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Breeding birds on organic and conventional arable farms

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Chapter 1

General introduction



ABC-book from the 1950s indicating that the skylark was a common bird in those days

Intensification of arable farming and the decline of farmland birds

During the past decades agricultural yields have increased enormously in north-western Europe (e.g. Chamberlain *et al.*, 2000). In order to reach these high yields European agriculture has intensified drastically. The process of agricultural intensification is characterized farm specialization, increased field size, removal of semi-natural habitats and increased inputs of agrochemicals (artificial fertilizers and pesticides). Mixed farms have been replaced by farms which focus on only one type of agriculture, such as arable or dairy. Moreover, arable farmers grow less different crop types and less varieties of certain crop types, and together with removal of semi-natural habitats this has resulted in larger monocultures (e.g. Stoate *et al.*, 2001; Robinson and Sutherland, 2002). The use of agro-chemicals has been expanded from the 1970s onwards. Larger areas are sprayed with pesticides and per area unit more fertilizers are applied (Chamberlain *et al.*, 2000; Stoate *et al.*, 2001).

As a consequence of processes linked to agricultural intensification, landscape quality, in terms of landscape diversity and areas of semi-natural habitats of modern farmland, has declined (Stoate *et al.*, 2001; Robinson and Sutherland, 2002). In the Netherlands currently, farm area covered with semi-natural habitats is only about 2-3% (Manhoudt and de Snoo, 2003). Semi-natural habitats like field margins and hedgerows are of large importance for plants, invertebrates, birds and mammals in agricultural habitats. As a result of this development agricultural landscapes offer less suitable habitat for many species.

Besides negative effects on landscape quality, agricultural intensification has also resulted in reductions of populations of a wide range of taxonomic groups. Herbicide use, increased inputs of fertilizers and increased tillage frequency have had negative effects on wild plants (Robinson and Sutherland, 2002; Baessler and Klotz, 2006). Increased usage of insecticides is

one of the main causes behind declines of invertebrate populations (Benton *et al.*, 2002; Robinson and Sutherland, 2002; Schweiger *et al.*, 2005). Reduction of available plant material and invertebrates has resulted in the fact that species higher in the food chain, such as birds, have become more and more under pressure as well (Siriwardena *et al.*, 1998; Donald *et al.*, 2001; Wretenberg *et al.*, 2006).

Population declines of farmland birds have strongly raised the attention of conservationists and ecologists. Consequently, relations between agricultural intensification and farmland birds have been studied intensively (e.g. Chamberlain *et al.*, 2000; Donald *et al.*, 2001, 2006, Wretenberg *et al.*, 2006). Populations of several species show severe declines and currently species like skylark *Alauda arvensis*, linnet *Carduelis cannabina* and grey partridge *Perdix perdix* have been placed on Red Lists in several countries (Gregory *et al.*, 2002; van Beusekom *et al.*, 2004; Gärdenfors, 2005). As an illustration table 1 shows the trends of characteristic bird species of arable land in the Netherlands, UK and Sweden, as well as their conservation status.

Several changes in current agricultural practice have initiated these population declines. During the breeding season, availability of suitable nest sites and food are limited in modern agricultural landscapes. First of all, the reduction of crop diversity has limited multi-brooded ground-breeding species (e.g. skylark, yellow wagtail *Motacilla flava*) to produce multiple broods. These species probably need more than one successful brood per breeding season in order to self sustain the breeding population (Wilson *et al.*, 1997). Secondly, the shift from spring sown cereals to autumn sown cereals which took place especially in the UK (e.g. Chamberlain *et al.*, 2000) has reduced the availability of suitable breeding habitat for species like skylark (Wilson *et al.*, 1997; Chamberlain *et al.*, 1999a). Thirdly, removal of semi-natural habitats like hedgerows has reduced the availability of suitable breeding sites for species like linnet and yellowhammer *Emberiza citrinella*. Fourthly, evidence has been

found that increased usage of insecticides has resulted in reduced food (invertebrate) availability and consequently a reduction in reproductive success (Potts, 1986; Hart *et al.*, 2006).

Besides problems during the breeding season, also winter habitat has been degraded. The switch from spring sown cereals to autumn sown cereals have reduced the availability of stubble fields, which are important foraging habitats for wintering granivorous farmland passerines (e.g Hancock and Wilson, 2003; Gillings *et al.*, 2005; Orłowski, 2006; Perkins *et al.*, 2008). The use of more efficient harvesting methods has reduced the amount of cereal grains left on the fields during winter. Furthermore, increased usage of herbicides has limited weed seed production. These factors have probably contributed to reduced winter survival rates of farmland birds and consequently population declines (Peach *et al.*, 1999; Siriwardena *et al.*, 2008).

