Agricultural Systems 160 (2018) 60–69

Contents lists available at ScienceDirect

Agricultural Systems

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

Evaluating the benefits of agri-environment schemes on farmland bird communities through a common species monitoring programme. A case study in northern Italy

Gianpiero Calvi[a,*], Tommaso Campedelli[b], Guido Tellini Florenzano[b], Patrizia Rossi[c]

[a] Studio Pteryx, Via Risorgimento 9, I-20060 Basiano, MI,Italy
[b] DREAM Italia, via Garibaldi 3, I-52015 Pratovecchio, AR,Italy
[c] Lipu/BirdLife Italia, via Udine 3/a, I-43122 Parma, PR,Italy

ARTICLE INFO

Keywords:
Agri-environment schemes
Farmland birds
Organic farming
Landscape structure

ABSTRACT

Biodiversity in agricultural environments is considered to be undergoing steep declines in most European countries. Among taxa which experienced consistent decreases, birds are of central importance, both for their value as ecological indicators and for the high number of species of conservation concern associated with agricultural ecosystems.

In this paper, using data from the Italian Common Breeding Bird monitoring programme collected in the period 2009–2014, we analysed the effect on breeding birds of four Agri-Environment Schemes (AES) in Emilia-Romagna region, one of the most important agricultural areas of Italy. Specifically we compared the values of three community parameters (total, farmland and generalist species richness) and the abundance of seven species (*Alauda arvensis*, *Hirundo rustica*, *Motacilla flava*, *Serinus serinus*, *Chloris chloris*, *Carduelis carduelis* and *Passer montanus*) in areas covered by AES and not.

The results of the analyses show that, at the scale we investigated, the positive effects of these measures are very limited and often not positive, particularly for farmland specialist species. These findings seem to suggest that the application of these measures, albeit widespread over the Region, is not able to counteract the negative effects of the simplification and impoverishment of the agricultural landscape. Our results show the AES management related more with single species metrics than community measures. Therefore to improve the effectiveness of AES, and to try to contrasts the dramatic decline of farmland bird species, we think these schemes should be designed on the specific needs of species and habitats of high conservation priority.

1. Introduction

Biodiversity in agricultural environments is considered to be undergoing steep declines in most European countries, and there are numerous confirmed cases of lower species diversity and population sizes for many plant and animal taxa (Andreasen etal., 1996; Benton etal., 2002; de Heer etal., 2005; Kuussaari etal., 2007; Potts etal., 2010; Stoate etal., 2009; Van Dyck etal., 2009). Of the latter, birds are of central importance, both because biodiversity losses among them are extensive and well documented (Donald etal., 2001; Reif etal., 2008; Voříšek etal., 2010; Wretenberg etal., 2006), and because they are often used to study the impact of environmental practices on biodiversity (Birkhofer etal., 2014; Sauberer etal., 2004; Tuck etal., 2014) due to their effectiveness as environmental indicators (Gregory etal., 2005, 2003; Gregory and van Strien, 2010). Since 2007, the population trends of birds typical of agricultural landscapes are used as an indicator for the European Union's rural development policies (Annex 4, Regulation 808/2014/EU). The Farmland Bird Index is also one of the European Union's Structural Indicators of Sustainable Development.

The decline of farmland birds on a European scale has been attributed to many interrelated factors, whose effects vary depending on environmental and geographical context (Tryjanowski etal., 2011) and on crop and soil types (e.g. pastures or seed crops: Kuemmerle etal., 2008; Orłowski, 2010, 2005; Orłowski etal., 2011; Spitzer etal., 2009).

The effects of the changes in farming practices (Butler etal., 2007; Chamberlain etal., 2000; Reif etal., 2008; Siriwardena etal., 1998), the use of pesticides (for a review see Boatman etal., 2004; Burn, 2000) and at least in certain context, the reduction of cultivated surface area (Moreira and Russo, 2007), have caused and continue to cause a reduction in food resources and in suitable breeding habitats for birds.

* Corresponding author at: Studio Pteryx, Via Risorgimento 9, I-20060 Basiano, MI,Italy
E-mail address: g.calvi@pteryx.it (G. Calvi).

http://dx.doi.org/10.1016/j.agsy.2017.09.002
Received 30 August 2016; Received in revised form 5 August 2017; Accepted 8 September 2017

The agri-environment schemes (AES) established under the Common Agricultural Policy are the main available instruments to address biodiversity loss in farmland (Butler etal., 2010; Donald and Evans, 2006), especially since they potentially act on a much larger scale, affecting a sizeable proportion of the European surface area (Vickery etal., 2004) unlike traditional biodiversity management and protection tools such as the establishment of protected areas. Nevertheless, the application of these measures has not reversed negative biodiversity trends at the continent-wide scale or in individual EU countries (Batáry etal., 2015; Dicks etal., 2013) and despite the existence of confirmed positive effects on certain species (Martín etal., 2012; Perkins etal., 2011), results have not always been positive; Konvicka etal. (2008) for example, showed that the accession of Czech Republic to EU and the subsequent adhesion to agri-environment schemes resulted in the local extinction of a strong population of the globally threatened butterfly *Colias myrmidone*.

A particularly interesting aspect affecting the effectiveness of these measures appears to be the environmental context in which they are applied (Concepción et. al., 2008). Numerous studies have shown that these measures are significantly more effective when applied in modern agricultural landscapes with few natural areas (Kleijn etal., 2006, 2004; Ohl etal., 2008), as opposed to more diversified and less intensive agricultural areas (Kovács-Hostyánszki etal., 2011).

