Critical appraisal of agri-environment schemes for biodiversity targets

Final report

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Client Ref: INS305-05 (UKCEH project 09436)
Issue number 0
18.12.2024

UK Centre for Ecology & Hydrology

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1. Executive summary

Project context

- Agri-environment schemes (AES), whereby farmers and other land managers are paid to implement management with environmental objectives, are a primary conservation policy mechanism for the government. Substantial public funding supports these AES.
- The Environmental Land Management Schemes (ELMS) in England include the existing Countryside Stewardship scheme (CS), and the recently introduced Sustainable Farming Incentive (SFI), a broad and shallow scheme which aims to attract most farmers. In addition, Landscape Recovery (LR, the top tier in ELMS) funds large-scale, long-term individual projects which aim to undertake more substantial change in habitat.
- There is an ambition for 70% of farmland and 70% of all farms in England to be under ELMS by 2028 (Defra 2023b).
- Biodiversity is in decline, with the abundance or range of many species reducing over the last few decades, across multiple taxa. Preventing the ongoing loss of biodiversity is an urgent priority (Turney et al. 2020).
- The UK government committed to targets in the recent Environmental Targets Regulations 2023, which include halting the decline in species abundance by 2030, and increasing species abundance by at least 10% by 2042. Species abundance is summarised in this context as a composite indicator that combines change in species-level abundance data for 1177 species across multiple taxonomic groups, relative to a 1970 baseline (Defra 2022).
- In addition, the Environment Targets Regulations 2023 include habitat targets likely to influence biodiversity, including for wildlife-rich habitat restoration or creation (Hall et al. 2024) and for woodland and trees outside woodlands in England (Natural England 2024).

Aim - This project aimed to appraise the potential for ELMS (CS and SFI) to support the delivery of the species abundance targets relating to the species abundance indicator (Tasks A and B) and wider biodiversity targets (Task C), in terms of ELMS design and uptake. This project did not appraise the structure or content of the species abundance indicator or targets per se; that has been the subject of a separate project (Henly & Henrys 2024).

Task A – broad approach

- The objective of Task A was to assess the likely efficacy of CS and SFI 2023 options to support species groups in the species abundance indicator.
- This assessment drew on evidence collated for the recent Defra qualitative evidence review of potential land management actions (QEIA, Defra 2023c).
- Scoring within Task A focussed on terrestrial species groups in the abundance indicator that were considered within the QEIA review, namely birds, mammals, butterflies, moths, bumblebees and vascular plants. These groups contain 905 of the 1177 species in the abundance indicator. Freshwater fish and invertebrates were not included in the QEIA review, and are not covered here.
- To utilise the evidence collated for the QEIA review, each QEIA action was assessed for each terrestrial species group that forms part of the abundance indicator. Scores were assigned for likely effect on the species group, confidence, and attributes of the available evidence. Scores were assigned largely based on the QEIA evidence reviews,

supplemented by more recent published studies and the project team's expert knowledge.

- Response variables scored were at the level of species group, or habitat associations within a species group (e.g. butterfly species richness, abundance of farmland mammals). The choice of response variable was determined by the response variables in the evidence reviewed.
- QEIA actions were matched to current options within CS and SFI 2023 schemes, and the confidence of this matching process recorded. The scores assigned for each species group per QEIA action were mapped to the matched CS or SFI option(s). These CS and SFI options that were attributed biodiversity scores through the matching were the focus of later Tasks in this project, and considered 'priority options' (in relation to biodiversity)
- A dashboard was developed to demonstrate national uptake patterns of CS options likely to benefit each species group.
- Scores were summarised as the number of actions / options in each scoring category per species group, and as the total option uptake in each scoring category.

Task A – key findings

- The majority of actions in QEIA, and options within CS or SFI 2023, were scored as likely to be beneficial to one or more species groups.
- Of the 187 CS and SFI 2023 options which matched to QEIA actions scored for benefit, only 20 CS options were scored as no likely effect or no evidence found across all the species groups. These 20 CS options were mainly capital and supplementary options that do not benefit biodiversity in themselves, but are likely to be combined with main CS options that do support biodiversity.
- For all taxa scored, more of the actions and options scored as beneficial were in a category with low confidence (3, score based on expert judgement / species ecology) than in a high confidence category (1, score based on empirical evidence).
- Birds were the species group with the most AES actions / options scored as beneficial with high confidence (1, score based on empirical evidence for QEIA, CS and SFI 2023). In addition, more AES evidence was found for individual bird species responses, and for change in abundance over time (population change), than for the other species groups.
- In contrast, the insect taxa scored (butterflies, moths, bumblebees) had a greater proportion of action scores attributed that were based on expert judgement / understanding of species ecology. Overall, more scores for the insect taxa were attributed with lower confidence than for birds.
- Fewer actions or options could be scored with confidence (green or amber) for moths than for birds, butterflies, bumblebees or plants. Moth are the group with most species in the abundance indicator (446 species, 37.9% of indicator species). The shortage of empirical results for moth responses to AES management types results in considerable uncertainty around how AES is likely to affect abundance indicator species.
- The type of empirical studies varied between the species groups, in addition to the amount of empirical evidence. More QEIA actions were scored as having been the focus of regional-scale studies for birds than for other taxa. Perhaps linked to the regional scale of studies on birds, there were more composite studies on several AES options or management types than for other taxa ('C' in Table 3), which reduced the certainty with which scores for bird responses could be attributed to individual options or actions.
- Spatial targeting, whereby the efficacy of an action or option depends on it being in a particular landscape type or farming system, was important for around half the CS options scored for birds, and for just a few options for other species groups. This may reflect a difference in the type and amount of available evidence between the taxa, with

the greater availability of evidence for birds making identification of spatial targeting more likely.

