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Stakeholder perceptions of the effectiveness and efficiency of agri-environment schemes in enhancing pollinators on farmland

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ABSTRACT

In parts of the northern hemisphere, many pollinator species are in decline, with potential adverse implications for pollination and the ecosystem service of food production. It is therefore important to understand how habitats primarily orientated towards food production can be managed in an efficient way to enhance pollinator populations for current and future food security. In Europe, agri-environment schemes are a well-established method for promoting nature conservation on farmland. Some previous studies indicate that certain agri-environment schemes may be beneficial to pollinator populations by promoting increased floristic diversity in agricultural habitats. However, there has been no analysis of the efficiency or cost-effectiveness of these interventions. We used an online survey to evaluate the perceptions of growers in England following the Conservation Grade environmentally-sensitive farming protocol, regarding the effectiveness of different agri-environment scheme options in enhancing pollinators on their farms and the costs of implementation. Options within the agri-environment schemes that were perceived as most effective in enhancing pollinators were those related to improving floristic diversity of field headlands and enhancing or restoring semi-natural grassland. However, these options were not generally the most efficient, due to their high cost. Hedgerow management interventions were shown to be the most efficient, despite being perceived as relatively ineffective, due to the low costs of these options. We have therefore found that there is often a mis-match between effectiveness and efficiency of interventions for enhancing pollinators. Trade-offs are likely to be necessary when making decisions on implementing interventions, and farm size as well other local differences should be taken into account in this decision-making process.

Introduction

Many pollinator species are declining across the northern hemisphere. (Biesmeijer et al., 2006; Potts et al., 2010; Cameron et al., 2011). This decline is a consequence of a number of different factors including, land use change, changes in farming practices, disease and contamination of the environment with fertilisers and pesticides (Vanbergen et al., 2012). These factors can affect pollinators both directly and indirectly through changes to the ecosystem, particularly food supplies (Carvell et al., 2006; Potts et al., 2010; Sutherland et al., 2011). While declines in some species may have slowed recently in some European countries (Carvalheiro et al., 2013), any decline in pollinators is likely to have an adverse impact on pollination. Pollination underpins the functioning of many ecosystems (Kremen et al., 2007; Potts et al., 2010; Vanbergen et al., 2012), as well as having a direct impact on the ecosystem service of food production (Klein et al., 2007). In the light of increasing concerns about food security in both developed and developing nations (Tscharntke et al., 2012), it is important to understand how habitats primarily orientated towards food production can be managed in an efficient way to enhance pollinator populations for current and future food security.

In recognition of the important ecosystem services that pollinators provide, many countries are investing resources in interventions to enhance pollinator populations, either in terms of encouraging bee-keeping (Aizen and Harder, 2009) or encouraging the management of landscapes in ways that are considered to be more beneficial to pollinators. In Europe, conservation-orientated interventions in agricultural landscapes are encouraged by agri-environment schemes, which are voluntary agreements entered into by farmers who are then provided with payments to manage their land according to certain prescriptions to enhance their conservation value (Kleijn & Sutherland, 2003). There has been much debate over the effectiveness of agri-environment schemes

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for biodiversity and conservation in England (Kleijn & Sutherland, 2003; Whittingham, 2011; Courtney et al., 2013), including in relation to pollinators (Carvell et al., 2007, 2011; Pywell et al., 2006, 2011a,b). These authors concluded that specific targeted interventions were significantly more beneficial for bee and butterfly populations than more general conservation management options. A list of possible interventions to benefit wild bee populations has been provided by Dicks et al. (2010). Although the effectiveness of some of these interventions has been measured in terms of species richness and diversity, few studies have tested the effectiveness on population responses of pollinators (Scheper et al., 2013). An assessment of effectiveness that is uniform and comparable across all these agri-environment interventions has not yet been implemented.

In England, agri-environment schemes operate currently at two main levels: Entry Level Stewardship (ELS) and High Level Stewardship (HLS). The ELS is a basic scheme offering farmers over 60 options to choose from (Natural England, 2010a). The Higher Level Stewardship (HLS) is focused on priority areas and demands more complex management from farmers with more specific conservation goals (Natural England, 2010b). Although there is a diversity of agri-environment management options available under both the ELS and HLS, uptake by farmers tends to be biased towards the lowest-cost options (Hodge and Reader, 2010). Despite the importance of cost as a driver of decisions concerning implementation, there is a very little information about the economic efficiency of the agri-environment scheme policies that enhance ecosystem services on farmlands (Kleijn and Sutherland, 2003).

