Building biodiversity through land management: An evidence based assessment of the needs of butterflies and moths and the opportunities for a countryside rich in insects

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Saving butterflies, moths and our environment

Contents

Summary

1) This report focuses on what habitat management works best for Lepidoptera in the farmed environment. It combines a scientific review with Butterfly Conservation's extensive practical experience of delivering agri-environment type advice and management. It aims to inform future sustainable land management schemes across the four UK countries.

2) The report highlights the declines in our wider countryside species and the key role sustainable land schemes will play in future in reversing that decline. We cover the role of butterflies and moths as indicators of environmental health, Butterfly Conservation's expertise based on our data and real world experience and the basics future schemes need to deliver for Lepidoptera.

3) The chief conclusions are:

- Future schemes need to be deliverable at a landscape scale. It is only by working on multiple sites at scale that entire populations can persist.

- We need higher tier initiatives that target and support the management of our key semi-natural habitats. It is important that high level support is offered to landowners managing these sites.

- For our wider countryside Lepidoptera and other insects we need targeted packages underpinned by the best available evidence. 'Butterfly-friendly' options have shown the greatest positive impacts on abundance.

- Making best use of knowledge by working with species NGO's in agri-environment scheme (AES) design, implementation and review to enable transfer our wealth of knowledge about species needs.

- Butterflies are currently the only insects with sufficient monitoring to assess spatial and temporal population status and trends with respect to land use and land management practices. Formal mechanisms to monitor the impacts of AES should be implemented with continued consultation and in the context of the datasets already available, such as the UKBMS.

- Further to this we need to understand the impact of land management on wider countryside species. This research will help us to understand the multiple benefits of wildlife friendly land management on factors such as animal welfare, farm income, ecosystem resilience. Framing research within a landscape context will be essential.

- Continue support for and refinement of models, such as the Facilitation Fund in England and Environmental Co-operation Action Fund in Scotland are vital to gain stakeholder buy-in. Similar schemes should continue to be developed and implemented across UK.

1. Introduction

Butterfly Conservation is committed to a healthy environment for butterflies and moths. We want to see sustainable land management that means a future for nature and a future for land managers. We believe that data and targeting are critical to ensuring that the right action is taken in the right place to meet the needs of the species, habitats, ecosystem services such that thriving landscapes can deliver food, resources and public goods.

It's time to realise that land management practices, systems and subsidies are not working for land managers, wildlife or UK citizens. For instance, agri-environment schemes (AES) have helped to support practices to deliver environmental benefits and support the rural economy but the scale and effectiveness has been patchy. The evolution of these schemes has helped and provided a test bed for new ideas and ways of working. The challenge now is to ensure the UK and devolved administrations learn from best practice.

It's not all bad news. Butterfly Conservation and many other conservation charities have tried to work closely with government in the development of the AES in England, Northern Ireland, Scotland and Wales. We have worked closely in partnership with farmers, foresters, rural business, non-governmental organisations (NGOs) and governments, to deliver tailored advice and management for priority species and semi-natural habitats. Where our knowledge and expertise, relating to priority species, has been embedded in schemes, those management principles have led to success (Brereton *et al.,* 2005).

However, away from our top priority semi-natural habitats, the picture for wider countryside species is bleak. There is a perception that the UK countryside is our green and pleasant patchwork quilt but the harsh reality is that its land managers, its ecosystems and its wildlife are in trouble.

This report reviews the evidence from our monitoring programmes, published papers, and our practical experience on the ground. It presents the successful tools for saving our more widespread but declining butterflies and moths. It supports the move towards a healthier environment for insects using butterflies and moths as ambassadors.

1.1 Why are butterflies and moths indicators of a healthy countryside?

Butterflies and moths collectively represent around 2,560 species in the UK, which accounts for over 10% of its invertebrate fauna. They have a variety of requirements that need to be met in order to support healthy populations. If these are met, there will be benefits for a wide range of other species.