- Just under two-thirds of the QEIA actions were linked to CS or SFI 2023 options with strong confidence, with the remaining linked with moderate or weak confidence. The approach of assigning scores to CS and SFI options through links to evidence previously collated for the QEIA project was time-efficient, but introduced some uncertainty through this matching process and due to the sometimes vague and unclear named actions in QEIA.
- The rapid nature of this review has limited the extent to which wider expert judgement could be considered, particularly in respect of the likely value of management at large scales and the interaction of multiple, potentially conflicting measures. Such consultation would be an important part of a more comprehensive review of scheme coverage of target taxa.
- Given the breadth and greater number of SFI 2024 (also referred to as SFI extended offer) actions compared to previous SFI schemes, a future review of SFI 2024 actions in relation to abundance of indicator species could be useful and should include wider expert consultation.
- There is a clear need for ongoing monitoring of AES, with feedback into option design, in particular as option details for future SFI are still being developed. Monitoring and evaluation of AES should focus on the taxa that dominate the species abundance indicator (e.g. moths, birds, plants), if the role of AES in contributing to these targets is to be better understood.
- Established schemes such as CS were not designed to benefit all species that feature in the abundance indicator targets. The scoring results indicate CS is likely to benefit the indicator taxa considered here, but with low confidence in much of the scoring. Significant additional actions that could be added to ELMS have not been found, but further research might usefully be conducted to identify interventions for less well-known taxa.

Task B – broad approach

- The objective for Task B was to score the ELMS priority actions for likely effects on changes to the abundance of individual species in the indicator, using available evidence. Priority ELMS actions in this context were the146 CS and 20 SFI 2023 actions that were scored during Task A as likely to benefit one or more species groups.
- A simplified version of the Task A scoring system was used in Task B, which captured the likely response of a species to the action, and the certainty associated with the response scores. Where no published evidence was available for a particular species and priority ELMS action, no score was attributed.

Task B – key findings

- Across the seven species groups scored, the available evidence for efficacy of priority SFI 2023 and CS actions at species level was relatively sparse. More than half (580 out of 905) of the abundance indicator species did not have scores attributed for any action. This was due to a combination of lack of evidence, and AES management not being relevant for all species considered.
- The evidence available to support attribution of scores for species-level effects of AES actions varied substantially across the species groups reviewed. Evidence was found to assign species-level scores for at least one priority action for: 45 out of 55 indicator butterfly species; only 40 (out of 446) indicator moth species; 52 (out of 168) indicator bird species and most (165 of 209) indicator plant species.

- The majority of priority ELMS actions could be scored for at least one bird species (131 of 146 CS actions), and around half (74 actions) were scored for one or more plant species.
- For the insect and mammal groups, the majority of priority actions could not be scored at species level. For example, 106 of the 146 priority CS actions were not scored for any butterfly species, 131 actions were not scored for any moth species, 136 could not be scored for bumblebees, and there was no species-level evidence to score 121 actions for bats or 124 actions for other mammals. This illustrates the paucity of published evidence at species-level, and the variation in evidence across species groups.
- The paucity of species-level evidence should not be interpreted as meaning CS and SFI 2023 actions are unlikely to benefit abundance indicator species. In general, there is a gap between evidence of a general benefit to a species or group of species, or expert opinion to that effect, and evidence of a specific relationship between management implementation and an abundance response.
- Where priority actions could be scored at species-level under Task B, in most instances they scored as beneficial. For example, 129 (out of 131 scored priority CS actions) were beneficial to at least one bird species, and 68 (of the 75 scored) actions were beneficial to one or more plant species.
- In addition, the Task A scoring showed that when expert opinion is included, the majority of actions were scored as likely to be beneficial for one or more species in each group, or for community responses.
- However, the lack of available species-level evidence of CS and SFI action effects on many abundance indicator species may be a risk to delivery of the indicator targets, given that ELMS is a major conservation lever.

