Institution: University of Reading

Unit of Assessment: Agriculture, Veterinary & Food Science

Title of case study: Informing management options and enhancing biodiversity in English farmland

1. Summary of the impact

Research conducted by the University of Reading between 2002 and 2007 influenced management options mandated under the UK Government's agri-environmental schemes. Several innovative large-scale manipulative field experiments were used to measure the diversity of different groups of invertebrates in response to various management regimes in uncultivated field margins of farmland. The outcomes of this research fed directly into agri-environment scheme options and provided supportive evidence for management advice and advocacy work by several environmental non-government organisations. Changes in the management of field margins brought about through government scheme agreements and advocacy efforts by conservation groups has led to enhanced farmland biodiversity and improved habitat for threatened wildlife valued by the general public and conservationists.

2. Underpinning research

Background

Maintaining biodiversity is vital for environmental health and human wellbeing and a cornerstone of sustainability. Bio-diverse environments are more stable and more resilient to adversities such as pests, disease and climate change. They provide a greater range and value of eco-system services, providing food, clean water, cycling of nutrients, crop pollination, recreational and other benefits (see UK National Ecosystem Assessment, 2011).

Since 1987, the UK has used Agri-Environmental Schemes (AES) to protect and improve biodiversity and to meet its legal commitment to the European Union, which made agri-environment programmes compulsory for Member States in 1992. The AES need to provide farmers and other land managers with a range of management options to support wildlife and the UK Department for Environment, Food and Rural Affairs (Defra) and other sponsors commissioned research to identify potential options for inclusion in English AES.

Testing management options for uncultivated margins in arable fields

Intensively managed fields for agricultural purposes have led to declining populations of UK grassland flora and fauna. Uncultivated field margins provide a straightforward way of improving biodiversity and as such, the establishment of grassy strips at the margins of arable fields is an AES option. However, the outcomes of some management practices and the respective benefits to plant and animal populations were only partially understood in 1980-1990s.

In 2002, the Sustainable Arable Farming For an Improved Environment (SAFFIE) [7] project was established, which brought together leading UK researchers to develop and test 'field margin' and 'in field' options to inform AES. A team from the University of Reading led the work on field margins and coordinated the contributions of other partners, including the Centre for Ecology and Hydrology (CEH) and the British Trust for Ornithology (BTO). The Reading team included Simon Potts, Professor of Biodiversity and Ecosystem Services (2002-), Valerie Brown, Director of Centre for Agri-Environmental Research and Professor of Agri-Environmental Science (2000-2004), Dr Ben Woodcock, Research Fellow (2002-2007), Dr Duncan Westbury, Research Fellow (2002-2008), Dr Jo Smith, PhD student (2004-2007) and Dr Alex Ramsay, Research Fellow (2003-2007).

Between 2003 and 2007, Reading quantified the responses of all plants and all invertebrates (except bumblebees and butterflies, which was led by CEH) to different field margin types, using several innovative large-scale manipulative field experiments in three experimental farms and 26 commercial farms throughout the UK. The team manipulated management practices such as seed mix and management type. Reading compiled the results from all partners into the final report on field margins [1].

The research findings identified management options that were most effective in enhancing biodiversity around arable land. For example, they found that sown seed mixtures that provided large scale architectural diversity along the field margins supported a greater abundance and diversity of beetles [2]. The team also found that minimising soil cultivation encouraged beneficial litter-dwelling soil invertebrates [3].

Testing management options for uncultivated margins in grasslands

During the same time period (2002-2007), Reading was a partner in the first ever large-scale UK grassland study, the Potential to Enhance Biodiversity in Intensive Livestock farms (PEBIL) [8], which looked at the response of multiple taxa to different types of field margins around pastures. Reading led the assessments of all invertebrates to complement work on plants, which was led by the Institute of Grassland and Environmental Research (IGER), and birds, which was led by the BTO.

Reading implemented manipulative field experiments across four farms in South-West England. The team manipulated conventional management practices, such as application of inorganic fertiliser, cutting frequency and height, and aftermath grazing, to create different treatment regimes along a gradient of decreasing management intensity.

The findings provided options for management of grasslands that enhanced invertebrate diversity. They found that stopping the use of inorganic fertiliser, reducing cutting frequency and grazing were all beneficial to butterfly diversity and that sowing flower-rich habitat enhanced bumblebee diversity [4]. Fields that had no management or received only a single silage cut in July supported greater abundances and species richness of beetles [5]. Planthoppers and leafhoppers had the greatest abundance and species richness in extensively managed treatments, and were negatively affected by frequent cutting and grazing [6].

Reading's research substantially improved understanding of how uncultivated margins can be used to improve biodiversity, helped develop the mechanistic basis for the work, and provided a set of potential options for inclusion in and further development of English AES.

