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CHANGES IN THE HOUSE SPARROW POPULATION IN BRITAIN

ABSTRACT

The number of House Sparrows has declined markedly in mid-latitude western Europe in the last 25-30 years. This was first noticed in Britain in farmland about 1979, though after a fall of about 60% the population appears to have stabilised at this lower level. It is now generally accepted that this decline was a consequence of reduction in the availability of food resulting from intensification of agricultural practices.

There has also been a reduction in built-up areas, though it is considered that, with little interchange between the two populations, the two declines are not directly related. The urban decline did not become obvious until about 1990, where in the centres of some large towns the decline, unlike that in farmland, took place at an increasing rate leading to virtual extinction. Closer examination shows that the situation in the built-up areas is far from uniform, with a similar decline to that in the urban centres occurring in the so-called "leafy affluent suburbs", but any decline being much less pronounced in the inner residential areas and modern housing estates. The main cause of the urban decline is again reduced availability of food, but here compounded by reduced availability of nesting sites and increased predation by cats and Sparrowhawks, with these factors having differing impacts in the different

built-up habitat types. The House Sparrow is a social species, breeding in loose colonies, which depend on social stimulation for successful breeding. It is suggested that, when the colony size falls below a certain level, the birds cease to breed because of the lack of social stimulation and the colony collapses (the "Allee Effect"). This stage has been reached in the centres of some large towns, where lack of nesting sites has been the critical factor, and in the „lafy suburbs", where the separation of the buildings on which the birds prefer to nest leads more rapidly to lack of social stimulation than in the case of the other residential areas where the houses are much closer together. Any decrease in these latter areas has occurred though an increased spacing of the colonies rather than by a decrease in colony size.

INTRODUCTION

While it is not possible to put numbers on the House Sparrow *Passer domesticus* population in Britain prior to the development of modern scientific field ornithology in the 20th century, there is little doubt that it became a common bird following the advent of 'high farming' with its intensive mixed farming methods in the 18th century. This is highlighted by the recognition of the species as an agricultural pest with the payment of bounties for eggs and dead birds, together with the formation of "sparrow clubs" dedicated to the destruction of the bird. Bounty payments continued into the beginning of the 20th century (Clark 2000). Increasing urbanisation (agricultural acreage fell by approximately 750,000 ha in the second half of the 19th century), with horse drawn transport providing food for the bird in the spillage of oats from the nosebags and undigested seed in the droppings and generally poor street hygiene, provided a habitat of growing importance for the bird.

House Sparrows are extremely sedentary birds, the majority living out their lives within an ambit of 1-2 km. Moreover, evidence from ringing, both recoveries of birds with numbered rings, and also sightings of colour-ringed ones, suggest that there is little interchange between the farmland birds and those living in built-up areas (Summers-Smith & Thomas 2002).

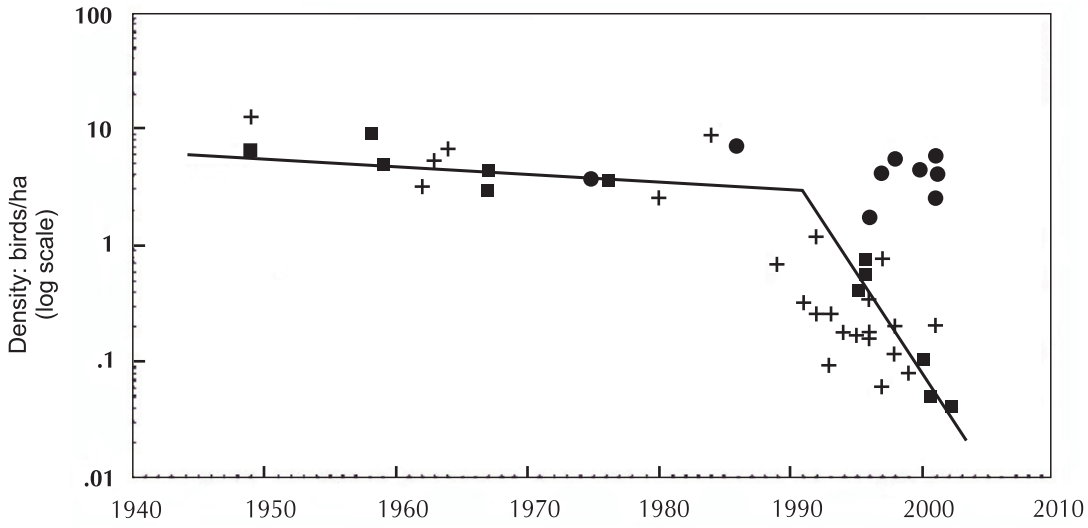
Major changes have occurred in both the populations of house sparrows living in farmland and those in built-up areas in the last 100 years. The situation up to the end of 2001 has been reported elsewhere (Summers-Smith 2003). The objective of this paper is to examine the situation in built-up habitats in the hope that this will provide some insight into the underlying causes for the current decline.

