

The decline of the House Sparrow: a review

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292. House Sparrow *Passer domesticus*. Tim Loseby

ABSTRACT The House Sparrow *Passer domesticus* population in Britain suffered a major decline in the 1920s, particularly in built-up areas, which coincided with the replacement of the horse by the internal combustion engine. The mixed fortunes of House Sparrows since then are examined, emphasising that factors operating on farmland populations differ from those in towns and cities. Farmland sparrows decreased by about 60% between 1979 and 1995, but then stabilised at a new, lower level; this decline is attributed to changes in agricultural practices. The situation with sparrows in built-up areas is much more complex, with a gradual decline until about 1990. Since then, a massive decrease has led to almost complete extinction in some urban centres, while in the suburbs and small rural towns, sparrows have decreased little, if at all. Some speculative ideas are put forward to account for the situation in built-up areas.

The recent decline of the House Sparrow *Passer domesticus* in the United Kingdom and parts of western Europe is widely recognised (Summers-Smith 1999; Crick *et al.* 2002). Indeed, in December 2002, the *Telegraph Magazine* considered the species' appearance on the Red List of UK endangered species (Gregory *et al.* 2002) as one of the notable events of the

year! This paper aims to review the present situation, recognising that there are substantial differences in what is happening in farmland, urban centres, and small rural towns and suburbs, and also between the UK and the neighbouring continental mainland. The decline of the House Sparrow in farmland parallels that of many other farmland species, but

the situation in built-up areas is much less clear. Some ideas are put forward with a view to identifying areas of possible future research.

The farmland situation

Data on House Sparrows in farmland are provided by the BTO's Common Birds Census (CBC), which gives a population index based on annual surveys of 200-300 sample areas, each of approximately 100 ha, distributed across the UK (Marchant *et al.* 1990). Although the CBC began in 1962, sufficient data were not available to obtain a reliable index for the House Sparrow until 1970. Fig. 1, the House Sparrow index from 1970 to 1999, shows an increase up to 1979 followed by a decline of about 60%, although this had flattened out by 1995, suggesting that the farmland population has now stabilised at a new, lower level. This decline is in line with that of many other farmland species (Fuller *et al.* 1995) and is attributed to changes in farming practices:

- the switch from spring- to autumn-sown cereals
- increased use of pesticides
- increased use of herbicides
- the switch from haymaking to cutting for silage before the grass has set seed
- reduced spillage of grain and improved storage to meet EU regulations

These changes have reduced food availability, both of seeds, which sustain birds throughout the year, and of invertebrates, which are required by House Sparrows for rearing young

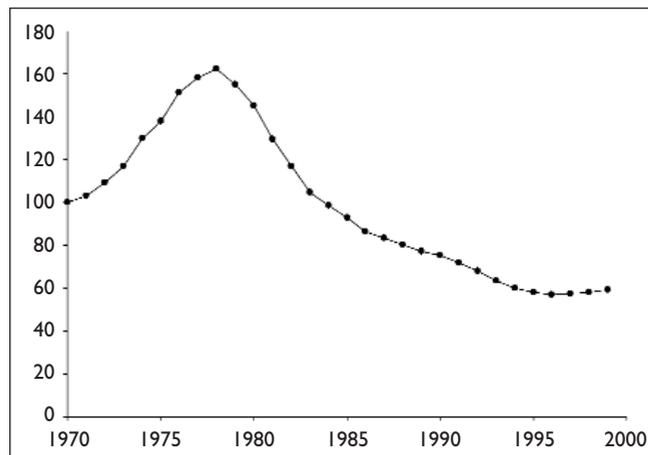


Fig. 1. Population index for the House Sparrow *Passer domesticus*, 1970-1999, based on BTO Common Birds Census data.

(Summers-Smith 1980). Studies have suggested that a major impact has been a reduction in the survival rate (Siriwardena *et al.* 1999), specifically of first-year birds (Crick *et al.* 2002), rather than a decrease in productivity.