3. References to the research

Other than the project report [1], each of the research papers listed below are in some of the highest ranked agro-ecology journals and are of at least 2* in terms of quality and most of them have been rated as 3* internally.

[1] Potts S.G., Westbury D.B., Woodcock B.A., Ramsay A.J., Harris S.J., Springate S., Pywell R., Meek B., Carvell C., Hulmes L., Warman L., Sparks T., Cook S.K. & Henderson I.G (2007). Experiment 2 - management of the non-cropped margin structure to maximise biodiversity, In: The SAFFIE Project Report. ADAS, Boxworth, UK. <http://www.hgca.com/cms_publications.output/2/2/Publications/Final%20project%20reports/The%20SAFFIE%20Project%20Report.mspx?fn=show&pubcon=3919>

[2] Woodcock B., Westbury D., Potts S.G., Harris, S. & Brown V.K. (2005) Establishing field margins to promote beetle conservation in arable farms. *Agriculture, Ecosystems and Environment* 107: 255-266. DOI: 10.1016/j.agee.2004.10.029

[3] Smith J., Potts S.G., Woodcock B.A. & Eggleton P. (2008) Can arable field margins be managed to enhance their biodiversity, conservation and functional value for soil macrofauna? *Journal of Applied Ecology* 45: 269-278. DOI: 10.1111/j.1365-2664.2007.01433.x

[4] Potts S.G., Woodcock B.A., Roberts S.P.M., Tscheulin T., Ramsay A.J., Pilgrim E., Brown V.K. & Tallowin J.R. (2009) Enhancing pollinator biodiversity in intensive grasslands. *Journal of Applied Ecology* 46: 369-379. DOI: 10.1111/j.1365-2664.2009.01609.x

[5] Woodcock B.A., Potts S.G., Ramsay A.J., Tscheulin T., Parkinson A., Smith R.E.N., Martyn T.M., Pilgrim E., Gundry A., Brown V.K. & Tallowin J.R. (2007) The potential of grass field margin management for enhancing beetle diversity in intensive livestock farms. *Journal of Applied Ecology* 44: 60-69. DOI: 10.1111/j.1365-2664.2006.01258.x

[6] Blake, R.J., Woodcock, B.A., Ramsay, A.J., Pilgrim, E.S., Brown, V.K., Tallowin, J.R. & Potts,

S.G. (2011) Novel margin management to enhance Auchenorrhyncha biodiversity in intensive grasslands. *Agriculture, Ecosystems and Environment* 140: 506-513. DOI: 10.1016/j.agee.2011.02.003

Grants

[7] Brown and Potts (2002-2007) *SAFFIE: Sustainable Arable Farming for an Improved Environment,* Sponsors: Defra, the Scottish Executive Environment and Rural Affairs Department and Natural England (formerly English Nature), British Potato Council, Agricultural Industries Confederation, Crop Protection Association, Home-Grown Cereals Authority, Jonathan Tipples, Linking Environment And Farming, Royal Society for the Protection of Birds, Sainsbury's Supermarkets Ltd, Syngenta, the National Trust, and Wm Morrison Supermarkets PLC, £3.5M (£639,000 awarded to Reading).

[8] Brown and Potts (2002-2007) *PEBIL: Potential to Enhance Biodiversity on Intensive Livestock farms,* Defra, £1.1M (£395,000 awarded to Reading) .

4. Details of the impact

Reading's research findings were presented to Defra, Natural England, National Farmers Union, Home Grown Cereal Authority and farmers through a combination of scientific publications, project reports, presentations and discussion meetings.

Influencing management options in AES

The Entry Level Stewardship (ELS) scheme and associated guidance handbook, was rolled out in 2005, with updated versions of the handbook published in 2008, 2010 and 2013. The Reading research was "*immediately picked up in the scheme design and rolled-out as an option*" [a]. The research, which identified the "*crucial importance of the need to manage margins (e.g. through a summer cut of the outer 3m of 6m margins) has been carried through into scheme design/delivery*" [a]. The findings from the PEBIL project [4-6] "*was a valuable basis for the development of EK1*" [b], which takes field corners out of management and requires that no fertilisers be applied and reduced cutting take place to promote the growth of plants that provide large scale architectural diversity. *"It was also part of the evidence base underpinning EE4, EE5 and EE6 buffer strip options*" [b] on intensive grasslands.

SAFFIE data also "*contributed to the body of evidence that has led to greater incentivisation for floristic supplementation of buffers in ELS*" [c]. "*Formerly there were no additional points for sowing flower-rich rather than cheaper grass-only seed mixes, with the cost of the more expensive flower-rich mixes only met in HLS agreements"* [c].