Replacement of the horse by the internal combustion engine

A major set-back to the House Sparrow occurred in the 1920s with the replacement of the horse by the internal combustion engine as the source of power for transport. Although not particularly well recorded, there is little doubt that the consequent loss of food for the bird resulted in a major decline in the urban population. The maximum effect of this change was over by the 1930s, though there is some indication that the density of birds in urban centres continued to fall, though albeit at a much reduced rate (Figure 1). However, with ongoing urbanisation creating more built-up areas, the prime habitat for the House Sparrow, and increasing agricultural activity, numbers overall were increasing, detailed studies of the data accumulated by the British Trust for Ornithology (BTO) suggesting that the breeding population in Britain was between 12 and 15 million pairs in 1970 (Crick *et al.* 2002).

The decline in farmland

Excellent data on the farmland situation is provided by the Common Bird Census (CBC) enquiry organised by the BTO. This monitored the number of breeding birds annually on 200-300 farmland and woodland plots between 1962 and 2000, expressing the result for each species as a "Population Index" that gives an indication of its abundance. Although the CBC began in 1962, the House Sparrow was largely ignored in the early years and sufficient data from the farmland surveys for indexing purposes only became available in the 1970s (Figure 2). The plot shows that a marked decline set in about 1979, with a fall of approximately 60% up to the mid 1990s when the index appears to have stabilised at a lower level.



■ Kensington Gardens London, + large town centres, ● small rural towns'

Fig. 1. House Sparrow densities in built-up areas

The lines are the linear regressions of the Kensington Garden counts for 1945-1975 and 1995-2002. The other large town centre results show a reasonable fit for the regression lines, but those for the small rural towns do not show the dramatic decline after 1990 (Summers-Smith 2003).

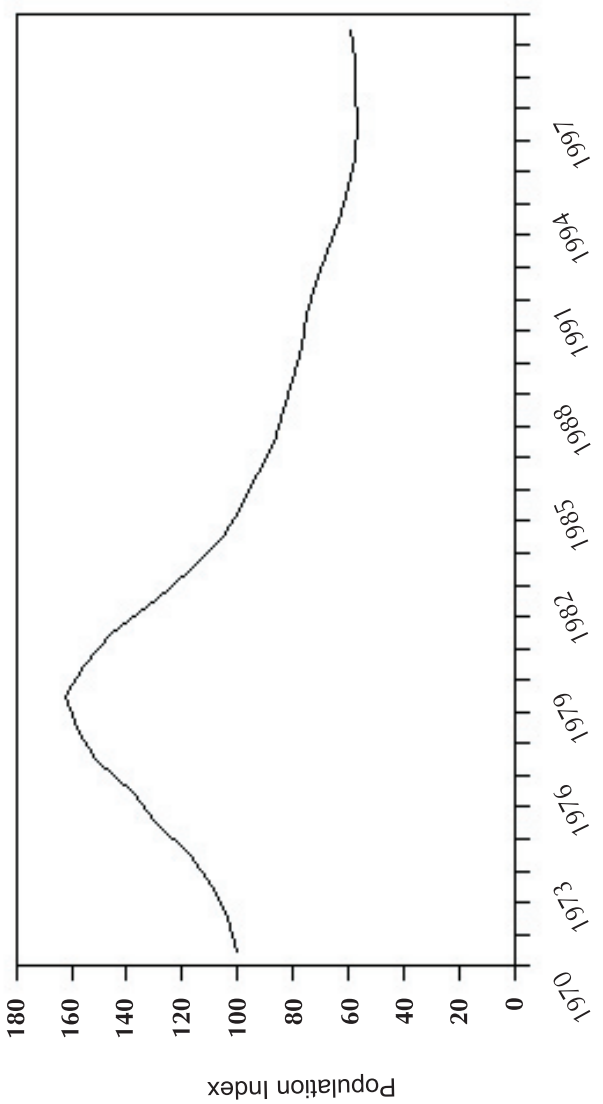


Fig. 2. Farmland Population Index for House Sparrow

The Population Index, a measure of abundance, is derived from the Common Bird Census enquiry of the Britsh Trust for Ornithology with data from 200-300 farmland plots (Summers-Smith 2003)