Task C – broad approach

- The objective for Task C was to assess the coverage of broader biodiversity targets by the ELMS (CS and SFI 2023) priority actions. The UK's Environmental Targets (Biodiversity) (England) Regulations 2022 include a legally binding wildlife-rich habitat restoration or creation target, and a woodland and trees outside woodland cover target.
- Neither of these targets had a formal monitoring or reporting structure in place at the time of this project. For Task C, we developed a data collation process which is not an official method, to combine data sources for reporting progress to these targets. It must be noted that this methodology can only provide a rough estimate of the contribution of AES to meeting the targets. A more structured approach will be possible once an official reporting and monitoring structure is developed.
- The wildlife-rich habitat restoration or creation target aims to restore or create more than 500,000 hectares of a range of wildlife-rich habitats outside of protected sites by 2042, with an interim target to restore or create 140,000 hectares of a range of wildlife-rich habitats outside protected sites by 2028.
- Within this target, ELMS actions are mentioned as forming one component of habitat creation, along with other mechanisms such as Biodiversity Net Gain. AES or government grants count towards the target because they are ‘reasonably expected to lead’ to the creation or restoration of wildlife-rich habitat that is of sufficient quality for the purpose of measuring progress towards the target’ (Hall et al 2024).
- CS and SFI actions, with a principle objective of habitat creation, were matched to the habitats listed in the wildlife-rich habitat definitions and descriptions document (Hall et al 2024), and current uptake of these options summarised.
- The target for woodland and trees outside woodland is to increase the combined canopy cover of woodlands and trees outside woodlands in England to 16.5% by end of 2050.

- Current values of woodland in England in 2024 as a good baseline for the target to work from are calculated and reported through National Forest Inventory Statistics 2024 (NFI) (Brady 2024). Brady (2024) estimates this to be 1338 thousand hectares which accounts for 10% canopy cover. Around 16 thousand hectares of publicly funded woodland restocking were reported in the UK in 2023/24.
- Canopy cover is calculated for NFI statistics, by combining the measurements collected during field survey with the area and general woodland composition data derived from the NFI woodland map, and reports all woodland over 0.5 ha in size and at least 20 m width. 3,128 hectares reported as planted in England in 2022/23 – a 40 percent increase on the previous year (Brady 2024).
- AES option and actions were selected if their specific objective or aim was to create new woodland or to plant trees outside of woodland (including those within hedgerows, but not hedgerows themselves).

Task C – key findings

- The uptake of current creation options within CS and SFI 2023 that are likely to contribute to the wildlife-rich habitat target is 37,2115 hectares. This is a substantial contribution to the target to create 140,000 hectares by 2028.
- In addition, seven SFI 2024 actions are likely to contribute further to the target. Uptake data for SFI 2024 actions were not available, within the timescales of this project, to include in the total.
- The potential 188,315 ha of combined woodland creation and tree planting is a 14% potential increase of woodland area under AES. This would see AES contribute towards the canopy 2050 target of 16.5%.

Wider discussion

- Many factors influence the uptake and quality of implementation of AES options, including social factors, the advice and training offered to farmers (Mills et al. 2021), spatial factors, how straightforwardly the AES management fits into existing farm operations, AES payment rates and farm incomes. Literature on these factors are briefly covered in the main report discussion, along with a case study for one option type.
- Monitoring of AES impacts on biodiversity has not historically focussed on all the species groups within the indicator, though there is some overlap with AES target groups. Different monitoring approaches are discussed in the main report below.

Conclusions and gaps / recommendations

- The species abundance indicator scoring in this project focussed on terrestrial species. A future assessment of the likely effects of AES on the abundance of freshwater species within the abundance indicator is needed to fill this gap.
- This project found substantial gaps in the available evidence for AES effects on abundance of individual species, for many of the species groups in the indicator. This lack of evidence is a risk, in relation to how CS and SFI may help to deliver the abundance indicator targets.
- Ongoing and upcoming monitoring will help to fill some of the gaps in understanding of how ELMS may affect abundance change for a substantial number of indicator species. However, additional modelling would need to be carried out to assess the contribution of ELMS to abundance indicator targets, potentially including data from some of the long-term, national species monitoring schemes.

2. Introduction

2.1 Context

Agri-environment schemes (AES), whereby farmers and other land managers are paid to implement management with conservation objectives, are a primary conservation policy mechanism for the government. Substantial public funding supports these AES, in the UK £357 million was spent on AES in 2022 (Defra et al. 2023a). The Environmental Land Management Schemes (ELMS) in England include a continuation and development of the existing Countryside Stewardship scheme (CS), and the recently introduced Sustainable Farming Incentive (SFI), a broad and shallow scheme which aims to attract the majority of farmers (Defra 2020). In addition, Landscape Recovery (LR, the top tier in ELMS) funds large-scale, long-term individual projects which aim to undertake more substantial change in habitat, and are coordinated across groups of neighbouring landowners and other stakeholders (for example, conservation NGOs; Defra 2024). There is an ambition for 70% of farmland and 70% of all farms in England to be under ELMS by 2028 (Defra 2023b).

Biodiversity is in decline, with the abundance or range of many species reducing over the last few decades, across multiple taxa (for example, birds (Burns et al. 2021) and pollinating insects (Powney et al. 2019)). Preventing the ongoing loss of biodiversity is an urgent priority (Turney et al. 2020). The UK government committed to targets in the recent Environmental Targets (Biodiversity) (England) Regulations 2023 (https://www.legislation.gov.uk/uksi/2023/91/made), which include commitments to halt the decline in species abundance by 2030, and to increase species abundance by at least 10% by 2042. Species abundance is summarised in this context as a composite indicator that combines change in species-level abundance data for 1177 species across multiple taxonomic groups, relative to a 1970 baseline, although most component species only enter the dataset in the second half of the time series (Department for Environment, Food and Rural Affairs 2022). In addition, the Environment Targets Regulations 2023 include habitat targets likely to influence biodiversity, including for wildlife-rich habitat restoration or creation (Hall et al. 2024) and for woodland and trees outside woodlands in England (Natural England 2024).

