The second Silent Spring?

The drive to squeeze ever more food from the land has sent Europe's farmland wildlife into a precipitous decline. How can agricultural policy be reformed so that we have fewer grain mountains and more skylarks?

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CORBIS

Menaced by monoculture: the numbers of British farmland birds, such as (from left to right) corn bunting, skylark, house sparrow, lapwing, linnet and yellowhammer, are falling rapidly.

The Roman poet Catullus lamented the death of a pet sparrow ("*Passer mortuus est meae puellae*"), probably a house sparrow (*Passer domesticus*) or, just conceivably, a tree sparrow (*P. montanus*). In either case, a present-day Catullus would have ample cause for lamentation. Both kinds of *Passer* are among the many species of birds, invertebrates and plants that have declined dramatically in Northern Europe during the past 25 years.

We estimate that, in the past 20 years, ten million breeding individuals of ten species of farmland birds have disappeared from the British countryside. For example, the corn bunting (*Emberiza calandra*) and tree sparrow have declined for periods of up to a decade at an average rate of more than 5% per year. The declines in bird numbers in part reflect those in the invertebrate and plant populations upon which they depend.

Parallel changes have taken place in many other European countries, although these have not been documented in as much detail as in Britain, where censuses are carried out by the British Trust for Ornithology (BTO). In all, 116 species of farmland birds — one fifth of European avifauna — are now of conservation concern. Such is the significance attached to the loss of bird populations that John Prescott, UK Deputy Prime Minister and environment secretary, has included a composite trend of 139 species in the list of 13 headline indicators of sustainable development upon which the government reports annually.

Where have all the birds gone?

Rachel Carson's classic 1963 book *Silent Spring* alerted the public to the toxic side effects of the organochlorine insecticides, such as DDT, that had fuelled the green revolution. Residues of these pesticides were found to persist in the food chain, reaching higher concentrations, and hence having more severe effects, at successive trophic levels. Famously, they were identified as the cause of rapid population decline in birds of prey, such as the peregrine falcon and sparrowhawk, through the thinning of eggshells. The offending chemicals have now been phased out in the United Kingdom and many other countries, but their use is still increasing in some parts of the world.

The new losses in biodiversity are sometimes called the 'second Silent Spring'. However, although they are associated with the intensification and industrialization of agriculture[1], they involve more subtle and indirect effects than the poisoning of wildlife by pesticide residues. In general terms, intensification is about making as great a proportion of primary production as possible available for human consumption. To the extent that this is achieved, the rest of nature is bound to suffer.

Detailed ecological studies have shown the devastating effect of the intensification of agriculture on biodiversity. Here we summarize some of the key results, taking birds as our illustrative taxon, and link them to the broader issues of society's choices about the kind of landscape and environment it wishes to bequeath to future generations.

Can we be sure that the bird declines in the United Kingdom are caused by agricultural intensification? Most of the evidence is by association, but in sum total it is damning. For example, annual BTO censuses of 42 species of breeding birds show that 13 species living exclusively in farmland, such as the skylark (*Alauda arvensis*) and corn bunting, declined by an average of 30% between 1968 and 1995, while 29 species of habitat generalists, such as the carrion crow (*Corvus corone*) and the wren (*Troglodytes troglodytes*), have increased by an average of 23% (ref. 2). More direct evidence is that the declines of four species have actually been reversed, at least on a local scale, by 'experimental' changes in farming. These are the grey partridge (*Perdix perdix*; by reduced pesticide input, provision of nesting cover and predator control)[3], cirl bunting (*E. cirlus*; provision of overwinter stubbles and grass margins)[4], corncrake (*Crex crex*; provision of early nesting cover and delayed harvest of grass for forage)[5] and stone curlew (*Burhinus oedicnemus*; adjacent fields of spring crops and grazed pasture)[6]. Most of these manipulations would not make it into a textbook on experimental design, but they are about as strong as the evidence is likely to get that agriculture can be modified for the benefit of wildlife.

Table 1 **Key changes in British agriculture over the past 30 years**

Land drainage
Hedgerow removal
Introduction of new crop types (oilseed rape, linseed)
'Improvement' of pasture (fertilizers, monoculture)
Increased agrochemical inputs
Switch from spring to autumn sowing
Silage harvest of grass
Reduction in traditional rotations
Reduction in undersown leys

Taken from ref. 7.

Drowning in food

The changes in British agriculture over the past 30 years, which have many parallels with other parts of the world, have sought to increase production and productivity (Table 1). The success of the green revolution in achieving this is undeniable: in spite of rapid population growth, about 25% more food per capita is produced now than 30 years ago.

In the European Union (EU), a large incentive to increase production has been the Common Agricultural Policy (CAP), which has subsidized production and kept prices artificially high. The CAP costs the EU tax-payer more than 40 billion euros

(US$43 billion) per year — more than half the total EU budget — and generates vast surpluses, politely called 'intervention stocks'. If the CAP continues on its present course, it will generate annual surpluses of 58 million tonnes of cereals and 1.5 million tonnes of beef by early next century. Wine and milk lakes tell a similar story. In England, subsidies vary from year to year, but from 1994 to 1998 they ranged between 45% (1994) and 123% (1998) of the 'total income from farming'. In 1998, income was £2.17 billion (US$3.5 billion) and subsidy was £2.67 billion — an extraordinary situation in a country where state subsidy for almost all industries has disappeared.

