

## S31-1 The population decline of the starling, *Sturnus vulgaris*, in Great Britain: patterns and causes

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**Abstract** Although the starling has the capacity for explosive population growth, its population in Britain has declined by two-thirds over the last 40 years. Here we summarize a major study (Crick et al., 2002) which investigates the reasons for this. The starling is commonest in urban and farmland habitats, though density in the latter is much lower; the total breeding population is estimated at 9 million birds. In general, breeding productivity has increased, while survival, particularly of juveniles, has shown periods of decrease. The decline on farmland has been greater in pastoral areas, and is probably linked to reduced foraging opportunities associated with more intensive agricultural management. There is some evidence for a decline in urban populations, but data are scant and possible reasons for decline there are unclear.

**Key words** Avian demography, Agricultural intensification, Pastoral farming, Survival

### 1 Introduction

The European starling, *Sturnus vulgaris*, is one of the most successful birds in the world. Indigenous to Europe and western Asia, it has been introduced successfully on to three continents (Feare, 1984). The population increase in North America has been particularly explosive. Around 60 birds were released in Central Park, New York, in 1890, and although initial spread was slow, the starling has now become one of the most numerous birds on the continent, numbering over 200 million individuals.

Even in its native range, the starling has expanded in historical times. Thus, in Britain in the early half of the 19th century, it was absent from much of mainland Scotland, southwest England and western Wales. Through the middle of the 19th Century and into the 20th Century, it spread north and west, becoming common in all except the most exposed upland areas (Holloway, 1996). Amelioration in climate, increased agricultural utilization of marginal upland areas and spreading urbanization are all likely to have played a role. The starling had become a pest in agricultural lands and its huge, fouling roosts, sometimes numbering in the millions, created public health hazards in urban areas (Feare et al., 1992). Starling populations are capable of expanding rapidly, their success attributable to a catholic diet, wide habitat tolerance and an aggressive attitude towards ownership of nest holes.

Because of the problems caused by large starling flocks and their ubiquity, the British government issued a general licence allowing their killing, and the destruction of their nests and eggs, in the interests of public health and safety and to prevent serious damage to crops or livestock.

This licence was re-issued in January 1993 under a derogation of the European Directive on the Control of Wild Birds (EC/79/409), which imposed the added responsibility of monitoring population trends nationally.

But all is not well for the starling. In Britain and elsewhere in northwest Europe, starling populations have declined over the last three to four decades. The decline has been so severe that the starling has recently been placed in the highest category of conservation concern in Britain (Gregory et al., 2002). In October 2000, the government's Department for Environment, Food and Rural Affairs (Defra) commissioned a comprehensive report on its status to ensure that legal control measures were not contributing locally to the national decline in numbers (Crick et al., 2002). We summarize the key findings of the report to examine why a population of such an apparently successful bird should decline so dramatically.

### 2 The status of the starling in Britain

Robinson et al. (2002a) quantified, for the first time, the size of the starling population breeding in Britain. It totaled some 9 million birds in the late 1990s. Although the density of birds breeding on farmland (typically about 30 birds.km<sup>-2</sup>) is much lower than in human-associated habitats (180 birds.km<sup>-2</sup>), a significant proportion of the total population occurs there because farmland forms the major land-use in Britain. Together, farmland and urban habitats account for the vast majority (87%) of the British breeding population. No data were available on the size of the wintering population, which includes immigrants from continental northern and eastern Europe, predominantly from around the Baltic Sea, that may equal or exceed the numbers of the

breeding population (Feare, 1984).

The breeding population of starlings has been monitored since 1962 by the British Trust for Ornithology's (BTO) Common Birds Census (CBC), a scheme based on territory mapping, mainly in woodland and farmland habitats, that counts around 200 sites each year. While populations have declined generally since 1962 (68%), the decline has been greatest in woodland (>90%). This is likely to reflect the fact that woodland is sub-optimal habitat for breeding starlings, but could also be due in part to a decline in the number of nest holes available. The population on farmland has declined by two-thirds, and mirrors the national trend, as this is where the bulk of birds occurs. Even within farmland, population declines differ: those breeding on pastoral farms have declined more than those on agricultural farms. Declines have been greatest in the south west of Britain where the rural industry is livestock-based.