2.2 Objective

This project aimed to appraise the potential for ELMS (CS and SFI) to support the delivery of the species abundance targets relating to the species abundance indicator (Tasks A and B) and wider biodiversity targets (Task C) in terms of ELMS design and uptake. This project did not appraise the structure or content of the species abundance indicator or targets per se; that has been the subject of a separate project (Henly & Henrys 2024).

2.3 Overview of approach and tasks

The appraisal of the potential for CS and SFI to support delivery of the species abundance targets was split into two tasks, A and B.

Task A was an assessment of the potential efficacy of management actions and options in the Environmental Land Management Schemes (ELMS, specifically the Sustainable Farming Incentive and Countryside Stewardship) to support species groups in the species abundance indicator. Task A drew on the evidence reviewed in reports for the recent Defra qualitative review of 741 potential land management actions (QEIA, Defra 2023c) in relation to 12 biodiversity indicators, and wider indicators including air and water qualities, carbon storage and greenhouse gas emissions. While biodiversity indicators were assessed for potential land management actions in the QEIA review, the QEIA biodiversity indicators did not relate directly to species or species groups in the abundance indicator.

Task A focussed on terrestrial species groups in the abundance indicator that were considered within the QEIA review, namely birds, mammals, butterflies, moths, bumblebees and vascular plants, which together contain 905 of the 1177 species in the abundance indicator. Freshwater fish and invertebrates were not included in the QEIA review, and are not covered here given the short timescales of this work.

In order to utilise the evidence collated for the QEIA review, each potential action addressed by the QEIA was assessed for each of the species groups above, and scores assigned for: 1) likely effect on the species group, 2) confidence in the effect score assigned, and 3) to capture attributes of the evidence available. For Task A, scores were assigned largely based on the QEIA evidence reviews, supplemented by more recent published studies and the project team's expert knowledge. A larger-scale review of the wider literature was not possible due to the short timescales of Task A. Response variables scored in Task A were at the level of species group, or habitat associations within each species group (e.g. butterfly species richness, abundance of farmland mammals), rather than per individual species.

QEIA actions were then mapped to current options within CS and SFI schemes, and the scores assigned for each species group per QEIA action were assigned to the mapped CS or SFI option(s). QEIA actions were only available as titles, whereas detailed prescriptions were available for each CS or SFI option, thus a confidence rating was assigned for each match. In order to explore national patterns in uptake of options likely to benefit the species groups, a dashboard was designed to show: 1) the dominant scoring per 10 × 10 km square across England for each species group and 2) the uptake of beneficial CS and SFI options for each species group. Finally, uptake of the CS and SFI options in each scoring category, for each species group, was summarised in Task A.

Task B was a more detailed assessment of the evidence for likely effects of CS and SFI options on individual species within the species abundance indicator. This involved a review of the published evidence available, to assign a score per species and per CS or

SFI option. Task B differed from Task A in that the evidence was considered at the resolution of individual species, and the assignment of scores was based on published and publicly available evidence (expert judgment was not included). 905 species included in the abundance indicator were assigned scores in Task B. The number of options per scoring category were summarised.

Task C was an assessment of the potential for ELMS (CS and SFI) options to contribute to the delivery of wider biodiversity targets, relating to wildlife-rich habitat restoration or creation and woodland and trees outside woodland in England. Options likely to contribute to the targets were identified, and their uptake summarised.

Full method details for Tasks A, B and C are in Sections 3-5 below.

3. Task A – Assess the likely efficacy of ELMS actions for potential to support species groups in the species abundance indicator

3.1 Introduction

3.1.1 Context and objective

The objective of Task A was to assess the likely efficacy of management actions and options in the Environmental Land Management Schemes (ELMS, specifically the Sustainable Farming Incentive and Countryside Stewardship) to support species groups in the species abundance indicator. Task A drew on evidence collated for the recent Defra qualitative evidence review of potential land management actions (QEIA, Defra 2023c). Task A scoring focussed on terrestrial species groups in the abundance indicator that were considered within the QEIA review, namely birds, mammals, butterflies, moths, bumblebees and vascular plants. These groups contain 905 of the 1177 species in the abundance indicator (Table 1). Freshwater fish and invertebrates were not included in the QEIA review, and are not covered here given the short timescales of this work.

To utilise the evidence collated for the QEIA review, each QEIA action was assessed for each terrestrial species group that forms part of the abundance indicator. Scores were assigned for likely effect on the species group, confidence, and attributes of the available evidence. Scores were assigned largely based on the QEIA evidence reviews, supplemented by more recent published studies and the project team’s expert knowledge. Response variables scored were at the level of species group, or habitat associations within a species group (e.g. butterfly species richness, abundance of farmland mammals).