- Butterflies and moths have short life cycles and react quickly to environmental changes.
- Butterflies have declined more rapidly than birds and plants (Thomas *et al.,* 2004) emphasising their role as indicators[1].

[1] http://jncc.defra.gov.uk/pdf/UKBI_2017.pdf

- Butterflies are well-documented, popular and easy to recognise unlike most other groups of insects.
- Half of all terrestrial wildlife species are invertebrates so it is crucial that we assess the fate of insect groups in order to monitor the overall state of biodiversity (Hammond, 1992).

There is a lack of research in to the role of butterflies and moths as pollinators and as part of the food chain. However, the role of moths as pollinators is likely to have been underestimated and undervalued (Hahn and Brühl, 2016, Macgregor *et al*. 2015).

1.2 Butterfly Conservation's background

Butterfly Conservation has spent 50 years building its capacity to capture, collate and strategically mobilise data. This enables us to make well informed land management decisions at the landscape scale. We have had close involvement in the shaping, targeting and options in AES, infrastructure projects and forestry management.

On the ground, we directly manage hundreds of key sites and give advice to many more land managers each year through our network of regional and country staff and volunteers, supported by a core science, research and evidence team. For instance, in England and Scotland we have delivered over 1,000 visits to ensure specialist knowledge transfer to AES advisers and land managers. At the local level we build relationships with farmers, foresters, statutory agency advisers, NGOs, utilities companies, rural businesses and communities to take action to reverse the decline in butterflies and moths.

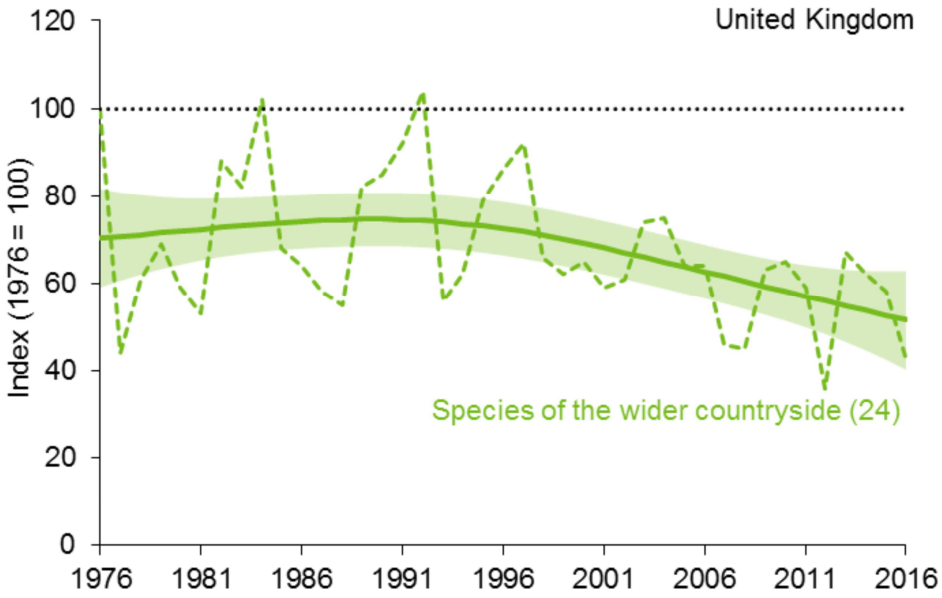
Butterfly Conservation has led on the Farmland Butterfly Initiative in England and advised on AES prescriptions for threatened butterflies and moths in all four UK countries. We are part of the Farm Wildlife (https://farmwildlife.info) and the Nature Friendly Farming initiative (https://www.nffn.org.uk).

We also lead on the UK monitoring schemes that provide so much of the evidence on impact of land management on butterflies through the UK Butterfly Monitoring Scheme (UKBMS) and have been involved in other monitoring programmes such as the Tir Gofal evaluation programme and delivering the Pollinators Package for the Glastir Monitoring and Evaluation Programme in Wales.