Very little is known about the winter dispersal and habitat use of British breeding starlings, though virtually all of the breeding population remains in the country, most of it within a few tens of kilometers of where it breeds (Feare, 2002). The wintering populations of immigrant starlings in different areas of Britain originate from different breeding populations, and the habitat used by the immigrants while in Britain is unknown. Few long term data are available on numbers in winter, though there is evidence of at least local declines, particularly in urban areas (Robinson et al., 2002b).

### 3 Demographic processes

Breeding productivity was quantified by using the archives of the BTO's Nest Record Scheme (NRS), which can be used to assess the success of individual breeding attempts (Siriwardena and Crick, 2002). The breeding performance of starlings, in common with many other British passerines, has increased over the last forty years. Such a pattern may represent a density-dependent response to a reduction in numbers, but could also occur if starlings have become more concentrated in more favorable habitats.

The NRS can only be used to investigate the number of fledgling birds produced in each nesting attempt. Productivity summed across the entire season is also important for understanding the population dynamics of a species. This was quantified from a study of a suburban colony in southern England (Feare and Forrester, 2002). The study ran from 1975 to 1997, covering the major period of decline in the national population and some immediately preceding years when the population index was largely stable. Although the number of birds fledged varied significantly from year to year, there was no overall trend in productivity. The proportion of birds laying second clutches also varied annually, being largely dependent on the date of laying of the first clutch. There was no systematic temporal trend in these variables either, nor in inter-clutch interval, an indicator of environmental stress.

Survival was quantified from numbers of birds ringed in Britain during the breeding season and subsequently

reported dead (Freeman et al., 2002). Survival during the 44 days immediately following fledging was estimated at 38%, that over the first winter for fledged birds at 39% and that for adults annually at 67%. Thus, birds were much less likely to survive their first year than any subsequent year. These estimates are comparable to those for other birds of similar size (Siriwardena et al., 1998). Juvenile survival, in particular, declined markedly through the 1980s, from 50% in 1980 to just 31% in 1991, but subsequently increased to around 45%. The decline in survival rates nationwide coincided with the major period of population decline. A population modeling exercise, whereby the demographic rates were held constant and each one allowed to exhibit time-dependent variation in turn, suggested that changes in first-year over-winter survival rates could best account for the observed population change, and were sufficient, on their own, to explain the broad pattern of decline (Freeman et al., 2002).

The potential impact of lethal control was assessed using a questionnaire survey of landowners and local governmental authorities (McKay et al., 2002). The vast majority of owner/occupier respondents and all Local Authority respondents had undertaken no lethal control. It was estimated that around 75 000 starlings were culled each year, mostly during the non-breeding season, when large numbers of immigrants are present. Most of this mortality is likely to be compensatory and the impact on the population negligible.

### 4 Starlings on farmland

On farmland, starlings are very much birds of pastoral and livestock systems. Their main prey are soil and ground-dwelling invertebrates, particularly leatherjackets (Tipulidae) and earthworms (Lumbricidae), although they also eat a wide range of other foods (Tinbergen, 1981). Densities of soil invertebrates are highest in pasture fields, particularly those which are undisturbed by cultivation (Whitehead et al., 1995). Although there is little published evidence that the density of tipulids has changed over time (Wilson et al., 1999), the area of permanent pasture has declined and the use of insecticides on them has increased. Starlings also often forage in association with livestock, particularly cattle, which create a heterogeneous sward in which starlings prefer to forage. The British cattle herd has decreased by 18% since 1970, mostly since 1980.