Table 1. Number of species within the abundance indicator, for each species group reviewed in this project. Percentage of total species in the abundance indicator. This project reviewed 77% of species in the abundance indicator.

Subgroup	Number of species in species abundance indicator	Percentage of total species in indicator
Birds	168	14.3%
Mammals	16	1.4%
Bumblebees	11	0.9%
Moths	446	37.9%
Butterflies	55	4.7%
Vascular plants	209	17.8%
Total	**905**	**77%**

QEIA actions were matched to current options within CS and SFI 2023 schemes, and the scores assigned for each species group per QEIA action were mapped to the matched CS or SFI option(s). A dashboard was developed to demonstrate national uptake patterns of CS options likely to benefit each species group.

3.1.2 Broad approach

Figure 1 summarises the approach used for Task A, with details of the methods in Sections 2.2 – 2.5.

The 741 QEIA actions were filtered, to remove any actions scored as unlikely to be relevant to all the 12 biodiversity indicators assessed during QEIA (Defra 2023c). This resulted in 313 QEIA actions considered to have potential to benefit the species groups in the abundance indicator (1. in Figure 1 below).

A rapid evidence review was conducted for each of the 313 shortlisted QEIA actions, for each species group in Table 1. The rapid evidence review built on the detailed QEIA review reports (Defra 2023c), references therein, and more recent papers (further details in Section 2.2). A full primary evidence review was out of scope given the timescales of this project. A scoring approach was used to summarise the likely efficacy of each QEIA action for the species groups reviewed, and key characteristics of the evidence (2. in Figure 1, details of scoring in Section 2.2).

Each ELMS (CS and SFI 2023) option was linked to one or more QEIA actions. The CS and SFI actions were well defined, with management prescriptions available. QEIA actions were less well defined, with only a title available for each action, and varied in breadth from a specific management (e.g. Arable-01 Extended stubble - unharvested crop stubble followed by a one-year fallow) to a broad aspiration to create wildlife habitat (e.g. ETPW-171 Allow natural regeneration and extension of existing habitat (e.g. hedgerows, scrub, rough grassland, Defra 2023c). Given the varying amount of detail in QEIA action titles, an uncertainty rating was applied for the linking process (3. in Figure 1).

Landscape Recovery (LR) projects, the top tier of ELMS, were not included as management is bespoke to each LR project and there is no publicly available information on the detail of habitat management / creation or the uptake of LR projects. Ongoing Environmental Stewardship (ES) options, a legacy AES that is being phased out but has some agreements running to 2028 particularly in upland areas, were also not included. ES uptake data was not publicly available for ongoing ES options, and as ES is being phased out its likely contribution to AES delivery is small and diminishing.

For each CS and SFI option, the QEIA action with strongest link was used to attribute the QEIA scores for each taxa response variable to the CS or SFI option (step 4. Figure 1). Priority CS and SFI options were identified, as those which were likely to benefit at least one species group. Spatial uptake of CS and SFI options were summarised (step 5), in relation to the likely benefit / disbenefit for each species group, and various attributes of the scoring that describe the type of AES evidence available. A dashboard was developed to demonstrate national uptake patterns of CS options likely to benefit each species group.