Butterfly Conservation's long running and popular volunteer monitoring and recording schemes are critical to understanding the status of the UK's biodiversity. The UK government and some devolved administrations started adopting biodiversity indicators based on butterflies in 2006 (Brereton *et al*., 2011). Whilst there have been some positive stories of recovery among the specialist species (Ellis *et al*., 2011), we have identified the decline of widespread butterflies and moths as a major issue needing attention.

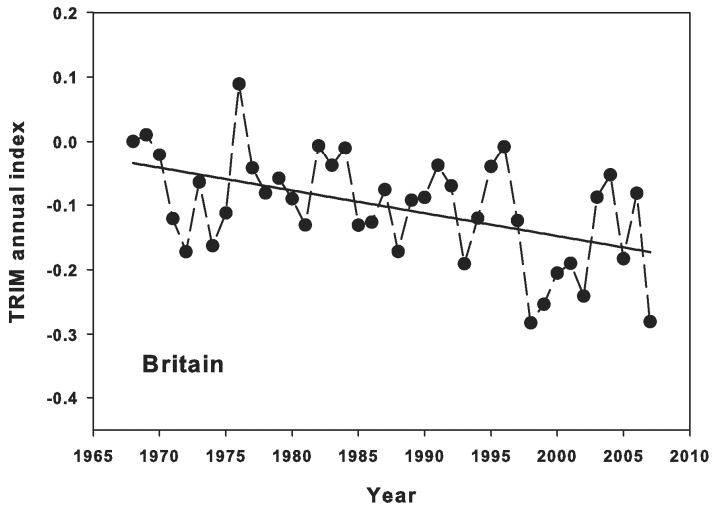
Results presented in the recent State of UK Butterflies 2015 (Fox *et al*., 2015) show that overall numbers of wider countryside species have declined by 25% since 1976, with serious declines in species such as Essex Skipper (-88%), Wall (-87%), Small Skipper (-75%), Small Tortoiseshell (-73%), Small Heath (-54%), Gatekeeper (-41%), Small Copper (-37%), Large White (-30%).

Figure 1. Trends in butterfly populations in the UK: species of the wider countryside 1976 - 2016. (http://jncc.defra.gov.uk/pdf/UKBI_2017.pdf)



Widespread moths have also declined seriously, with a decline in numbers of 28% from 1968-2007. Numbers have declined more seriously in the south than the north. Two-thirds of 337 species assessed had declined and 61 species had declined by over 75%.

Figure 2. Change in total abundance of larger moths 1968-2007 (Fox *et al*, 2013)



1.3 What do butterflies and moths need?

It is important to identify what insects need in the countryside and how the response of butterflies and moths to measures and improvements can indicate the success of sustainable land management. Among all invertebrate taxa there are those species that have more generalist requirements and those that have specialist ones.

1.3.1 Habitat specialists

These are often associated with semi-natural habitats and require particular conditions, habitats or resources such as larval foodplants, associations with other species or a specific micro-climate. It is well understood that for specialist butterflies and moths, the greater the size of good quality breeding habitat, the greater the size of the population (Thomas *et al.,* 2001). Where the needs of these species are well understood they can be conserved through targeted habitat interventions such as has been successfully achieved under the higher level AES in England.

1.3.2 Wider countryside species

These more generalist species, on the other hand, are distributed through the landscape and rely on more common and widespread habitats found outside of nature reserves and semi-natural habitats. We present evidence below on what works for these species. These species make up the greatest proportion of invertebrates in the UK countryside and it is their needs, whilst being easier to meet, that are suffering due to agricultural intensification, urban development and other land use changes (Hayhow *et al.*, 2016).