The situation in built-up areas

The CBC has two limitations as far as the House Sparrow is concerned. First, results are limited to farmland and woodland, and thus provide little information about built-up areas, the prime habitat for this species. Second, the CBC is biased towards the populous southeast, so that the results do not necessarily reflect the true situation throughout the UK. The only trend data for House Sparrows in built-up environments come from Kensington Gardens, London; these include autumn counts, which began in 1925 and have been repeated somewhat erratically since then, together with counts in five years during spring and the breeding season (Sanderson 1995, 1999, 2001). These data are presented in fig. 2, where the breeding-season counts are plotted as estimates of the previous autumn's counts, assuming a 25% winter mortality (Summers-Smith 1959). Fig. 2 shows a decline which appears to have occurred in three phases. A steep decline in the 1920s was caused by the replacement of the horse with the internal combustion engine and the consequent loss of food to House Sparrows, in the form of spillage from nosebags and undigested seed in horse droppings (Summers-Smith 1963). There is only one count available for this period, but it is likely that by the start of the 1930s the population had eventually stabilised

at a new level (this phase is shown tentatively by a dashed line). Subsequently, a gradual decline from 1945 to 1975 is followed by a rapid decline from about 1990/91 to 2001. The transition from the second to the third phase is not defined precisely, but for the sake of illustration the phases are joined by extrapolation of the lines of best-fit. Anecdotal evidence in support of the last phase is provided by numerous letters from the general public to the press.

In the absence of trend counts, some information on the urban-centre situation is

available from sample censuses in three British cities: London (R. Bland *in litt.*, who analysed London Natural History Society counts from 1925-1998), Glasgow (author), and Edinburgh (Dott & Brown 2000). These are supplemented by counts from Dublin, Ireland (author), and Hamburg, Germany (Mitschke 1999; Mitschke *in press*; Mitschke *et al.* 1999), and shown in fig. 3, superimposed on the plot for Kensington Gardens (fig. 2). The points are plotted as breeding-season densities, previous autumn count figures being reduced by 25% (see above). The sample census results clearly support the separation of the second and third phases of the sparrow decline, in particular the repeat censuses from all locations, which confirm the steep decline in the 1990s.

Similar census counts from small rural towns are also plotted in fig. 3: data from Stockton-on-Tees, Co. Durham, 1959 (Summers-Smith 1963); Tranent, Lothian, 1986 (da Prato 1989); Crewkerne, Somerset, 1976 and 1996 (Parsons 1999); Guisborough, Cleveland, 1997 and 1998 (Summers-Smith 1999); Sandhurst, Berkshire, 2000 (Sussex 2000); Sandhurst and Crowthorne, Berkshire, and Bracknell, Berkshire, 2001 (Robinson 2002). These counts show no significant change in House Sparrow numbers during this period, though it is possible that any declines in small towns may have been buffered by birds moving in from adjacent farmland.

The BTO's Breeding Bird Survey (BBS) provides more relevant data on the House Sparrow in built-up areas, though this study did not begin until 1994 (Noble *et al.* 2001). The BBS shows that built-up areas have the highest den-

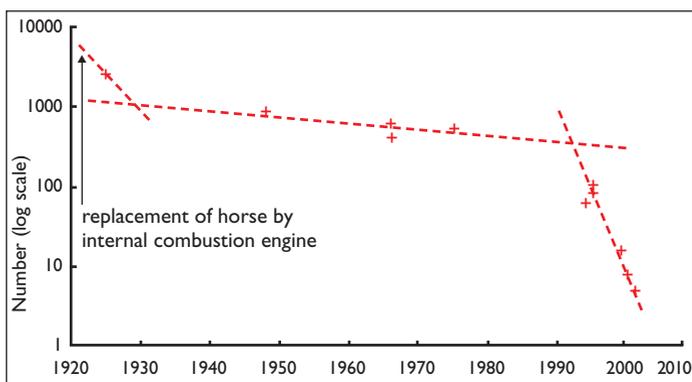


Fig. 2. Autumn counts of House Sparrows *Passer domesticus* in Kensington Gardens, London. The data come from autumn surveys and breeding population estimates, the latter plotted as the number counted the previous autumn minus an assumed winter loss of 25%. 1945-1975: $r = -0.78$, ns, $n = 4$; 1996-2001: $r = -0.89$, $p < 0.05$, $n = 6$.

