings. Each chick, which survived to day 12 (where day 1 is the day of hatching), was marked with one metal ring (supplied by British Trust for Ornithology, BTO) and with three plastic rings whose colour combination is unique for each individual. Breeding individuals were identified by observing this ring combination or capturing them at the nestbox. During this intensive study period, over 95% of house sparrows were marked at any one time.

RESULTS AND DISCUSSION

Population size during the breeding season and other breeding parameters are listed in Table 1. The table also includes the estimated numbers of chickens on the island. The number of breeding females is presented rather than that of breeding pairs because a small number of males were found to be polygamous (Griffith, 1998; Griffith *et al.*, 1999b). Since the introduction in 2000, the total number of birds and the number of breeding females has gradually increased. The increases between 2003-2004 (total number 114 to 172 and breeding females 52 to 81, respectively) were especially remarkable, considering that the stable population was between 30-50 breeding pairs before the population crash in 1997. Two possible explanations are suggested for this increase. The first is the start of more intensive chicken farming in 2003 (chicken population size 100), which almost certainly increased the abundance of food for adult sparrows all year round and increased their winter survival. The second is the recent climatic tendency for mild winter weather, which may have enhanced winter survival (see Watkinson *et al.*, 2004). It is likely that both of these factors played a part in the increase of the population size to its current peak of 172 birds in 2004.

Other notable patterns in Table 1 are the total and average numbers of hatchlings in 2003 and 2004 (total hatchlings 419 and 622 and average numbers 8.1 and 7.7 respectively; Table 1).

The increase in the number of breeding birds cannot entirely explain the observed rise in these numbers. The explanation may lie in the observed change in breeding patterns shown in Table 2. The dates for the first and last fledglings are presented rather than dates for the first and last clutches. The first laid or the last laid clutches of the breeding season often fail, and therefore the dates for the first and last fledglings are more important. The effective breeding days given in Table 2 are calculated as the difference between the dates for the first and last fledglings. It is noteworthy that the dates for the first fledglings show a tendency to become earlier and that in 2004 the first set of chicks fledged 45 days earlier than in 1995. In contrast, the dates for the last fledglings were within 18 days of each other and showed no apparent trend. A trend towards earlier breeding has recently been reported in many avian species across the world (e.g. Mexican jay, *Ahelocoma ultramarina*, Brown *et al.*, 1999; pied flycatcher, *Ficedula hypoleuca*, and collared flycatcher, *F. albicollis*, Both *et al.*, 2004). This trend for earlier breeding by house sparrows on Lundy resulted in a longer breeding season; the number of effective breeding days was greatest in 2004 (117 days).

Although most of the population have tended to increase through time, the average fledging number per pair in 2004 (2.9) was the poorest for all of the recorded years. Figure 1 shows the hatchling to fledgling success in percentage (number of fledglings / number of hatchlings x 100) during the study period. The success rate in 2004 (38.1%) is particularly low compared with other years, and was less than half of that seen in 2001 (80.3%; the highest success). Two possible explanations are suggested for this poor performance in 2004, both related to the fact that hatchlings are obligatorily insectivorous until 4 to 5 days old (Summer-Smith, 1963). Thus, if the weather condition is adverse during this critical period (house sparrows show relatively synchronous breeding patterns), parents will fail to find enough insects or other invertebrates to feed chicks, resulting in mortality of chicks (chick mortality was observed to be much higher during this period than any other periods). Alternatively, it may be that the limited supply of insects on the island has remained constant, and that the number of hatchlings in 2004 exceeded the carrying capacity of the island. In order to clarify which of these suggestions is more likely, the study of the house sparrows on Lundy will be continued by the University of Sheffield. Future studies will concentrate on the relationship between breeding success and both climatic change and the carrying capacity of the island.

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Table 1. Estimated house sparrow population sizes during breeding seasons, other breeding parameters, and estimated numbers of farmed chickens (the numbers of fledged chicks were estimated as the numbers of chicks ringed at day 12; over 95% of these subsequently fledged)

Year	1995	1996	1997-1999	2000	2001	2002	2003	2004
No. of birds	73	102	30-40	78	82	99	114	172
No. of breeding females	30	46	ca. 15	25	35	46	52	81
No. of hatchlings	166	322	N/A	153	203	278	419	622
No. of fledged chicks	103	197	N/A	93	163	175	234	237
Mean no. of hatchlings per pair	5.5	7.0	N/A	6.1	5.8	6.0	8.1	7.7
Mean no. of fledglings per pair	3.4	4.3	N/A	3.7	4.7	3.8	4.5	2.9
No. of chickens	15	20	15-20	15	15	30	100	60

Key. Sources of data (1995-1999): Griffith (1998; *personal communication*), (2000-2002): Ockendon (2003; *personal communication*), (2003-2004): this study.

Table 2. The dates for the first and last fledglings of each breeding season and the effective number of breeding days (the difference between the first and last fledging date).

Year	1995	1996	1997-1999	2000	2001	2002	2003	2004
Date for first fledglings	6 Jun	31 May	N/A	27 May	29 May	8 May	10 May	23 Apr
Date for last fledglings	14 Aug	28 Aug	N/A	30 Aug	12 Aug	22 Aug	26 Aug	18 Aug
Effective breeding days	66	89	N/A	93	74	106	107	117

Key. Sources of data (1995-1999): Griffith (1998; *personal communication*), (2000-2002): Ockendon (2003; *personal communication*), (2003-2004): this study.

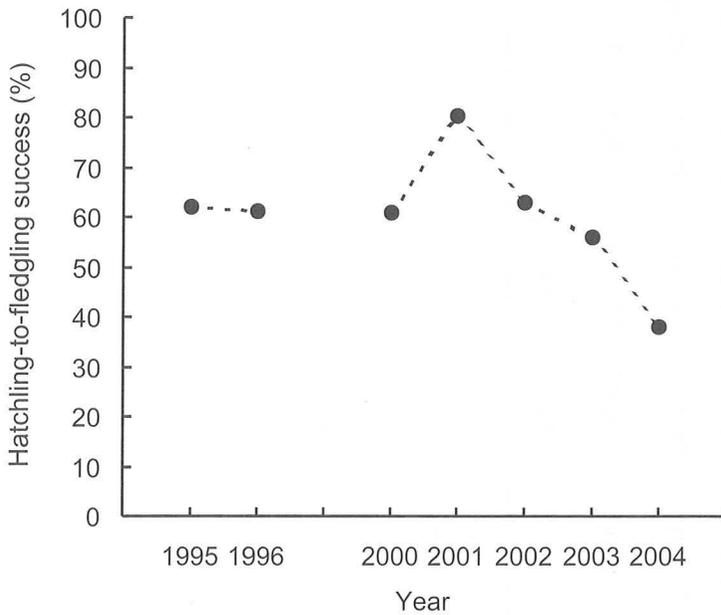


Figure 1. Changes in hatching-to-fledgling success during the intensive study periods.

Key. Sources of data (1995-1999): Griffith (1998; *personal communication*), (2000-2002): Ockendon (2003; *personal communication*), (2003-2004): this study.