1.3.3 General principles for wider countryside butterflies and moths:

- Enough of the right kind of resource at the right time of year to cater for all life stages - breeding, sheltering, feeding and over-wintering.
- Increasing habitat diversity - spatial and temporal diversity is needed to sustain healthy populations of butterflies and moths.
- Enhancing landscape characteristics - functioning, connected landscapes are needed for butterflies and moths to meet all their life stage requirements.
- Reducing intensification - pesticides, relaxed grazing, sensitive development with respect to retaining biodiversity.

2. Scientific Review

2.1 What works for butterflies and moths in the wider farmed landscape? The evidence.

We have collated (Table 1) the evidence from published studies on types of wildlife friendly interventions on farmland, how to manage them and where to position them in the landscape to yield the greatest benefits for butterflies and moths.

Table 1: Evidence from studies on types of wildlife friendly interventions on farmland

What works	Details/ Evidence	References
Natural species rich margins	Good for breeding particularly if larval foodplant diversity is increased.	(Potts *et al.,* 2009) (Lagerlöf *et al.,* 1992)
Sown field margins	In sown margins, the species assemblage of adult butterflies is determined by floral abundance and richness (the availability of nectar resources), and sward structure. Not good for breeding due to lack of larval foodplant provision.	(Haaland *et al.,* 2011) (Haaland and Gyllin, 2010) (Potts *et al.,* 2009) (Pywell *et al.,* 2007) (Critchley *et al.,* 2006) (Carreck and Williams, 2002) (Bosshard and Kuster, 2001) (Carreck *et al.,* 1999) (Feber and Hopkins, 1997) (Hopkins and Feber, 1997)
Unsprayed headlands	Unsprayed conservation headland management results in more butterflies and higher diversity than those that are fully sprayed.	(de Snoo *et al*.,1998) (Dover, 1997) (Rands and Sotherton, 1986)
Grass margins (species mix which includes bents, fescues and meadow-grasses).	Lower diversity of adult butterflies but important for moths and as breeding areas for grass-feeding larvae. Encouraging a diversity of grasses that are managed by cutting (with collection) on rotation, leaving at least a third uncut each year, allows breeding and overwintering for a variety of grass-feeding Lepidoptera and other invertebrates.	Fuentes-Montemayor *et al* ., 2010) (Musters *et al.,* 2009) (Field *et al.,* 2007) (Field *et al.,* 2006a) (Field *et al.,* 2006b) (Field *et al.,* 2005) (Field and Mason, 2005)
Hedgerow management	To support a wide variety of Lepidoptera, hedgerows should be cut less frequently. If possible, the rotation should be greater than two years. Timing of cutting should be sensitive to any breeding priority species. Hedgerow trees and wide field margins should be encouraged.	(Staley *et at.,* 2017) (Staley *et al.,* 2016) (Holland *et al.,* 2015) (Facey *et al*., 2014) (Merckx *et al.,* 2010a&b) (Merckx *et al.,* 2009b)

Low intensity grazing	Lenient grazing encourages a higher number and diversity of butterflies, moths and other invertebrate species. Though different management intensities are needed regionally.	(Mangels *et al*., 2017) (Rickerts *et al*., 2012) (Wallis De Vries *et al.,* 2007) (Öckinger *et al.,* 2006) (Pöyry *et al*., 2004) (Kruess and Tscharntke, 2002) (Bosshard and Kuster, 2001)
Increasing habitat size	Habitat specialists respond most to increasing the area of their breeding habitat.	(Botham *et al.,* 2015)) (Öckinger *et al.,* 2010) (Krauss *et al.,* 2003)
Improving the quality of semi-natural areas	Moth species richness is highly dependent on plant species diversity within habitats.	(Alison *et. al*., 2017) (Summerville and Crist, 2004)
Increasing landscape diversity and complexity	Landscape diversity is important for generalist butterflies. More habitats and more diversity increases wider countryside species diversity and abundance.	(Botham *et al.,* 2015) (Merckx *et al.,* 2012) (Krauss *et al.,* 2004)
Connecting and configuring semi-natural areas (reducing fragmentation / isolation)	Species richness of butterflies and moths declines with increasing isolation of habitat patches. Connectivity has been found to be particularly important for moths.	(Alison *et. al*., 2017) (Alison *et al.,* 2016) (Fuentes-Montemayor *et al*., 2010) (Botham *et al.,* 2015) (Delattre *et al.,* 2013) (Öckinger *et al.,*2010) (Tscharntke *et al.,* 2002) (Dover, 1996)
Locating newly created features (more connected landscapes)	Linear features connected to semi-natural habitat elements support more butterflies and moths. Semi-natural elements act as population sources. Significantly more butterflies were seen on the sown 6m grass margin next to set-aside than on any of the other methods of establishment. For some species sown grass margins with adjacent hedgerows and on control sites with hedgerows were preferred to grass margins without hedgerows.	(Delattre *et al.,* 2013) (Fuentes-Montemayor *et al*., 2010) (Field *et al.,* 2006a) (Öckinger *et al.,*2006) (Field *et al.,* 2005) (Field and Mason, 2005)