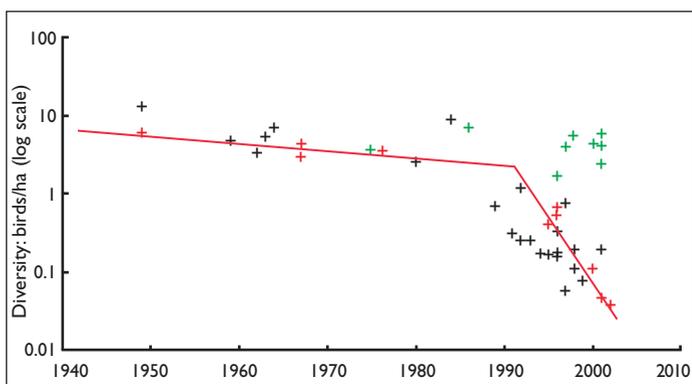


Fig. 3. Breeding-season density of House Sparrows *Passer domesticus* in built-up areas, based on sample censuses: Red – Kensington Gardens, London (see fig. 2); Black – Large town centres (London (excluding Kensington Gardens), Edinburgh, Glasgow, Dublin, Hamburg); Green – Small rural towns ($r = -0.15$, ns, $n = 9$).

sities of House Sparrows in Britain, holding over 60% of the population, with more than half of this figure in suburban areas. This survey shows that during 1994-2000, the urban population decreased by 5.6%, while the suburban population decreased by 3.3% (although these differences are not significant – Crick *et al.* 2002).

The reality is more complicated, however, than the above generalisations suggest. The situation in urban centres is by no means simple; while there have been dramatic declines, almost to the point of extinction, in central London (RSPB 2003), Glasgow, Edinburgh, Dublin, Hamburg, and Ghent (*pers. obs.*), there appear to have been no comparable declines in Man-



293. House Sparrows *Passer domesticus* in farmland are thought to have decreased by around 60% between the late 1970s and the mid 1990s in Britain. Agricultural intensification is thought to have been the main factor behind this decline, in particular the shift from spring- to autumn-sown cereals in arable areas, and the replacement of haymaking with silage in pastoral regions; greater use of herbicides and pesticides; and the reduced spillage of grain as farming operations have been modernised and 'cleaned up'.

chester (Prowse 2002), Berlin (Böhner *et al.* in press) and Paris (McCarthy 2000; C. Galinet & C. Wilkinson, *in litt.*). Moreover, BBS data suggest that, while there has been an overall decline of House Sparrows in England during 1994-2000, the species has actually increased in Scotland and Wales (Raven *et al.* 2002).

While the separation of built-up habitats into large town centres and small rural towns/outer suburbs is a convenient generalisation, the urban habitat is by no means uniform, and detailed studies have shown that the decline of sparrows in human settlements has been patchy. The patchiness of the decline in London has been clearly demonstrated by the RSPB (2003), and also shown by, for example, Paston (2001) and Robinson (2002). Paston and Robinson both found the decline to be more severe in the 'leafy' suburbs than in more socially deprived areas, whereas Wilkinson (*in prep.*) found that the presence of House Sparrows in suburban Oxford was positively related to the density of bushes, particularly native species, in gardens. In the outskirts of Hilversum, in the Netherlands, van der Poel (2000) showed that sparrows favoured newer buildings (later than 1953) rather than the older ones. These differences tell us more about the habitat preference of the species, but perhaps the habitats abandoned by the birds also provide some clues on the factors influencing the decline.

Discussion

For a species to decline there must be either a reduction in breeding productivity and/or in survival. Survival can be determined from ringing recoveries or resightings of colour-ringed individuals; determination of breeding productivity is much more difficult for a multi-brooded species like the House Sparrow, unless marked individuals are followed throughout the breeding season. In fact, it is too simplistic to treat productivity and survival as independent. For example, the adults may work harder to maintain their output at a cost to their own survival.

Shortage of winter food may not reduce survival, but could delay the onset of breeding (although this is not supported by the BTO's Nest Record Scheme, which suggests that the beginning of breeding has advanced by five days in the past 25 years, in line with climate change – Crick *et al.* 2002). Moreover, a proportion may fail to breed, or perhaps rear young which are not fit enough to survive and fill gaps in the breeding population.

The situation in farmland appears to be quite distinct from that in urban centres. A major decline in farmland began in the late 1970s, but after a decrease of about 60% the population had stabilised by about 1995 (fig. 1). In contrast, a gradual decline in urban centres continued, with little change for 50 years from the 1930s, before the urban population went into free-fall in the late 1980s or early 1990s (fig. 3). A gradual and continuing decline is probably also taking place in suburbs and small towns, though it has not yet become catastrophic.