In order to reverse the declines of farmland bird populations, roughly two approaches could be adopted: (1) agri-environment schemes and (2) organic farming. Agri-environment schemes are based on the principle that some area of the agricultural land is managed less intensively in order to provide suitable habitat for certain species or taxonomic groups. The remaining area can still be managed very intensively. Examples of agri-environment schemes are uncropped field margins and set-aside land. In contrast with agri-environment schemes, organic farming aims at sustaining healthy ecosystems. IFOAM, the worldwide organization for organic farming, uses the following definition for organic farming:

“Organic farming is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the

shared environment and promote fair relationships and a good quality of life for all involved.”

As a result of this system-broad conversion it a wide spectrum of species and taxonomic groups benefits from this (Hole *et al.*, 2005).

Table 1 Population trends and presence on Red Lists of bird species characteristic to arable farmland. Population trends are expressed as % of population change, NDA = no data available. NL = the Netherlands, UK – United Kingdom, SW = Sweden. Sources: Gregoroy *et al.*, 2002; van Beusekom *et al.*, 2004; Gärdenfors, 2005.

Species	Population trend			Present on Red List		
	NL (1973-2000)	UK (1970-2001)	SW (1976-2001)	NL	UK	SW
Grey Partridge	-73	-86	NDA	X	X	X
Skylark	-90	-54	-55	X	X	X
Tree Sparrow	-84	-94	-25	X	X	
Linnet	-53	-51	-53	X	X	X
Yellowhammer	0	-52	-40		X	
Corn Bunting	-94	-89	NDA	X	X	X
Reed Bunting	+55	-48	-1.8 ¹		X	
Yellow Wagtail	-18	-59	-3.9 ¹	X		
Meadow Pipit	-25	-31	-1.4 ¹	X		
Lapwing	+5	-41	-32			
Turtle Dove	-74	-77	Not breeding	X	X	NA
Barn Swallow	0	+11	-3	X		

¹ = Mean population change per year

Managing birds on arable farmland

Agri-environment schemes

In arable areas, one of the most common initiatives is the installation of uncropped field margins. In general, these margins are approximately 3-10 m wide, with a grass or herbaceous vegetation. Aim of these margins is often to

safeguard habitats for plants, invertebrates and birds. Some evidence has been found that uncropped field margins can be an effective measure for flora protection in agricultural habitats (Kiss *et al.*, 1997). In addition to this, several studies have pointed out the importance of uncropped field margins for different invertebrate groups (e.g. Dennis and Fry, 1992; Kromp and Steinberger, 1992). Also for birds positive effects of field margins have been recorded. Field margins can have different functions for birds, such as foraging sites (Perkins *et al.*, 2002) and breeding sites.

A second widespread agri-environment scheme is set-aside. Originally, the EU installed the set-aside regulation in the early 1990s in order to counteract overproduction of cereals. As a result of this regulation farmers were obliged to take some of their land out of production in order to counteract the overproduction. Side-effect of this regulation was a positive effect on farmland bird numbers. Soon it was clear that set-aside fields attracted high numbers of bird during the breeding season and during winter (Berg and Pärt, 1994; Buckingham *et al.*, 1999; Henderson *et al.*, 2000). In the Netherlands Montagu's harrier *Circus pygargus* numbers increased as a result of the introduction of set-aside fields which resulted in high numbers of voles (Koks *et al.*, 2007).

Although some studies have proven that agri-environment schemes can enhance farmland bird populations (e.g. Peach *et al.*, 2001), the effectiveness of agri-environment schemes has been under debate (e.g. Kleijn *et al.*, 2001; Kleijn and Sutherland, 2003; Kleijn and van Zuylen, 2004). Besides this, agri-environment schemes are financed with government money and thus vulnerable for changes in the political field. This means that there is no guarantee for subsidies and thus for sustainable management of farmland birds.

Organic farming for farmland birds

Organic arable farms and 'landscape lay-out': crop rotation and semi-natural habitats

Organic arable farmers generally grow more different crop types than conventional farmers (McCann *et al.*, 1997; Levin, 2007). This is mainly done to reduce the risk of outbreaks of crop damaging fungi and soil active invertebrates (e.g. Nematoda). More different crop types provide more different habitats and that might result in higher avian diversity. Besides that, higher crop diversity on organic farms might provide multi-brooded species with more suitable nesting sites throughout the entire breeding season. Besides more different crop types, organic farmers grow often spring sown cereals instead of autumn sown cereals (Bengtsson *et al.*, 2005; Hole *et al.*, 2005). Growing mainly spring sown crop probably enhances food accessibility for ground feeding birds as swards are less dense during the breeding season. Furthermore, it is probably more suitable as nesting site for ground-breeding species, such as lapwing and skylark.