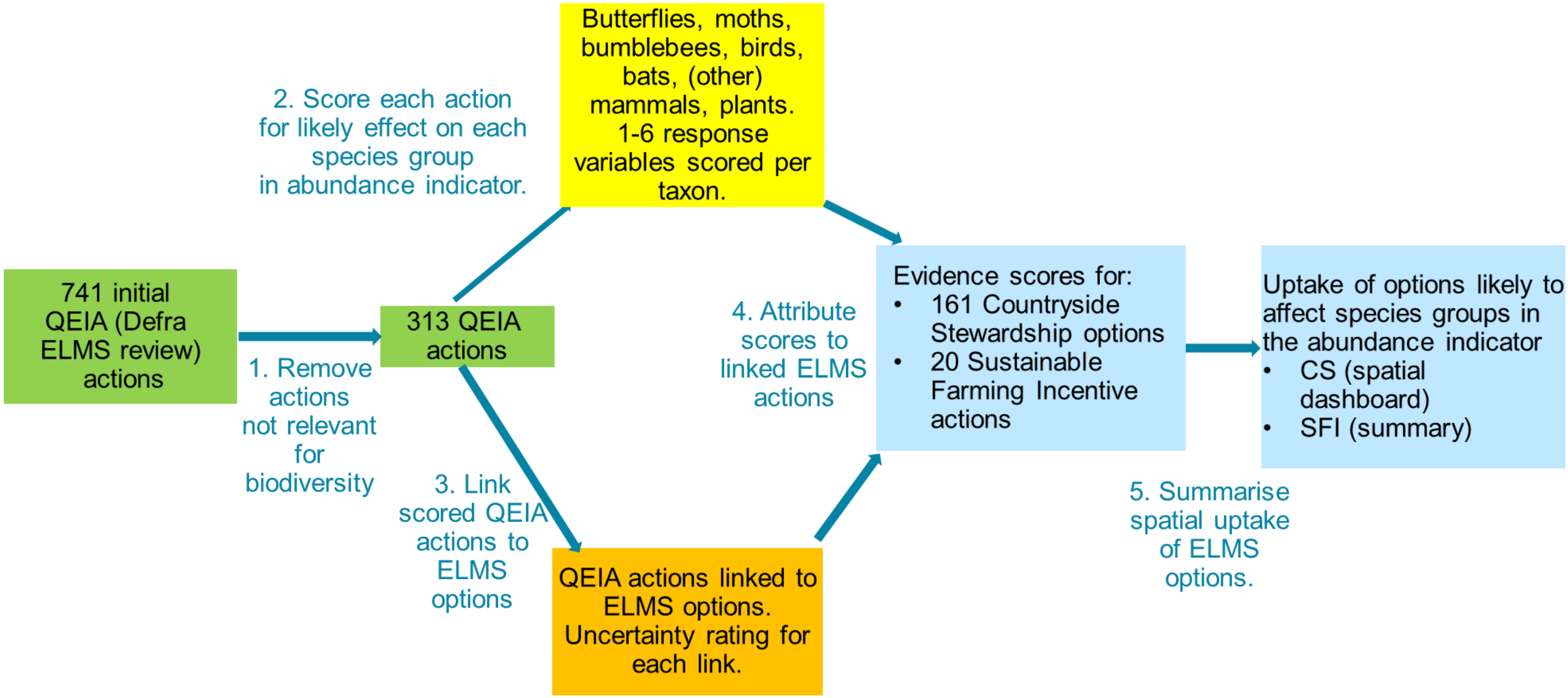

Figure 1. Overview of approach taken for Task A. Further details in Sections 2.2 – 2.5 below. Not relevant for biodiversity = not scored for any of 12 biodiversity indicators in QEIA review scoresheet (Defra 2023c).

3.2 Likely effect of QEIA actions for each species group

A rapid scoring approach used to assess the likely efficacy of each of the 313 QEIA actions for each species group (birds, mammals, butterflies, moths, bumblebees and vascular plants). The review and scoring for mammals were split between bat species and other mammal species in the abundance indicator.

The rapid evidence review to support the scoring drew on the detailed QEIA review reports (Defra 2023c) and references therein. In addition, more recent papers and other evidence known to the project team was included. To supplement the project team's specific expertise, the Bat Conservation Trust completed a brief expert opinion-based review of the assessments. A full primary evidence review and extended consultation with a wider range of experts were out of scope given the timescales of Task A. Examples of the evidence reviewed for four of the QEIA actions, and the scores attributed, are given in detail for one case study QEIA action below, and a further three QEIA actions in Appendix 8.1.

3.2.1 Scoring system and response variables

The QEIA actions were scored for each species group at the level of composite or community response variables, for example total abundance of all species in a taxon or species richness. Much of the evidence of AES efficacy is for community response variables, particularly for invertebrates and plants. The species responses scored for each group were informed by the response variables in the evidence being reviewed. Responses scored for all taxa included total abundance and species richness. For some taxa, scores were also attributed to the response of groups of species associated with specific habitats (e.g. woodland vs farmland butterflies). Where species-specific evidence was found (mainly for birds and a few butterfly species), this was flagged during the Task A scoring and included in Task B1.

A main score of 1-5 was attributed to each species group response variable and action to capture the likely benefit and uncertainty associated with any benefit (scores 1-3), disbenefit (score 4) or no likely effect of the action (5) on the species group response. The likely scale of any benefit or disbenefit (minor vs. major effect) was also captured, Table 2.

Table 2. Main scoring codes for rapid evidence review in Task A.

Evidence number denoting likely benefits (and confidence in benefit rating linked to type of evidence) vs disbenefit or no likely effect		Benefit level
1	Clear evidence of benefit, empirical evidence	** Major benefit
		* Minor benefit
2	Benefit, at least 1 empirical study showing result	** Major benefit
		* Minor benefit
3	Likely benefit, expert judgement / understanding of species ecology	** Likely major benefit
		* Likely minor benefit
4	Disbenefit from this action	** Major disbenefit
		* Minor disbenefit
5	No likely effects on this species / species group / taxon	X = untested, expert judgement

Additional score codes were attributed to capture key features of evidence that may affect confidence in the evidence, or the relevance of the study to the abundance indicator. For example, additional codes included whether the evidence related to change in abundance over time (population effects) or a spatial comparison, and whether spatial targeting was required for the action to be successful for that species group.

Additional scoring codes

C evidence only from COMPOSITE studies of multiple AES option types, effects likely/partially attributable to this action.
D mixed effects: benefits for some taxa but disbenefits for others
L evidence only from LOCAL studies, e.g. single or few sites
M refers to a MANAGEMENT plan (generally score as 3 M)
R evidence from at least one REGIONAL study, multiple sites across several regions relevant to action management
T requires spatial TARGETING for benefit
P evidence of POPULATION (temporal) change (only mobile taxa, not plants)
X untested

Hypothetical examples of scoring system

1 ** P T action with empirical evidence of population growth effects for a given bird species, that requires spatial targeting to be effective
2 * L action with limited empirical evidence of increase in species richness for bumblebees, evidence from local-scale studies
4 ** L action shown to strongly disbenefit specific priority arable weed species, evidence from local-scale studies

Case study scoring examples

The following case study illustrates the rapid scoring approach applied to each species group in detail for one QEIA actions. Three additional case studies are in Appendix 8.1. Scores were attributed using the system described above (Section 2.2.1). The footnotes explain the rationale for each element of scoring, and the references that contributed to scoring that response variable. The codes for the case studies below refer to the QEIA codes (Defra 2023c). The details in square brackets ([]) link each element of the scoring to the evidence.