There is no evidence of any significant interchange of House Sparrows between farmland and urban populations (Summers-Smith 1956; Wernham *et al.* 2002), and it is almost certain that the factors for the declines are largely unrelated. Thus, while the work of the Farmland Bird Group at Oxford (Hole *et al.* 2002) has provided sufficient data to assess the relevance of productivity and survival for farmland sparrows, the data are not necessarily relevant to those birds in

towns and cities. The urban sparrow population itself is far from homogeneous and is more realistically split into birds which populate urban centres and those in the outer suburbs/small towns, perhaps subdividing the latter further by separating birds living in 'rural' built-up areas. The key parameter defining these habitats is the 'home range' – the foraging area utilised by the birds – which for adult House Sparrows extends to a radius of 1-2 km from the breeding colony (Summers-Smith 1963).

A number of explanations, summarised below, have been proposed for the urban House Sparrow decline. Clearly, any credible explanation must take into account the difference in the rate of decline between urban centres and the suburbs.

(i) Increased predation by Eurasian Sparrowhawks *Accipiter nisus*, Magpies *Pica pica* and domestic cats *Felis catus*

Eurasian Sparrowhawks and Magpies have certainly increased in urban areas, but there is no reason why they should have had more impact in city centres. Furthermore, Magpies predate eggs and chicks in open nests and are unlikely to have had much impact on sparrows, which breed in enclosed, inaccessible sites. The domestic cat, on the other hand, is a significant predator of House Sparrows (Churcher & Lawton 1987). Woods *et al.* (in press) suggested

that cats (both domestic and feral) accounted for 26 million House Sparrows in Britain during 1997, of a total population of 49 million (Crick *et al.* 2002). This is a significant cull rate, but it is a spot check and it is not known whether the number of cats increased over the period of interest. With a limited supply of prey in city centres, however, a differential effect between city centres and small rural towns must be a possibility.

(ii) Competition for food from other urban species

Feral Pigeons *Columba livia* and gulls *Larus*, particularly Lesser Black-backed Gulls *L. fuscus*, are the main potential competitors for food, but it is unlikely that either would give rise to a differential effect between the two urban habitats.

(iii) Loss of nesting opportunities

A reduction in the availability of suitable nest holes in modern buildings and renovated old buildings must have occurred. The effect could be more severe in city centres, since thick hedges provide alternative nesting opportunities in rural towns and modern housing estates.

(iv) Spillover from farmland

The farmland decline preceded that in the cities and some suggest that the urban decline was a consequential effect. This seems unlikely, owing



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294. House Sparrows *Passer domesticus* and Common Starlings *Sturnus vulgaris* crowding round a bird-feeder in a suburban Kent garden. Sparrows in some suburbs and small towns of Britain have not experienced the alarming population crash which has been evident in many city-centre populations since the early 1990s.

to the lack of exchange between the two habitats, and because any knock-on effect from farmland would have been more likely to affect small rural towns than urban centres.

(v) Disease

House Sparrow populations affected by epidemic disease have been reported by Menegaux (1919-21) and Stenhouse (1928), but such declines are limited in duration because the disease organism attenuates as the host develops resistance – in other words, quite different from the present urban-centre decline, which has continued for at least ten years.

(vi) Traffic

Greater volume of traffic leads to increased disturbance and pollution from exhaust fumes, both of which would be greater in city centres than small towns. It seems unlikely that this alone could have been responsible for the urban-centre decline, but the introduction of unleaded petrol in the UK in 1989 was important. This involved the replacement of the octane improver tetra-ethyl lead by methyl tertiary-butyl ether. The latter is a carcinogen, and may enter the environment through spillage at filling stations and incomplete combustion in engines idling when stationary. Joseph (1999) attributed an increase in asthma in children and domestic cats in Philadelphia to toxic vapours

(methyl nitrite and compounds with hydroperoxy radicals) in the exhausts of engines running on unleaded petrol. It seems unlikely that this could cause sparrow deaths, but might depress invertebrate populations.

Bower (1999) attributed the decline in House Sparrows in Hamburg to a lack of insects, particularly at the beginning of the breeding period. Further support for the idea that shortage of invertebrate food could be important is provided by preliminary results from an ongoing study in Leicester (Vincent *et al.* 2002). In 2002, there was found to be complete failure of 14 broods (46%) in suburban nests, all but one of these in nests where clutches had been laid after the end of May. In the majority of cases, the nestlings died after only a few days, suggesting that starvation, possibly resulting from lack of invertebrate food, was the cause. Van der Poel (2002) suggested that the decline in Dutch urban centres was down to a lack of insects. Unfortunately, no relevant data on invertebrate populations in urban habitats are available, and there is no consensus as to causes of the shortage, although garden pesticides could be a possible factor in suburbia.