It is now widely accepted that this decline was the result of changes in agricultural practices that reduced the availability of food, not only for the House Sparrow, but also for a suite of other farmland birds ranging from finches to the Skylark *Alauda arvensis* and the Grey Partridge *Perdix perdix* (Chamberlain *et al.* 2000).

The decline in built-up areas

While the CBC Population Index for the House Sparrow has some limitations – a bias in the distribution of the survey plots to the populous south-east of England, lack of distinction between different farmland types (arable, pastoral, mixed) – it nevertheless gives a good indication of the overall farmland situation. In contrast, apart from some intermittent counts in Kensington Gardens, London, between 1945 and 2002, no comparable trend data are available for the built-up areas. As an alternative, Summers-Smith (2003) has used census data, with results expressed as birds/ha, to give some indication of the situation in the built-up environment, dividing this roughly into "urban centres" and "small rural towns"; the available data are plotted in Figure 1, which includes the Kensington Gardens data with the regression lines for the periods 1945-1975 and 1995-2002. This is much less secure than the CBC Population Index: most censuses refer to only one year so that there is no allowance for normal annual variations that for the House Sparrow may be as much as ±30-40%; House Sparrows are social animals living in small colonies, thus the density obtained depends critically on the census area; further, there is no standard protocol for the census technique. Accepting these caveats, the plot nevertheless confirms the suggestion of a slow decline in all built-up areas going back at least to the 1950s, with a dramatic collapse in the urban centre populations in the 1990s. In contrast to the situation on farmland, there is no suggestion of a slow-down in the decline or stabilisation at a lower level.

It is considered that the reason for the urban centre collapse is a consequence of the so-called "Allee Effect" (Allee 1938; see also Barnett 2001). Warder Allee was an American biologist who postulated that social animals depended on stimulation from their conspecifics if they

are to breed successfully. If a colony size falls below a certain critical level, the animals fail to come into breeding condition and the colony withers away. The House Sparrow is a social animal, living in small loose colonies. What appears to have happened in the urban centres is that the decline has reached the critical stage where the colonies are no longer viable.

The overall situation

The recent analysis of the BTO data suggests that the breeding population of the House Sparrow in Britain is currently about 6 million pairs, a decrease of between 50 and 60% since 1970, with two-thirds associated with built-up habitats (half of them in suburban areas) where population densities are about an order of magnitude higher (2.2-3.2 birds/ha) than in farmland (0.25-0.45 birds/ha); regionally the decline has been greatest in the south-east of England, with numbers actually increasing in Wales and Scotland (Crick *et al*. 2002).

DISCUSSION

The two most important factors that are likely to have affected urban House Sparrow numbers are:

1. A decrease in the availability of the animal food essential for rearing the young
2. A shortage of suitable nesting sites, particularly in the urban centres.

Although quantitative data are lacking, there is little doubt that the number of invertebrates has decreased: where are the flypapers that were once a *sine qua non* in every kitchen? how much reduced is the problem of squashed insects on our car windscreens? The increased coverage of exposed soil by concrete, improved street hygiene, increased usage of pesticides in parks and gardens, increased planting of exotics and sterile varieties have probably all played a part in reducing the number of invertebrates, as has possibly exhaust pollution from cars running on unleaded petrol. Both Bower (1999) and Vincent *et al.* (2002) have

produced evidence to suggest that shortage of animal food is a significant factor in breeding success. Lack of suitable nesting sites in modern buildings is certainly a factor in urban centres, though alternative sites like creepers on house walls and thick hedges can have compensated for this in residential areas. (In a survey covering the Greater London area (Noble & Eaton 2002), most nests were found to be in bushes and hedges).