Scoring of all QEIA actions took this approach, given the timescales of this project a detailed write-up for each action was not possible.

1. *Arable_01: Extended stubble – unharvested crop stubble followed by a one-year fallow [Restoration, management and enhancement / Cropland]*

Birds:

No classification (B)	1 ** D P R T
Farmland (F)	1 ** D P R T
Upland (U)	5 X
Woodland (W)	5 X
Coastal (C)	5 X
Wetlands/waterbodies (WW)	5 X

[**F:1**] Whilst no evidence was found pertaining to how different types of fallow impact farmland birds (i.e. fallow or set-aside), all fallow options have been found to benefit farmland birds when compared to cropped fields (Buckingham et al. 1999; Poulsen et al. 1998; Aebischer et al. 2000; Henderson et al. 2000; Firbank et al. 2003; Roberts & Pullin 2007; see also Van Buskirk & Willi 2004 for a meta-analysis of 127 studies).
[**F:****] Given that this action can impact several priority farmland species, across a broad geographical area (arable/lowland regions in the UK), this action was deemed to have a major impact on avian biodiversity.
[**F:D**] However, fallow fields can also be detrimental to farmland birds. For example, Skylark nests encounter higher rates of predation in open areas, compared to fields sown with cereals (Donald 2002).
[**F:T**] The duration over which a field is left fallow can impact benefit some species over others: Finches and Buntings were found to be more abundant in the first year of fallow, while Thrushes and the Grey Partridge prefer older fallow (Buckingham 1999). This variability affords some capacity to manage the action for target species.
[**F:P**] The provision of fallow fields following stubble increases breeding densities, reproductive output and winter population abundances, and tends to favour the widest groups of farmland birds.

Invertebrates:

Bumblebees	2 ** L T
Butterflies (Farmland)	1 **
Butterflies (Woodland)	5 X
Moths	3 *

Bumblebees: There are a small number of studies showing good evidence of significant positive effects of fallow land on bumblebee abundance and species **[2 **]** on some fallow land (equating to ETPW-257) and stubbles (similar to Arable01), but studies are localised **[L]**, and results were strongly dependent **[T]** on fallow type and duration (Kuussaari et al. 2011; Pywell et al. 2017). Sowing low rates or simple seed mixtures of robust species (e.g. ETPW-257) was associated with significant benefits of fallow land for bumblebees, compared to conventional cereal crops. Naturally regenerated fallows (e.g. Arable02) were most beneficial on light soils.
Butterflies (Farmland): There are multiple widespread studies **[1]** providing strong evidence that rotational fallows (ETPW-257, Arable01, Arable 02) are associated with arable butterfly species richness and abundance **[**]**. Greatest benefits on two-year fallows, fallows undersown with uncompetitive grasses or legume-rich mixes (e.g. ETPW-257), and naturally regenerated stubble or fallows (Arable01, Arable02) (Kuussaari et al. 2011; Toivonen et al. 2015, 2016; Pywell et al. 2017).
Butterflies (Woodland): It remains untested to what extent nearby arable fallows may be used by butterflies associated with woodlands, but effects are likely to be negligible **[5 X]**.
Moths: While there is no specific evidence for benefits of fallow land for moths, the strong positive evidence for butterflies and bumblebees gives good reason for expert opinion to infer a likely benefit **[3]**, although the magnitude is uncertain and so was conservatively assumed to be, at least, minor **[*]**.

Bats: 3*
No specific evidence of benefits of extended stubble management exists for bat species, but a possible benefit **[3]** is inferred from the likely benefit to invertebrate prey of bat species. The strength of benefit is less certain, so we assume a minor benefit **[*]**.

Mammals (excluding bats):

Mammals (Farmland)	1 **
Mammals (Farmland, Priority)	1 **
Mammals (Woodland)	5 X
Mammals (Woodland, Priority)	5 X

Mammals (Farmland): Fallow, stubbles and 'set-aside' land are widely reported **[1]** to be associated with increased abundance of **[**]**, or usage by, generalist farmland mammals, such as Rabbits and Roe Deer (Putnam 1986, Firbank 2003). Small mammals, such as mice and voles, are more abundant in fallow or set-aside land in arable landscapes,

compared to crops (Macdonald et al. 2007, Janova & Heroldova 2016), which is good evidence of significant benefits for their major predators on farmland, i.e. the Red Fox.
Mammals (Farmland, Priority): There is strong evidence from multiple widespread studies **[1]** that the priority Brown Hare is positively associated **[**]** with fallow land compared to cropped land (an extensive review by Smith et al. 2005; see also Hof & Bright 2010).
Mammals (Woodland) and **Mammals (Woodland, Priority):** There is no specific evidence that mammals in woodland habitats, including the priority Hazel Dormouse, benefit from these options, and any effects are presumed to be negligible **[5 X]**.

