Agriculture, Ecosystems and Environment 150 (2012) 82–90

Contents lists available at SciVerse ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Do skylarks prefer autumn sown cereals? Effects of agricultural land use, region and time in the breeding season on density

Matthew Hiron[a,*], Åke Berg[b], Tomas Pärt[a]

[a] Department of Ecology, Swedish University of Agricultural Sciences, SE-750 07 Uppsala, Sweden
[b] Swedish Biodiversity Centre, Swedish University of Agricultural Sciences, SE-750 07 Uppsala, Sweden

ARTICLE INFO

Article history:
Received 14 September 2011
Received in revised form
23 November 2011
Accepted 6 January 2012
Available online 13 February 2012

Keywords:
Farmland birds
Skylark
Land use specific density
Habitat switch
Source-sink
Ecological trap

ABSTRACT

Explanations for causes of farmland biodiversity declines often assume no spatial or temporal variation in the effects of land use on species abundance and performance. For example, European populations of skylark are assumed to have declined partly due to the switch from spring sown to autumn sown crops. Still, land use preferences of farmland birds may vary with region, landscape structure and time in the breeding season. We inventoried 430 transects in 36 landscape plots (each 25 km^2) in three major agricultural regions of southern Sweden and show that land use-specific densities of skylarks display strong temporal and regional differences. Pre-nesting densities in late April–early May were highest in autumn sown cereals and other arable land use with vegetation, but decreased during the course of the breeding season such that densities in spring sown cereals were slightly higher than those in autumn sown cereals late in the season. This temporal shift in crop-specific densities of skylarks differed between regions. Temporal patterns of crop-specific densities of skylarks could be explained in terms of vegetation-dependent nest predation risk and foraging conditions. We suggest that land use preferences of farmland birds often could be expected to display a temporal and spatial variation and this should be reflected in a more flexible, context-dependent approach for the conservation of farmland biodiversity.

1. Introduction

Farmland biodiversity has declined rapidly during the last few decades (Robinson and Sutherland, 2002; Butler et al., 2007) due to agricultural intensification (Donald et al., 2001b; Geiger et al., 2010). Agricultural landscapes of Europe are dominated by arable farming and studies on biodiversity issues often focus on arable systems and how to reduce biodiversity loss and increase ecosystem services such as pollination, natural enemies to pests, and cultural benefits (Öckinger and Smith, 2007; Bradbury et al., 2010; Geiger et al., 2010). An especially well studied group of species is farmland birds, several species of which have displayed dramatic declines since the early 1980s (Siriwardena et al., 1998; Wretenberg et al., 2006). Birds are often viewed to be good indicators of the “health of ecosystems” partly because they are frequently top predators in food chains and thus sensitive to changes at lower trophic levels (Gregory et al., 2005).

Farmland birds display different population trends in different parts of Europe and this variation in trends may partly be explained by variation in farming intensity and cereal yield (Donald et al., 2001b). The switch from spring sown to autumn sown cereals is one component of intensification that has been seen as a major factor behind loss of biodiversity in farmland (Chamberlain et al., 2000a; Butler et al., 2007) partly because autumn sowing of crops may reduce winter survival in many farmland bird species through the loss of important food-rich post harvest stubbles (Robinson and Sutherland, 1999). However, it has also been suggested that autumn sown crops negatively affect birds in the breeding season because their tall, dense vegetation reduces food availability and depresses reproductive output (Donald et al., 2001a; Wilson et al., 2005; Douglas et al., 2010). Also, studies show that habitat preference, reproductive performance and adult survival rates may vary with the height of the ground vegetation for several farmland bird species (Butler and Gillings, 2004; Devereux et al., 2004; Morris et al., 2004; Whittingham and Evans, 2004; Arlt et al., 2008; Gilroy et al., 2010). As consequence, some farmland bird species have been shown to shift habitats during the breeding season in order to utilize fields with a vegetation structure that is suitable for foraging or nesting (Wilson et al., 1997; Gilroy et al., 2010; Kragten, 2011; Brambilla and Pedrini, 2011). However, the timing of vegetation growth will vary depending on e.g. latitude, climate and soil conditions and as a result we may expect patterns of habitat preferences of farmland birds to vary spatially.

A flagship bird species of arable farmland is the skylark *Alauda arvensis*. Skylarks nest and forage in open agricultural fields and vegetation structure is believed to have a major influence on habitat

* Corresponding author. Tel.: +46 018 672420.
E-mail address: matthew.hiron@slu.se (M. Hiron).

0167-8809/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
doi:10.1016/j.agee.2012.01.007

preference and reproductive success (Wilson et al., 1997; Donald et al., 2001a; Toepfer and Stubbe, 2001; Eraud and Boutin, 2002; Morris et al., 2004). Therefore, the switch from spring sown to autumn sown crops has been considered an especially important driver of the large negative population trend observed in skylark populations across Europe the last decades (Wilson et al., 1997; Chamberlain et al., 1999, 2000b). As a consequence, spring sown cereals are often viewed as better breeding habitat for skylark than autumn sown cereals because of their comparatively low vegetation height (Chamberlain et al., 1999). However, studies of skylarks indicate that crop preference differs over the breeding season and between regions with different vegetation growth patterns. For example, skylark densities early in the breeding season have been observed to be higher in autumn sown compared to spring sown cereals (Schläpfer, 1988; Eggers et al., 2011), show little difference (Chamberlain et al., 1999; Eraud and Boutin, 2002) or have higher densities in spring sown cereals (Donald and Vickery, 2000). Higher average skylark densities calculated over the breeding season have been found in autumn compared to spring cereals in Scotland (Browne et al., 2000) and higher rates of occurrence were observed in winter green fields, such autumn sown crops, in Finland (Piha et al., 2003). This observed variation in crop preferences questions whether the switch from spring to autumn sown crops has had the same effects on breeding skylarks in all agricultural regions of Europe; and conversely if conservation measures designed to increase the area of short vegetation in arable landscapes will benefit skylark to the same degree across all regions. For example, in Sweden, skylark populations have decreased by more than 50% since the mid 1970s, but this decline is not tightly temporally associated to a corresponding increase in autumn sown cereals (Wretenberg et al., 2006).