While the available evidence points to a shortage of invertebrate food as the most likely cause of the decline in built-up areas, the possibility of an overall decrease in productivity in a colony, even though this is still above the critical „Allee level" cannot be discounted. Seeds are probably important in the diet of the adult birds, with increasing reliance on scraps possibly reducing their physical condition (fitness). This could result in failure of a female to come into breeding condition or a reduction in the number of breeding attempts per pair. Neither of these would be detected by the BTO nest record data, but would require a study of an individually marked population similar to that carried out by the Oxford Farmland Study Group (Hole *et al*. 2002)

Further, while not a primary factor, increasing predation by Sparrowhawks *Accipiter nisus*, added to that existing from cats *Felis catus*, both domestic and feral, cannot have helped with populations already under pressure. The domestic cat, not dependant on its prey for survival, poses a particularly severe threat (Woods *et al.* in press).

The built-up habitat is a complex one. Clearly the situation with House Sparrows is influenced by variations on a much finer scale than that of 'urban centres' and 'small rural towns' used in Figure 1. (The Greater London Survey in 2002 (Noble & Eaton 2002) showed large variations in abundance in the different boroughs.) For the purpose of discussion, the built-up habitat can be divided into the following sub-types, though these are not necessarily discrete and tend to merge with one another. However, it is hoped that the examination of the House Sparrow situation in each of these sub-types can throw some light on the causal factors for the decline in the built-up habitat.

1. Highly developed urban centres with vegetation largely limited to squares, parks and a few waste areas, with a high density of traffic.

2. Residential areas, ranging from inner city areas with a high density of housing and small, often neglected, gardens ("socially-deprived areas") to the outer suburbs, both those with large, well-developed gardens and a low density of housing ("leafy suburbs") and modern estates with a high density of housing and small, but well-tended, gardens and often thick hedges.

3. Small towns where the above categories are less clear and tend to merge together.

4. Rural villages with a varied density of housing and easy access to open country.

The most dramatic decline has been in some urban centres where a sudden collapse began in the late 1980s or early 1990s and has led to almost complete extinction (Figure 1). The factors most likely to have caused this are decreased availability of the invertebrates required to rear the young and loss of suitable nest sites in modern buildings and loss of holes through rehabilitation of older properties.

The only other significant avian species in the urban centre habitat is the Feral Pigeon *Columba livia*. This species does not appear to have decreased, but, unlike the sparrow, it is not dependent on invertebrates, being able to rear its young on „crop milk" derived from vegetable food. Moreover, it has not suffered from a decrease in the ledges that it uses for nesting.

Not all urban centres have lost their House Sparrows: according to Judith Smith (quoted by Prowse 2002) there has been no decline in Greater Manchester; Böhner *et al.* (2003) report no significant decrease in Berlin; House Sparrows are still common in the centre of Paris (McCarthy 2000), though a survey in 2002 showed an overall decrease of 36% from an earlier census in the 1960s (Galinet 2003). Perhaps, however, these anomalies are more apparent than real, reflecting differences that have allowed the colonies to be maintained above the critical "Allee level" – possibly fewer petrol-engined cars in Paris, more open areas in Berlin.

The residential areas provide a mixed bag, with good populations in areas of high density housing, both the older inner city areas and the new housing estates (even those estates with the birds nesting in thick hedges where the houses themselves do not provide nesting opportunities). Small towns and villages similarly hold good populations, though, in contrast, the 'leafy suburbs' have largely been abandoned. House Sparrows effectively disappeared from my garden in 1996, since when they have only been very irregular visitors. Paston (2001), Robinson (2002) and Tulley & Bland (2002) report a similar situation for Norwich, Crowthorne (Berkshire) and Bristol respectively even where there are plenty of nesting opportunities (creepers on walls, thick hedges), provision of seeds and scraps, and evidently enough invertebrate food to satisfy the requirements of other small passerines that occur as breeding species in built-up areas (Appendix 1). The built-up centres have probably always been a marginal habitat for these birds and only used opportunistically by wandering colonists (dispersers), though they have been able to maintain small numbers in the parks and gardens. For example, in a study of the breeding birds of Buckingham Palace Gardens, London, Sanderson (1999) found that, whereas the House Sparrow had become extinct in 1961, the other small passerines had only decreased by less than 30% (Appendix 2). The autumn bird counts in Kensington Gardens, London, give a similar picture, though being autumn counts rather than a breeding census this could be a reflection of their mobility rather than an indication of breeding numbers.

This effect in the town parks and the "leafy suburbs" is likely to be a consequence of the following key defining characteristics of the House Sparrow:

- obligate associate with man's built-up environment,
- extreme sedentariness,
- social behaviour.