An independent report commissioned by Defra [d] presented SAFFIE, and the Reading research within it, as an example of a "*successful project*" and stated "*the research was evaluated as having Medium scientific and commercial impact with High environmental impact. This project has been well communicated and disseminated through a range of channels. There is evidence of uptake and dissemination through NGO partners such as [the Royal Society for the Protection of Birds] and BTO.This is an example of a multi-stakeholder project that has delivered positive results and, specifically, some new options for the Entry Level Environmental Stewardship (ELS) scheme*" [d].

Supporting guidance and advocacy work of NGOs

The research conducted by Reading has been incorporated into the guidance and advocacy work of numerous non-government organisations, supporting their conservation programmes. The Royal Society for the Protection of Birds (RSPB) provides advice for farmers on maintaining field margins on grasslands [e] and arable land. Results of SAFFIE "*have been used extensively to inform practical implementation of measures (on RSPB landholdings and advisory guidelines to other land managers) and in policy advocacy*" [c]. Butterfly Conservation also provides advice around supporting butterfly diversity in farmland that recognises the importance of maintaining flower-rich margins [f].

Influencing projects that bring environmental and economic benefits

The management options under AES and guidance provided by various NGOs in relation to field margins has been influenced by the research conducted at Reading. These projects have in turn led to considerable environmental benefits. Between 2005 and 2009 in England, there were 21,463 agreements set up containing field margin options that incorporated Reading's research. In 2009 alone there were 1,977 agreements for option EF4 (Nectar Flower mixture) with a total area of 2,002ha. By 2013 the number of agreements had increased by 38% to 2,728 with an area of 3,618ha (59% increase). This equates to 34,736 ha of farmland that has undergone changes mandated by the scheme and outlined in the ELS handbooks, improving habitat for declining species including kestrels and severely declining species like UK tree sparrows [g].

While the exact economic benefit of improved biodiversity is difficult to estimate, a survey conducted in 2010 [g] estimated the benefit of AES in England to be between £0.8 billion and £1.5 billion per year based on citizens' willingness to pay.

Helping the UK government meet national and international biodiversity commitments

In 2008, the Joint Nature Conservancy Committee revised the cereal field margin priority habitat under the UK *Biodiversity Action Plan* (BAP) to broaden the scope to arable field margins [h]. These priority habitats were identified as the most threatened and requiring conservation action under the UK BAP and are now used under the *UK Post-2010 Biodiversity Framework* to help set conservation priorities at the country level.

At an international level, the management of field margins is driven by numerous international policies and directives, including the Nitrates Directive, the Water Framework Directive and Environmental Stewardship. Therefore, well-evidenced management strategies for field margins help support UK government implementation of these directives [i]. The UK government uses AES options, such as field margins, as a contribution to its commitments to the European Union and Convention on Biological Diversity.

5. Sources to corroborate the impact

[a] Senior Environmental Specialist - Ornithology, Technical Advice & Designations Team, Landscape & Biodiversity, Natural England†

[b] Senior Specialist, Land Management Strategy, Natural England†

[c] Senior Conservation Scientist, RSPB†

[d] Davies A., Tas M. and Gilliam L. (2010) Assessing the Impact of Evidence on Policy, In House Policy Resource, Pp 114-115. <http://archive.defra.gov.uk/corporate/docs/policy/evidence-policy-report.pdf> Provides an independent assessment of the impact SAFFIE had on public policy.

[e] RSPB (2008) 'Field margins on grasslands', Advice for Farmers. URL: http://www.rspb.org.uk/ourwork/farming/advice/details.aspx?id=204324 [accessed 16 Sep 2013].

[f] Butterfly Conservation. *Butterflies and farmland*, Produced in association with Farming and Wildlife Advisory Group and sponsored by Natural England. <http://butterfly-conservation.org/files/habitat-butterflies-and-farmland.pdf>

[g] The Food and Environment Research Agency and Centre for Research in Environmental Appraisal and Management (2010) *Estimating the wildlife and landscape benefits of environmental stewardship - final report.* <http://archive.defra.gov.uk/evidence/economics/foodfarm/reports/documents/estimatingthewildlife.pdf> Provides an overview of the environmental benefits of field margin options,

[h] Joint Nature Conservation Committee (2011) *UK BAP list of priority habitats*. URL: http://jncc.defra.gov.uk/page-5706 [accessed 16 Sep 2013].

[i] Coleman, C. *et al.* (2010) *Agricultural advisory services analysis*, AEA Group report to Defra, ED47617, Issue Number 4. <http://archive.defra.gov.uk/foodfarm/landmanage/climate/documents/advisory-analysis.pdf>

† Testimonial letters available upon request