Siriwardena *et al.* (1999) and Crick *et al.* (2002) suggested that decreased survival was the reason for the House Sparrow decline, whereas lack of invertebrates would cause a decrease in productivity. Their conclusions are not necessarily incompatible with a view that invertebrate population declines are important: they were based respectively on the national datasets of the BTO and a specific farmland investigation and, as already mentioned, may not be strictly relevant to the urban situation.

The question of why House Sparrows should have declined so markedly, yet other urban species have not been similarly affected is also important. The other significant city-centre species, the Feral Pigeon, rears its young entirely on a vegetable diet and thus would not be affected by a shortage of invertebrates. Other small



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295. One factor which may have adversely affected the House Sparrow *Passer domesticus* in built-up areas in the latter part of the twentieth century is the more efficient design of modern housing (and the renovation of older buildings), which offers fewer safe nesting opportunities for sparrows

passerines form a less significant part of the urban avian biomass, so that any decline may be less noticeable, at least by the general public.

A hypothesis

I suggest that the following factors may, in combination, have been responsible for the urban-centre decline of House Sparrows, yet have had less effect in small rural towns and suburbs:

- increased predation by domestic cats
- loss of nesting opportunities
- pollution from unleaded petrol
- increased use of pesticides in parks and gardens

In addition, the House Sparrow is a social animal which nests in loose colonies and depends on social stimulation for its breeding success. Reduction of colony size below some critical threshold may impair breeding behaviour to the extent that success declines, perhaps ultimately resulting in the disappearance of the colony. This is known as the 'Allee Effect' (Allee 1938), one of the best known examples being the demise of the Passenger Pigeon *Ecopistes migratorius* (Halliday 1980). Such an effect is shown schematically in fig. 4. The way gaps in the breeding population were quickly filled prior to the recent decline (Summers-Smith 1963) is cir-



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296. Male House Sparrow *Passer domesticus*, Maywick, Shetland, 2003. The decline of the House Sparrow is far from uniform and, in contrast to the situation in most of Britain, the species may even be increasing in Scotland. Is this merely due to the persistence of more traditional agricultural practices in remote areas, such as Shetland, or is there a more subtle reason? We simply do not know.

cumstantial evidence of the presence of 'floaters', birds which could not find a gap in existing social communities. Reduced breeding output because of breeding impairment, together with loss of colonies due to an Allee Effect, would reduce the number, and possibly quality, of such floaters. This could explain the difference in the rate of the decline between urban centres and small rural towns, if decreases in the latter have not reduced colonies to the critical size. Some support is given for this idea by a study of House

Sparrows in London currently being carried out by Helen Baker (verbally). Preliminary evidence suggests that the decline she has recorded is not merely a function of reduction in colony size, but rather of increased dispersion of the colonies.

These ideas are not presented as 'the answers' to the House Sparrow problem, but in the hope of stimulating further research to test them, and perhaps to identify other possible causes of decline.

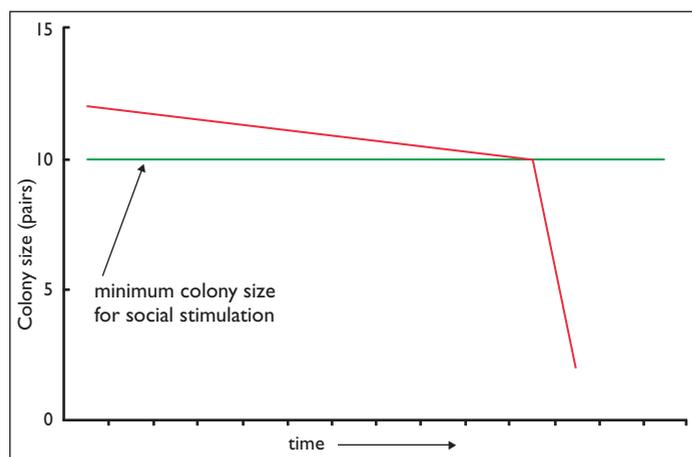


Fig. 4. Schematic representation of the 'Allee Effect'.

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