Increasing permeability (more connectivity)	AES that improves land quality surrounding core semi-natural areas (the matrix) by 'softening' agriculture could play an important role in reducing fragmentation effects in isolated habitat patches, and represent the most viable delivery mechanism for landscape-scale ecological restoration.	(Öckinger *et al.,* 2012) (Powny *et al.,* 2011)

3. Practice Review

3.1 Landscape characteristics that help butterflies and moths

With continued degradation and fragmentation of the wider countryside, in the last two decades research has shifted from site based conservation to landscape scale conservation. Themes such as connectivity, fragmentation and isolation have been studied extensively with butterflies and moths as a focus. The science of metapopulation biology gained traction in the 1990s and rapidly developed our understanding of how individuals move between habitat patches within a landscape (Hanski, 1998). The conservation of butterflies and moths has been a focal area of research that has highlighted the implications of habitat fragmentation and isolation - particularly concerning habitat specialists. Consequently the connectivity of occupied and unoccupied sites to maintain dispersal, and hence healthy populations, became a key tool in restoring butterfly populations. This theme of research and on the ground conservation persists today and grows with the ever increasing availability of geospatial data on habitats, features and land management. The publication of the Lawton report 'Making space for nature' cemented some core principles about landscape scale conservation (Lawton *et al.*, 2010). The phrase 'bigger, better and more joined up (connected)' is now the strapline for many landscape scale initiatives and projects.

In 2012 we published 'Landscape-scale conservation for butterflies and moths: lessons from the UK' (Ellis *et al.*, 2012). This report focused on evidence based case studies demonstrating the success of our landscape scale approach. Whilst this evidence focuses on the needs of threatened species, the principles can be readily applied to more widespread species and to other wildlife in the wider countryside.

3.2 What's working now?

Butterfly Conservation has worked closely with advisers and landowners to deliver tailored advice and management for priority species and semi-natural habitats. We have assessed what's worked for the conservation of butterflies and moths and compiled some overarching features, themes and practices from previous AES that we believe have delivered for the conservation of Lepidoptera in the UK. Continued support for specialist knowledge transfer between species NGOs and advisers and land managers is needed.

3.2.1 **Landscape-scale** working has been essential for the conservation success for our habitat specialists (Ellis *et al.*, 2012)

3.2.2 **Higher tier initiatives** that target and support the management of our key semi-natural habitats. These 'jewels in the crown' often rely on traditional agricultural practices to maintain the species and habitats that they contain. It is important that high level support is offered to landowners managing these sites. Among the species conservation NGOs, there is a wealth of knowledge about the needs of priority species and habitats and our involvement through transfer of knowledge, one-to-one advice and data are key to getting the best value for money.