Concurrent with increased use of general insecticides has been a growing use of anthelmintics in livestock (McCracken, 1993). Although starlings rely predominantly on subterranean invertebrates, they turn to surface-dwelling invertebrates if the former are scarce or unavailable due to drought or hard frost (Feare, 1984). Starlings will also utilize other food sources at such times, including invertebrates in dung. The importance of this source has not been established but, if it is important, depletion through the action of anthelmintics is likely to impact on the survival of individual birds, especially when subsurface prey is unavailable and birds are stressed.

Fertilization levels have increased and, although this seems to have little effect on leatherjacket numbers, the number and diversity of other insects taken by starlings may decrease (Paoletti, 1999). Fertilizer use also tends to promote taller, denser swards, in which starlings have greater difficulty foraging, and is likely to be associated with increased levels of grazing and/or mowing, which all tend to reduce invertebrate numbers. Starlings frequently forage around cattle feeding stations, where they may take significant amounts of food, particularly cereal grains (Feare, 1984). It is often the most dominant birds (primarily adult males) that use this food source, other individuals continuing to forage on grassland. The tendency to keep cattle indoors may have reduced foraging opportunities for them, though this needs to be quantified.

## 5 Starlings in towns

Relatively little is known about starlings in towns and cities. Their urban roosts are spectacular, sometimes numbering in excess of a million birds, as the birds wheel into them around stands of large trees in the darkening skies. A major finding of the Crick report (Crick et al., 2002) is just how important suburban and urban habitats are for starlings. For breeding, starlings require a suitable cavity for nesting with some short grass fields close to the nest; adults rarely forage more than 500 m from the nest (Feare, 1984). Such situations are widespread in many towns and cities, although the quality of the urban and suburban habitats in terms of food provisioning for nestlings is unknown. Nesting attempts in urban and suburban areas produce fewer young than rural areas, due to lower clutch sizes and hatching success (Siriwardena and Crick, 2002).

Lawns, parks and sports fields should provide an attractive alternative foraging habitat to preferred pasture fields. Although large numbers of starlings frequently forage in these areas, their quality and quantity of food production remains unquantified. Also unknown is the extent to which starlings use these resources. The ecology of urban starlings remains a woefully neglected area.

## 6 Discussion

In order to appreciate the causes of population decline, and to plan effective countermeasures in amelioration, one needs to understand the demography of the species concerned. Freeman et al. (2002) clearly show that changes in survival have driven the population decline in British starlings. There have been large-scale changes in the management of both pastoral and arable systems, and greater spatial separation of the two (Vickery et al., 2001; Robinson and Sutherland, 2002). These changes are likely to have resulted in decreased foraging opportunities in the non-breeding season, primarily in autumn when leatherjackets are scarcest. With their mobility and catholic diet, starlings seem less affected by spells of cold weather than other birds. Encouraging mixed farming practices through agri-environment schemes, and measures such as

the introduction of pockets of grassland cultivation in arable areas, should benefit the starling and other species.

Although the population decline has been largely driven by changes in survival, the farmland population may have been limited by the numbers of nest sites too. Providing extra nesting-sites within good areas of farmland may have the potential to increase the size of the breeding population in these areas, but this requires that sufficient foraging resources are available to support the increased numbers (Bruun, 2002). Careful monitoring would be needed to check that birds were not simply moving in from other sites.

The starling clearly has the ability for explosive population growth, and populations in Britain have expanded in historical times. Today, however, the starling population is declining. In the wider countryside, this appears to be due a reduced food supply; the population dynamics of urban populations are simply not known. Food supply is a key determinant of local population density, as many studies have shown (Newton, 1998). Changes in food supply because of agricultural intensification have been implicated in the declines of other farmland species which had attained population highs in the 1960s (Robinson and Sutherland, 2002). Thus it seems that the fortunes of the starling, as of other birds which live in close proximity to man, are destined to fluctuate according to the vicissitudes of his land management.

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