Several studies showed that organic farms have more semi-natural habitat (i.e. habitats not used for production purposes) compared to conventional counterparts (van Mansvelt *et al.*, 1998; Fuller *et al.*, 2005; Gibson *et al.*, 2007; Levin, 2007). Additionally, semi-natural habitats on organic farms are found to have larger dimensions as well (Chamberlain *et al.*, 1999b; Fuller *et al.*, 2005; Gibson *et al.*, 2007). As semi-natural habitats probably need a certain minimum size in order to attract birds (Sparks *et al.*, 1996; Marshall *et al.*, 2006) the effects on bird densities might be stronger when they are larger, wider or taller.

Organic arable farms and crop management: pesticides and fertilizers

In organic agriculture the use of artificial pesticides is prohibited (SKAL, 2008). In stead, organic farmers apply “natural” methods to control insect pests and weeds. Among other ways, insect pests are controlled by enhancing populations of natural enemies (e.g. Staphylinidae, Parasitica). Weeds are mainly controlled mechanically, by harrowing and hoeing. Although the prohibition of artificial agrochemicals is likely to result in higher food abundance (invertebrates and plant material) for birds, mechanical weeding might be a potential threat to especially ground-breeding birds (e.g. skylark, yellow wagtail, lapwing).

Instead of artificial fertilizers, organic farmers apply organic manure and sow nitrogen binding crops after harvesting. As a result, soil organic matter probably increases, stimulating soil life. Consequently, a richer soil life probably also stimulate above ground invertebrates (Smeding and de Snoo, 2003), which form an important part of the diet of many farmland birds (Holland *et al.*, 2006).

Objectives

There are several previous studies that compared breeding bird densities between organic and conventional farms (Christensen *et al.*, 1996; Wilson *et al.*, 1997; Chamberlain *et al.*, 1999b; Freemark and Kirk, 2001; Beecher *et al.*, 2002; Lubbe and de Snoo, 2007). Most of these studies concluded positive effects of organic farming on breeding bird densities, but the reasons behind these differences are not clear yet.

However, territory establishment is only one part of the story. Differences in crop management and crop partition are likely to affect breeding success. This information is of crucial importance in order to conclude whether organic farming does not only hold higher densities of bird, but also enhances

farmland bird populations. The objective of this dissertation is to compare organic and conventional arable farms as breeding habitat for farmland birds. Therefore, territory densities, breeding success and food abundance will be compared between organic and conventional arable farms. Differences will be explained by investigating the effects differences in farm lay-out (crops and non-crop habitats), crop management and food abundance (for territory densities and breeding success).

In pursuit of this goal, a series of studies was carried out with the following objectives: (1) assessing and explaining differences in breeding bird densities between organic and conventional arable farms, (2) assessing and explaining differences in breeding success of birds between organic and conventional farms, (3) assessing the effectiveness of volunteer nest protection on reproductive success on both farm types, (4) assessing chick food availability on organic and conventional arable farms. Differences in breeding bird densities were explained by looking at three different factors: (1) abundance of non-cropped habitats, (2) crop partition, and (3) within-crop factors. The latter includes sward structure and food abundance. Concerning reproductive success, direct effects of farm management on nest survival were investigated. Additionally, the possibility of indirect effects of differences in food resources on breeding success was assessed as well.

Thesis structure

Differences in breeding bird densities

Chapter 2: In this chapter territory densities of ground-breeding birds were compared between organic and conventional arable farms for a selection of farmland bird species. Additionally, it was analysed why the abundance of certain species differed between the two farming systems and why this was not

the case for other species.

Chapter 3: This chapter describes differences in abundance of breeding barn swallows (*Hirundo rustica*) on organic and conventional arable farms. Besides this, farmers' attitude towards presence of Barn Swallows was compared as well.

Differences in breeding success

Chapter 4: This chapter focuses on the nest success of lapwings (*Vanellus vanellus*) on organic and conventional farms. Differences in nest success between the two farming systems were analysed and explained by investigating three causes of nest failure: (1) farming operations, (2) predation, and (3) nest desertion.

Chapter 5: This chapter focuses on the breeding activity and breeding success of skylarks (*Alauda arvensis*) on organic and conventional arable farms. The effects of crop partition on breeding activity and crop management on breeding success are evaluated.

Chapter 6: In this chapter it was analysed whether volunteer nest protection of lapwings could be a possibility to enhance populations of ground-breeding farmland bird. Therefore, a case study was carried out comparing the nest success of lapwings on organic and conventional arable farms with and without nest protection.

Differences in food abundance

Chapter 7: In this chapter bird chick food availability is compared between organic and conventional farms.

Chapter 8: General discussion

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