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Higher-tier agri-environment scheme enhances breeding densities of some priority farmland birds in England

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ABSTRACT

Agri-environment schemes (AES) are the main policy mechanism available to reverse the widespread losses of farmland biodiversity across Europe. Previous examples of AES enhancing the abundance of farmland birds have been restricted to targeted species recovery programmes, often with bespoke habitat management and high levels of advisory support for landowners. Here, we tested whether standard higher-tier AES agreements targeted at multiple species and with lower levels of advisory support than targeted species recovery programmes can enhance the breeding densities of farmland birds. Surveys of breeding birds were undertaken during 2008 and 2011 on 65 farms under higher level stewardship (HLS) and 21 farms lacking AES interventions, in three regions of England. After allowing for any impacts of predator control, changes in density were more positive on HLS farms in at least one region for six priority species. Five of the six species had mixed diets and were predominantly associated with field edges; the other (lapwing) probably responded to the provision of field-centre fallow plots. Changes in bird numbers were not consistently related to the extent of AES habitat provision. This is the first study to demonstrate that standard AES management without substantial ongoing advisory support can increase or maintain the densities of widespread declining species.

1. Introduction

Agricultural intensification poses one of the largest threats to biodiversity, alongside climate change and introduction of invasive species (Pullin, 2002; Tscharntke et al., 2005). Changes in farm management, as a result of technological advancements and changing agricultural policy, have reduced the carrying capacity of the farmed landscape to support wildlife, resulting in widespread biodiversity loss (Donald et al., 2001; Robinson and Sutherland, 2002; Green et al., 2005; Reidsma et al., 2006). In the EU, the abundance of common farmland birds has halved on average since 1980 (Voříšek et al., 2010). Despite the presence in the UK of some form of agri-environment scheme (AES) since 1987, UK farmland bird populations have also experienced large declines in abundance and range since the mid-1970s (Baker et al., 2012; Balmer et al., 2013; Harris et al., 2014), with a multi-species aggregate indicator of abundance, the UK breeding 'Farmland Bird Indicator' (FBI) continuing to decline and falling to its lowest ever level in 2013, at 46% of its 1970 value (Defra, 2014).

Evidence for AES increasing the abundance of widespread priority species of farmland birds is limited. A review of European AES by Kleijn and Sutherland (2003) found that most schemes were not adequately monitored, and of the 19 studies that employed statistical tests, four reported increases in avian abundance associated with AES management, two decreases, and nine a mixture of increases and decreases. A subsequent review of the effects of conservation measures on farmland biodiversity concluded that impacts were mixed (Kleijn et al., 2011). Most previous AES evaluation studies have compared species abundance or richness between habitats and sites, with and without AES management, at a single point in time (e.g. Dallimer et al., 2010; Davey et al., 2010a; Field et al., 2010; Batáry et al., 2011). However, such differences could simply reflect the preferential recruitment into AES of sites that were relatively rich

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in biodiversity prior to entry into AES. More recently trends in the abundance of a suite of granivorous farmland birds have been shown to be positively related to the amount of AES seed-rich habitat in the landscape, particularly over-winter stubbles (Baker et al., 2012). The clearest examples of AES reversing farmland bird population declines all involve the deployment of bespoke conservation measures tailored to the requirements of individual range-restricted species with high levels of targeting and ongoing advisory support for land owners: e.g. stone curlew (*Burhinus oedicnemus*), corncrake (*Crex crex*), cirl bunting (*Emberiza cirlus*) and corn bunting (*Emberiza calandra*) (Aebischer et al., 2000; Peach et al., 2001; Davies et al., 2011; Perkins et al., 2011).

Since 2005, the main AES in England (Environmental Stewardship (ES)) has had two main elements, the 'broad and shallow' entry level stewardship (ELS) and the 'narrow and deep' HLS. By October 2013, 57% of English farmland was managed under ELS agreements, and a further 14% (over 1.27 million ha) under HLS agreements. The former was open to all farmers and involved the deployment of basic land management options designed to ameliorate widespread environmental issues, while the latter was competitive, targeted towards the most valuable environmental assets and involved more complex land management and capital works. HLS agreements were often combined with ELS, so the management may involve a number of basic options (e.g. grass buffers, hedge management) in conjunction with more complex options (e.g. enhanced wild bird seed mix plots) or a greater range of options tailored towards a particular outcome (e.g. priority farmland bird species). HLS agreements (including HLS agreements combined with ELS or organic ELS) accounted for 51% of total annual AES spend in England in February 2014 (Radley et al., 2005; Natural England, 2014).