There are other elements that can significantly influence the efficacy of these interventions, and they should be taken into account during the planning of agri-environment schemes. Many authors have long lamented the lack of sufficient monitoring tools for the impact of agri-environment schemes (Kleijn and Sutherland, 2003), particularly to provide positive feedback into scheme design: Baker etal. (2012) showed the importance of AES targeted towards well documented population-limiting factors (e.g. winter food supply). Moreover, others have recently emphasized the need to implement monitoring tools that can capture the effects of agri-environmental policies on a broad scale (Kleijn etal., 2011).

Another key question is the involvement of farmers, in terms of shared goals and awareness of the importance of nature conservation (Defrancesco etal., 2008; Kragten etal., 2011; Kragten etal., 2008), and of knowledge and training in environmental management (Lobley etal., 2013). It has been shown that farmers with prior experience in the management of natural habitats are able to create high-quality habitats for insects, butterflies, and birds (McCracken etal., 2015), as well as, farmers more aware about farmland biodiversity loss, are more willing to join AES(Herzon and Mikk, 2007).

Among agri-environment schemes, particular attention has been paid to analysing the effects of organic agriculture measure, often one of the most widely-used measures, since its avoidance of synthetic pesticides was presumed to have positive effects on biodiversity. The many studies on this topic, especially in northern and central Europe, have found some positive effects – particularly for *taxa* such as wild plants and certain groups of invertebrates – which nevertheless do not seem to be applicable to all species or habitats (for a review see Bengtsson etal., 2005; Dicks etal., 2013; Tuck etal., 2014). Although some studies have registered positive effects on birds (Dicks etal., 2013), many others have registered none (Geiger etal., 2010) or at least not on all species (Donald, 2004; Kragten etal., 2011), with sometimes significant differences depending on the type of crop that was analysed (Wrbka etal., 2008). Birkhofer etal. (2014) went so far as to use the terms “losers” and “winners” to characterize species depending on the effects of organic farming on their presence and abundance.

This work sets out the results of analyses on the effects of agri-environment measures applied in Emilia-Romagna, especially its lowland areas which are part of the Po Plain and host intensive farmland. The Po Plain is in fact one of Italy's most important agricultural regions. Here, environmental conditions facilitated the development of intensive agriculture, which is highly productive but causes heavy cost in terms of environmental impacts. These negative impacts have been highlighted by numerous studies and indicators, including the Farmland Bird Index that shows a long term decline (− 30% between 2000 and 2014; Rete Rurale Nazionale, Lipu, 2015a).

The present paper has two main goals: firstly it aims to provide an assessment at a regional scale of the effectiveness, on bird used as surrogate of biodiversity, of the agri-environment measures detailed in the Rural Development Programme (RDP) 2007–2014 in a Mediterranean country, an area that has received little study so far (Tuck etal., 2014). During the study period (2009–2014), the AES implementation has interested > 135,074 ha/year, almost the 12.5% of the entire agricultural surface of Emilia Romagna region; during the same period the FBI index continue to decrease at a rate of 2.3%/year (Rete Rurale Nazionale, Lipu, 2015a). Given the huge amount of economic resources invested, we tried to understand what kind of impacts these programs have on agricultural biodiversity, namely breeding farmland birds populations.

Secondly this paper aims to evaluate the possibility of using large-scale monitoring projects for the inspection of AES effects on biodiversity at a wide scale, an action recommended by several authors (Baker etal., 2012; Hiron etal., 2013; Kleijn etal., 2011; Princé etal., 2012).

2. Material and methods

2.1. Study area

The study was conducted in the lowlands of the Emilia-Romagnaregion, an area of about 11,000 km^2 occupying the southern part of the Po Plain, the main floodplain in Italy. This area is characterized by a continental temperature regime, with a climate gradient from the Mediterranean warm climate to the inland temperate climate. Potential vegetation is mainly represented by mesophytic mixed oak-hornbeam woodland (*Quercus robur–Carpinus betulus*), with hygrophilous woodlands along the rivers. Natural vegetation has been almost entirely replaced by anthropogenic environments. Farmland (mainly arables, vineyards and orchards) and urban areas occupy most of the land.

2.2. Bird data

Bird data used in the analyses come from the Italian Common Breeding Bird monitoring programme, which actively contributes to the Pan-European Common Bird Monitoring Scheme (PECBMS). It is based on single-visit point counts, and a stratified sampling design (Fornasari etal., 2002). Italy has been subdivided into 10 × 10 km (UTM projection) squares; in each of these squares a point count is conducted in 15 of the 100 1 × 1 km cells. These cells are the sampling units of this study. The census technique consisted of unlimited-distance point counts (Blondel etal., 1981) lasting 10 min and conducted between 10th May and 20th June, during morning hours.

For this study we used data collected between 2009 and 2014. The original sampling design was integrated in the study area, between 2011 and 2013, with an increase in the number of point counts in cells where specific agri-environment measures were implemented. Thanks to this integration, in the considered period 690 sampling units were sampled, of which 634 consist of 1 × 1 km cells where at least half of the surface was covered by various farmland types. These latter units were selected for the analyses (Fig.1). Within selected units, 308 were visited one year, 103 two years, 45 three years, 40 four years, 62, five years and the remaining 76 every year.

2.3. Agri-environment schemes

We analysed the effects of four different agri-environment schemes (AES) included in Measure 214 –Agri-environments payments of Rural Development Programme 2007–2013. We took into account the most