The importance of evaluating the effectiveness and efficiency of conservation measures has received increasing recognition in recent years, as policy-makers seek evidence of successful returns on investment (Ferraro and Pattanayak, 2006; Kapos et al., 2008; Shwiff et al., 2013). For many conservation projects, although outcomes can be quantified, they cannot be expressed in monetary terms. In these circumstances, cost-effectiveness analysis can be used to assess the change in units of conservation output relative to the cost invested in an intervention to produce these outputs. Financial efficiency can be expressed in terms of cost per unit of conservation effectiveness, with programmes with a low cost per unit of conservation output having a high efficiency (Cullen et al., 2001, 2005; Laycock et al., 2009, 2011).

Here we evaluate the cost, effectiveness and efficiency of a selection of management interventions under the ELS and HLS thought to enhance pollinators on farms in England. We use the perceptions of farmers to obtain information on the effectiveness of different interventions for enhancing pollinators and explore the relationship between effectiveness and efficiency for these interventions. The interventions that are considered to be most effective may not necessarily be the most cost-effective and trade-offs may often be necessary when implementing interventions to enhance pollinators with limited financial resources. Farm size and other factors may also have an impact on cost and effectiveness of the interventions and therefore these factors are also explored using both quantitative and qualitative data.

Methods

Questionnaire of farmers and growers

We designed an online survey targeted at farmers in England who followed the Conservation Grade protocol (Conservation Grade, 2012). Conservation Grade seeks to promote farming methods that will help to halt and reverse declines in farmland biodiversity. Farmers who follow the Conservation Grade protocol are required to adopt certain farming practices, including creating a wildlife area on at least 10% of their farm and maintaining pollen and nectar mixes on at least 4% of their farm. Two pollen and nectar habitats should normally be provided: (1) grass and wildflower mixtures and (2) grass and legume mixtures. However, existing pollen and nectar habitats (naturally occurring or sown) can count towards the total habitat area. The Conservation Grade protocol has been designed with other Environmental Stewardship options in mind such as ELS and HLS. However, the Protocol is not necessarily compliant with any particular scheme or intervention under these schemes (Conservation Grade, 2013).

Within the Conservation Grade group of farmers, we targeted our survey at those farmers who had implemented an ELS or HLS intervention on their farms for a minimum of 2 years, whether currently or in the past. Farmers that follow the Conservation Grade protocol are granted premium prices for their crops each year. However, cost is still likely to be important in determining which of the ELS or HLS options are implemented by farmers on their farms.

We included a total of 22 interventions in the questionnaire, 14 from ELS and 8 from HLS (Table 1). Interventions were selected on the basis of evidence provided in Carvell et al. (2007), Pywell et al. (2012), Sutherland et al. (2011) and Bumblebee Conservation Trust (2012) regarding their potential benefits to pollinators (Table 1).

Table 1
List of ELS and HLS agri-environment scheme interventions included in the questionnaire with an explanation of how they are thought to benefit pollinators. Sources for information on benefits: Carvell et al. (2007, 2011); Natural England (2010a); Pywell et al. (2005, 2006); Bumblebee Conservation Trust (2012).

Details of management intervention	Agri-environment scheme option code	Benefits to pollinators
Hedgerow management on both sides of a hedge, on one side of the hedge and enhanced management.	EB1, EB2, EB3	Nesting and pollen and nectar source
Management of woodland edges	EC4	Rearing, nesting and hibernation
2 m, 4 m and 6 m wide buffer strips on cultivated land	EE1, EE2, EE3	Nesting and pollen and nectar source
Management of field corners	EF1	Nesting
Nectar flower mixture	EF4	Pollen and nectar source
Beetle banks	EF7	Nesting
Unharvested cereal headlands	EF10	Nesting and hibernation
Uncropped cultivated margins for rare plants	EF11	Pollen and nectar source
Undersown spring cereals	EG1	Pollen source
Permanent grassland with very low input	EK3	Pollen and nectar source
Management of hedgerows of very high environmental value	HB12	Pollen and nectar source and nesting
Floristically enhanced grass buffer strips (non-rotational)	HE10	Pollen and nectar source
Unharvested, fertilizer-free conservation headland	HF14	Nesting and hibernation
Cultivated fallow plots or margins for arable plants (rotational or non-rotational)	HF20	Pollen and nectar source
Maintenance, restoration and creation, respectively, of species-rich, semi-natural grassland	HK6, HK7, HK8	Pollen and nectar source
Enhanced buffer strips	HE11	Nesting and pollen & nectar source