Here, we use data from a large scale bird survey conducted in three agricultural regions of southern Sweden to investigate land use specific temporal trends of skylark abundance (i.e. land use × time interactions) in six common arable land uses with different vegetation height and vegetation development. We focus on spatial and temporal comparisons of skylark abundance in spring sown and autumn sown cereals, since the general view is that skylarks are more abundant in spring sown than in autumn sown cereals. Earlier studies have suggested that heterogeneous habitats may provide suitable nesting and foraging habitat throughout the breeding season (Schläpfer, 1988; Jenny, 1990; Wilson et al., 1997; Chamberlain and Gregory, 1999; Chamberlain et al., 1999). Therefore, we also investigate to what degree temporal patterns of local abundance in autumn sown and spring sown cereal fields depend on the amount of fields with tall or short vegetation adjacent to surveyed fields (i.e. with vegetation height contrasting to that of the focal field) and also presence of field margins.

2. Methods

2.1. Swedish agriculture, study regions and landscape plots

Swedish agricultural landscapes have traditionally been divided into three types: intensive arable plains, mosaic landscapes (large areas of farmland inter-dispersed with woodland) and small scale farming in forested landscapes (Wretenberg et al., 2007). This study is restricted to the arable plains and mosaic landscapes located in Skåne, Götaland and Svealand (i.e. southern Sweden) (Fig. 1a). The growing season in areas covered by this study varies between 180 days and 210 days (north to south), see SMHI (2011), compared to e.g. 290 days in the Netherlands (Environmental and Nature Data Compendium, 2005). The agricultural land cover in landscapes used in this study was predominantly arable (94%) and approximately 48% of that arable land was used for cereal crops, 22% for grass (animal fodder), 7% for set-aside and the remaining area was used for a variety broadleaved crops (e.g. rape, sugar beet and legumes). Autumn sown wheat was the dominant cereal crop followed by spring sown barley and oats, which in 2009 accounted for 44%, 28% and 14% of cereal area, respectively, in the regions of our study. For general comparisons of Swedish agriculture with other parts of Europe (especially U.K.), see Wretenberg et al. (2006).

We conducted bird surveys in 36 landscape plots, each 25 km^2, in the three major agricultural regions of Sweden (Fig. 1a) in 2009. When choosing study plots we used digital land cover maps in ArcGIS to identify 318 25 km^2 map squares containing at least 60% agricultural land (mean = 82%). GIS data from the Swedish Agricultural Board database of agricultural land use (from 2006), as well as Swedish digital land cover maps, were then used to summarize the land area in each of the 318 landscape plots used for specific arable land uses and pastures (including rough semi-natural pastures). We randomly chose 36 landscape plots stratified to create landscape gradients in the proportion of arable land used for autumn sown crops within each region. Ten plots were situated in the south region (Skåne), 13 plots in the central region (Götaland) and 13 plots in the north region (Svealand) (Fig. 1a). Within each region, the minimum distance between plots used in this analysis was 5 km.

2.2. Arable land use, habitat mapping and selection of transects

To allow for a stratified selection of transects in relation to land use within each landscape plot we mapped land use in arable fields between January and early April 2009. Fields were classified into categories: autumn sown crops (cereal or oil), spring sown crops (bare ground or stubble at the time of land use survey), ley (cultivated grassland used for hay or silage), set-aside and cultivated open pasture.

Transects (median length = 250 m, min = 150 m, max = 300 m) were located in fields or between two neighbouring fields of the same land use type. In each landscape plot there were on average 13 transects. We placed transects either within fields or along field margins. Field margins with many trees and bushes were avoided in order to reduce negative effects of predator lookouts on local abundance of skylarks. Transect lines were located at least 300 meters apart within landscape plots to avoid double counting of skylarks. We placed transects at least 100 m from houses, woodlands and busy roads in order reduce potential effects of predator avoidance and human disturbance on habitat selection (Berg and Pärt, 1994; Erdos et al., 2009).

Information on crops and habitat variables within transects was also collected during bird surveys to validate or correct our previous land use mapping. The crops in the transect strip were classified as autumn sown crops, spring sown crops, ley, set-aside or cultivated pasture. Crop type in the field(s) on each side of the transect line was also noted as cereal crops, oil crops, bare ground or other (e.g. grass, legumes and sugar beet). Vegetation height was recorded with a ruler to the nearest cm at three points along each transect line. Almost all fields (>95%) used for spring sown cereal transects had been cultivated before the start of the bird inventory why all fields either consisted of bare soil or of small seedlings (<5 cm height) at the first inventory in late April–early May. Data from the Swedish agricultural board indicate that almost all (97%) of autumn sown cereal transects were in wheat fields, while spring sown cereal transects were mainly in barley (57%) or oat (23%) fields.

We used GIS to characterize land use surrounding the transect area by summarizing results from our land use survey within a 100 m buffer (band) around the 100 m wide transect strip (Fig. 1b) because this is within the range of typical skylark foraging distances (Donald, 2004). For each transect located in crops with tall