The European Commission recognizes that this cannot go on. First, production subsidies, typically at 20%, are inimical to the principles of free trade embodied in the World Trade Organization. Second, the expansion of the EU to include the agricultural countries of Eastern Europe would break the bank and/or generate even larger surpluses if the CAP were to continue on its present course. Third, the need to conserve wildlife in harmony with agriculture is beginning to be recognized. For these reasons a reform of the CAP, called Agenda 2000, was agreed in March 1999. Agenda 2000, presumably a step on a road to much larger reforms, does not do away with subsidies to farmers, but it facilitates the switch of subsidies away from production to flat-rate payments per hectare of land (a process initiated in earlier reforms). It is argued that this will reduce the incentive for production and allow other imperatives, such as environmental benefits, to come into play. But the proposals as they stand are virtually silent about what environmental benefits are expected and how they will be achieved. What would conservation ecologists recommend?

Conserving biodiversity

The United Kingdom has three agricultural schemes that could have benefits for biodiversity. Environmentally Sensitive Areas and the Countryside Stewardship Scheme (or regional equivalents) both pay farmers to preserve traditional landscape features; between them they encompass about 12.5% of agricultural land. Unfortunately, there are few data to demonstrate whether or not these schemes have benefited biodiversity, although some habitats, such as lowland heath, have been preserved or restored. Set-aside (farmers paid under the CAP to leave land fallow to reduce surplus production) accounts for about 10% of arable farmland; the available data show that certain kinds of set-aside can be beneficial for birds and other wildlife. But set-aside will probably be phased out early in the next century, so its benefits will disappear.

Although we can, as described above, devise plans that help individual species to recover, there is no magic bullet with which to reverse the declines of a large suite of species. The changes listed in Table 1, in different combinations for different species, have all brought about declines, and therefore the most general prescription is to reverse the intensification of agriculture.

Table 2 **Beneficial effects typical of organic farming**

Taxon	*Organic compared with conventional farming*	*Number of farms studied*
Earthworms[8]	Greater numbers and biomass	1*
Spiders[9]	More individuals and species	3
Butterflies[10]	Non-pest species more abundant	16
Arable weeds[11]	Greater cover and more species	8
Birds[12]	31 out of 34 species more abundant	62
Birds[13]	8 out of 18 species more abundant (others no difference)	44

*One site with 12 experimental plots

A slightly more specific prescription arises from the general result that heterogeneous landscapes are beneficial for birds; for example, where crops intermingle with hedgerows or field margins, or where a diversity of crops grow in close juxtaposition. Although several comparisons of organic and conventional farms have suggested that organic farming is good for biodiversity (Table 2), this benefit probably relates to general features of habitat heterogeneity and lower-intensity agriculture, rather than to any specific prescriptions in the theology of organic farming. There have been no systematic comparisons of the biodiversity benefits of organic and other 'wildlife friendly' farming methods.

There are three unexplored research areas that may help to guide future policy for managing the agricultural landscape: the benefits of stuctural heterogeneity at different spatial scales (field, farm, landscape); the trade-offs between conservation benefits and the economic profitability of farming; and the trade-offs (or synergies) between conservation of different taxonomic groups. To make research results more useful for policy-makers, there is a need for integrated, predictive modelling.

On an EU-wide scale, there are unresolved questions for conservation ecology about the relative merits of moving to less intensive, more environmentally friendly agriculture throughout the countryside (the Eastern European model) versus highly intensive agriculture in bread-basket regions with separate, large nature reserves or national parks for wildlife (the North American model). The United Kingdom is probably too small for the North American model, but one could envisage some form of it on a Europe-wide basis, especially if reduced subsidies were to make agricultural production uneconomic in some areas, and instead conservation were subsidized as a 'crop'.

The next revolution?

In the United Kingdom, as in most of Europe, people have made the landscape. This means that the characteristic habitats and species that conservationists wish to preserve (such as heather moorland) are generally there because of (traditional) land management rather than in spite of it. The future shape and purpose of the countryside is society's choice. At present, most of those in the United Kingdom who voice an opinion — from the more than one million members of the Royal Society for the Protection of Birds to John Prescott — would prefer a countryside in which agricultural production is tempered with conservation. And on a worldwide stage this makes sense for a sustainable future: the green revolution gave success at a price, and that price cannot be paid indefinitely.

The British public's concern about genetically modified (GM) crops, based in part on justifiable environmental concerns, must be placed in this context. Whatever hazard GM crops might be thought to pose to the environment is painted onto a biodiversity landscape that is already severely damaged by the intensification of agriculture. The environmental safety aspects of GM must be thoroughly investigated to define the risks before, if they prove acceptable, moving to large-scale commercial planting. Even then, there must be continued scrutiny and evaluation. But we must also recognize a potential benefit of GM crops — to give us a wider range of options as we try to make a more sustainable future for agriculture than that created by the last green revolution. □

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