3.2.3 Targeted packages and options for Lepidoptera and other insects in the wider countryside. 'Butterfly-friendly' options within schemes have shown the greatest positive impacts on abundance. Retaining measures that cater for all resource requirements (breeding, feeding and sheltering) is key for the success of AES for butterflies and other insects in the wider countryside (Oliver *et al.*, 2015). Advising on the best selection, diversity and configuration of options with respect to landscape features will be important in maximising benefits for butterflies, moths and other farmland invertebrates.

3.2.4 Strong links between NGOs and government. In a model where statutory agencies or government departments administer and deliver AES, it is critical that strong links between NGOs and agencies are maintained and strengthened. Therefore species experts and advisers can work together in the design, development and review of schemes.

3.2.5 Monitoring. Butterflies are currently the only invertebrates with sufficient monitoring in place to assess spatial and temporal population status with respect to land use and land management practices, such as AES. Formal mechanisms to monitor the impacts of AES should be implemented with continued consultation and in the context of the datasets already available, such as the UKBMS.

3.2.6 Research. The need for evidence-based options is crucial when our wider countryside species and the ecosystem services that they provide are under threat. Increasing the breadth of the research to understand the multiple benefits of wildlife-friendly farming on factors such as animal welfare, farm income, resource protection and water issues would add weight to the conservation of biodiversity on farmland. Framing research within a landscape context will be essential.

3.2.7 Continued support for co-operative farmer-led projects. These partnerships between land managers with NGOs, businesses/corporate partners and local communities have grown in the last 5 years. The model is of co-operative working between landowners across key landscapes with discrete priorities relating to many aspects of the environment. Our work at the landscape scale has been markedly successful with the positive outcomes (Ellis *et al.*, 2012). Continuing support for and refinement of models such as the Facilitation Fund in England and Environmental Co-operation Action Fund in Scotland are vital to gain stakeholder buy-in. Similar schemes should continue to be developed and recognised by governments across UK.

4. Conclusions and Recommendations

1.1 Landscape Scale by working on multiple sites at a scale that ensures entire populations of can persist.

1.2 Higher tier initiatives that target and support the management of our key semi-natural habitats. It is important that high level support is offered to landowners managing these sites.

1.3 Targeted packages and options for Lepidoptera and other insects in the wider countryside. 'Butterfly-friendly' options have shown the greatest positive impacts on abundance.

1.4 Making best use of knowledge by working with species NGO's in AES design, implementation and review to enable transfer our wealth of knowledge about the needs of priority species

1.5 Monitoring and data for spatial targeting. Butterflies are currently the only insects with sufficient monitoring in place to assess spatial and temporal population status with respect to land use and land management practices. Formal mechanisms to monitor the impacts of AES should be implemented with continued consultation and in the context of the datasets already available, such as the UKBMS.

1.6 Research. We need evidence-based options to understand the impact of land management widespread species. This will help us to understand the multiple benefits of wildlife friendly land management on factors such as animal welfare, farm income, ecosystem resilience. Framing research within a landscape context will be essential.

1.7 Continued support for cooperative farmer led projects. Continuing support for and refinement of models such as the Facilitation Fund in England and Environmental Co-operation Action Fund in Scotland are vital to gain stakeholder buy-in. Similar schemes should continue to be developed and implemented across UK.

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Who we are
Butterfly Conservation is the UK charity dedicated to saving butterflies and moths.

Why butterflies and moths matter
Butterflies and moths are important parts of the ecosystem. They are beautiful and inspirational and people enjoy seeing them in their gardens and the countryside. They are sensitive to change and their fortunes help us assess the health of our environment. Two-thirds of butterfly and moth species are in decline. This is a warning that cannot be ignored.

What we do
Butterfly Conservation maintains and enhances landscapes for butterflies and moths. We provide advice to landowners and managers on how to conserve and restore habitats. We gather extensive butterfly and moth data and conduct research to provide the scientific evidence that underpins our work. We have an established record of reversing declines. We run programmes for more than 100 threatened species and are involved in conserving hundreds of sites and reserves. We rely on donations, memberships and grants to fund our work.

With your support we can help butterflies and moths thrive.

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