Many of the options available under ES aim to provide resources for farmland birds, in particular, nesting sites and insect food during spring and summer, and seed food during winter (Natural England, 2013a,b). Whilst these measures could benefit a range of farmland bird species, one of the specific aims of HLS is to provide habitat and food resources for six of the UK's most threatened farmland bird species: grey partridge (*Perdix perdix*), lapwing (*Vanellus vanellus*), turtle dove (*Streptopelia turtur*), yellow wagtail (*Motacilla flava*), tree sparrow (*Passer montanus*), and corn bunting. HLS is targeted at areas supporting three or more of these species. Advisory support for HLS agreements typically involves initial site visits and consultation over option selection and management but with limited subsequent advice and support, and is considerably less than for the targeted, single-species recovery programmes.

Memmott et al. (2010) highlighted the need for adaptive management approaches and more replicated field studies testing ecological management interventions over multiple sites. Here, we test the hypothesis that farm-scale HLS land management can positively affect the population growth of priority farmland bird species in the absence of a species recovery project and with a modest level of advisory support (which under HLS is usually restricted to the application stage). We compare temporal changes in avian density on farms managed under HLS agreements with those under no form of AES management. In addition, we investigate whether the impacts of HLS management on changes in farmland bird abundance relate to the extent of AES provision of nesting and foraging habitat.

2. Materials and methods

Study farms were selected from three lowland areas with contrasting farming systems, based on one or more National Character Areas (https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles, last accessed 01/12/14):

1. 'East Anglia' (EA) (The Fens, North West Norfolk, East Anglian Chalk, Breckland, Bedfordshire and Cambridgeshire Claylands)–arable dominated.
2. 'West Midlands' (WM) (Shropshire, Cheshire & Staffordshire Plain)–grass dominated.
3. 'Oxfordshire' (OX) (The Cotswolds, Oxfordshire Upper Thames Clay Vales, Midvale Ridge)–mixed arable and grass.

HLS farms were selected according to the provision of "bird-friendly" measures (as defined by Winspear et al., 2010), and the presence of at least one HLS target bird species (either named in the Farm Environment Plan, a specific wildlife audit of the farm, or in a database of farmland bird distribution, http://www.rspb.org.uk/forprofessionals/targeting, last accessed 01/12/14). HLS agreements in this study involved managing an average of 7.4% of farmed land under AES options. Across all three regions, a minimum of 20 HLS farms were identified with records of each of the six HLS target species, with the exception of the rapidly declining turtle dove, which had a low rate of occurrence. Control farms were selected within a 2–10 km radius of HLS farms, with similar topography and soil type, so that the target species could reasonably be expected to be present if suitable habitat was available. Control farms were selected that were not subject to any form of AES agreement. Due to the high proportion of English farmland subject to AES and some of the farms remaining outwith AES having specialist land use characteristics different from those farms managed under HLS, it was not possible to select enough suitable non-AES control farms within the specified radius to follow a matched pairs design. A number of farms dropped out of the study between 2008 and 2011, either due to a change in land ownership, access permission or in AES status (usually because control farms entered ELS). A total of 65 HLS farms and 21 control farms maintained their AES status and were surveyed during both 2008 and 2011 (Appendix A,Table A.1). Although three years is a relatively short period over which to test for impacts of AES management on avian abundance, impacts of AES have been detected over similarly short periods in previous studies (Peach et al., 2001; Perkins et al., 2011; Baker et al., 2012). Fifty-six of the 65 HLS agreements were two years old at the time of our first bird survey in 2008, the remaining agreements being one ($n = 2$) and three ($n = 7$) years old respectively, meaning that most agreements were approximately half way through their 10-year duration by 2011.

The area within which farmland birds were surveyed was determined by placing a tetrad (2×2 km square) over as much of the farm as possible to enable the survey to be completed on a single day. Two bird surveys were conducted on each farm in each survey year, one during April–May and the other during June–July. For farms targeting summer migrants (turtle dove, yellow wagtail) or late-nesting species (corn bunting), the early summer visit was conducted after May 1st. Surveys were conducted using the 'complete area search' method (Wotton et al., 2004), which involved an intensive search of the entire survey area, recording all birds seen or heard. Bird surveys started about 1 h after dawn and typically finished by 12 noon. Observers walked all field boundaries and along parallel transects spaced 50–70 m apart across fields. We distinguished adult from juvenile birds where possible, and only the former were included in analyses. The route walked was reversed on the second survey to increase the likelihood of detecting early morning activity on all parts of the survey area. Surveys were not conducted during poor visibility, rain or strong wind (>Beaufort 4).

Areas of AES measures were mapped visually during field surveys and with reference to agreement maps and discussions with the agreement holders. As the absence of predator control can sometimes limit the effectiveness of habitat management (e.g. for grey partridge, Aebischer and Ewald, 2004), and game management may have beneficial impacts on non-target songbirds