Perhaps the parks and leafy suburbs are "sinks" for the other passerine species dependent on the mobility (dispersal) of their young, able to accommodate the odd pair of the non-social species, but offering insufficient invertebrate food to support a viable colony of House Sparrows. It is perhaps significant that the only other species showing

a major decline in Buckingham Palace Gardens between 1961 and 1997 is the semi-colonial Greenfinch *Carduelis chloris*.

CONCLUSIONS

The major difference between the House Sparrow and the other urban passerines is that the former is a colonial species, dependent on interactions with its conspecifics to provide the necessary social stimulation for breeding. It is thus limited to those urban areas where there are both sufficient nesting opportunities and invertebrate food to maintain a colony rather than just the odd pair.

With a continuing fall in the numbers of House Sparrows in all built-up areas, the future looks rather bleak for the bird. Moreover it is not easy to see what conservations measures can be taken to remedy the situation.

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APPENDIX 1. Some Comparative Data on Urban Birds

Species	General Comments	Hamburg cf 1960-70s with 1990s[2]	London 1994-1999[3]	Main Food[4]		Nest[4]
				Adult	Nestling	
1	2	3	4	5	6	7
Sparrowhawk	Has increased where there are parks and large gardens (trees)			Birds (House Sparrow frequent)	Birds (House Sparrow frequent)	Tree, sometimes on foundation of old nest of other species
Feral Pigeon	No evidence of negative correlation with House Sparrow			Vegetable – seeds, scraps[5]	Vegetable – (crop milk)	Ledges on buildings
Collared Dove[1]	Has increased where there are large gardens		+35%	Vegetable, including scraps[5] (mainly from ground}	Vegetable – (crop milk	Tree or ledge on buildings
Dunnock[1]	Mainly parks and residential areas with large gardens		+5%	Invertebrates on ground, seeds in winter	Largely invertebrates	Thick vegetation – hedgerows, creepers on walls
Robin[1]	ditto	Increased 4-4.5 times	+15%	Invertebrates on ground, fruit and seeds in winter	Mainly invertebrates	Low bush or bank
Blackbird[1]	ditto	+50%	-25%	Mainly invertebrates on ground, scraps[5]	Mainly invertebrates	Cup nest in bush, ledge

1	2	3	4	5	6	7
Blue Tit[1]	ditto	Increased 2-2.5 times	+25%	Invertebrates, vegetable matter	Larvae and aphids from foliage	Hole in tree or wall, nest box
Great Tit[1]	ditto		+63%	Invertebrates, vegetable matter	Moth larvae from foliage	Hole in tree, nest box
Magpie[1]	ditto	Increase 10 times	+22%	Animal matter, carrion, nestlings, invertebrates, scraps[5]	Mainly invertebrates	Trees
Chaffinch[1]	ditto		+5%	Vegetable matter, invertebrates	Mainly invertebrates from trees	Cup nest, trees, hedgerows
Greenfinch[1]	ditto		-6%	Mainly vegetable matter (seeds)	Vegetable matter, but also invertebrates	Cup nest in thick hedgerows, trees
House Sparrow[1]	Major decline in town centres and residential areas with large gardens	-50%	-50%	Seeds, scraps[5]	Invertebrates essential for first few days	Hole, usually in man-made structure, nest boxes, creepers on walls, thick hedges

[1] BTO Garden BirdWatch 'Top Ten'.
[2] Mitschke, *et al*. 2000.
[3] Extracted from British Trust for Ornithology Breeding Bird Survey (A Prowse. pers. comm.)
[4] Data from Cramp & Simmons 1980, Cramp 1985, Cramp 1988, Cramp & Perrins 1993, Cramp & Perrins 1994.
[5] Bread and other foodstuffs inadvertently or deliberately provided by man.

APPENDIX 2. Number of pairs of small "Top Ten" passerines nesting in Buckingham Palace Gardens, London (Sanderson 1999)

Species	Nesting Pairs	
	1961	**1997**
Dunnock	5-7	1-2
Robin	4-5	5
Blackbird	10-15	8-9
Blue Tit	3-4	6-8
Great Tit	2-3	2-3
Greenfinch	5-7	0
Total pairs	**27-39 (mean 34)**	**22-27 (mean 24.5)**
House Sparrow	5-10	1

Note. Chaffinch has been omitted as it is not mentioned in the text and only appears in parenthesis in the summary Table.