Plants:

Plants	1 *
Plants (Rare arable)	1 *

There are multiple studies providing good evidence **[1]** for fallow options providing some benefits for plant richness and abundance on farmland **[*]**, with most concentrating on the rarer arable plants only **[1 *]**. Short rotation, one-year fallow (Arable02) benefits species richness of arable annual species, whereas two-years or longer may benefit undesirable and problematic grasses and arable weeds (Wilson 1992; Albrecht et al. 2016; Pywell et al. 2017). Arable01 is expected to provide similar benefits for plant species richness, including for rare arable plants where these are present, due to the extended period of crop stubble followed by a one-year of fallow (Walker et al. 2007).

3.2.2 QEIA scoring results

Table 3. Count of scores across 313 QEIA actions for each species group. For groups with multiple response variables scored, count is for the maximum main score.

QEIA action scoring	Score (max)	Number of QEIA actions: Butterflies	Moths	Bumblebees	Birds	Bats	Mammals (terrestrial)	Plants
A. Main score for benefit, disbenefit or no likely effect:								
Clear evidence of benefit, empirical evidence	1	36	22	27	49	0	18	37
Benefit, at least 1 empirical study showing result	2	12	11	32	42	14	16	18
Likely benefit, expert judgement / species ecology	3	136	154	129	106	154	123	121
Disbenefit (main rating for species group)	4	5	5	5	7	7	7	7
No likely effect	5	119	71	84	109	138	146	76
No evidence found	X	5	50	36	0	0	3	54
Likely benefit regardless of confidence	1-3 above	184	187	188	197	168	157	176
Likely disbenefit for one or more species in group (4 above is a likely disbenefit for most species)	4 OR 1-3 with 'D'	17	20	12	91	27	10	26
B. Likely size of effect if action scored as beneficial:								
-large likely effect size	1-3, with **	55	42	66	78	57	49	58
- small likely effect size	1-3, with *	79	91	78	119	111	66	75
C. Spatial targeting required for action to be effective	Contains 'T'	3	1	13	109	20	1	3
D. Characteristics of evidence:								
Evidence for population change / abundance change over time	Contains 'P'	3	0	0	19	0	0	0
Evidence from composite studies of multiple actions - lower confidence attributing effect to specific action	Contains 'C'	10	9	9	22	10	8	8
Evidence from regional or national studies (otherwise only from smaller scale studies)	Contains 'R'	5	12	4	65	11	4	12
Total number QEIA actions scored		313	313	313	313	313	313	313

Counts of evidence scores across QEIA actions per species group (Table 3) have been grouped by four themes. Rows in theme A summarise the number of QEIA actions against the main score attributed for benefit (with confidence relating to type of evidence used), disbenefit or no likely effect on response variable scored, per species group. Where AES effects on species grouped within a response variable are likely to differ, the main score attributed is for most species covered by the response. Theme B summarises the scores for whether any benefit of the QEIA action is likely to be large or small for the species response being scored. Note effect size scoring was less commonly attributed to responses scored 3 (likely benefit but best evidence found was expert judgement or understanding of species ecology, no empirical studies), hence the totals for ** and * under B may not sum to the total for likely benefit regardless of confidence.

The rows in Table 3 under themes C and D give counts of evidence scores across the 313 QEIA actions attributed for characteristics of the AES study that affect how directly the evidence can be linked to species abundance indicator targets, or affect our confidence in the score. For example, studies on a combination of several AES actions or management types may provide strong empirical evidence for benefits for a particular species, without quantifying the relative contribution of each AES action type. Scores from these composite studies ('C') are attributed with lower confidence to individual QEIA actions. There is evidence for some species groups that AES management efficacy varies depending on the spatial context in which it is applied – for example, the farming system (arable vs grassland vs mixed) or the landscape type. Scores of 'T' were attribute to capture information on actions that needed to be spatially targeted in order to have an effect on the species response that was scored (Table 2).

3.2.3 Discussion – QEIA action scoring outcomes

The evidence base for efficacy of AES management varies substantially across taxa, both in terms of the amount of published research and the methodologies used in research. Birds were the taxon with the most published research linked to AES options or management types. In addition, more AES evidence was found for individual bird species responses, and for change in abundance over time (population change), than for the other taxa considered here. More QEIA actions were scored as having been the focus of regional-scale studies for birds than for other taxa ('R' in Table 3). Perhaps linked to the regional scale of studies on birds, there were more composite studies on several AES options or management types than for other taxa ('C' in Table 3), which reduced the certainty with which scores for bird responses could be attributed to individual QEIA actions. More actions were scored as needing spatial targeting to be effective in supporting birds, than for other taxa. This may reflect differences in the quantity and detail of evidence available rather than species requirements, but it may also reflect the scale of use of landscape by species groups that differ in mobility. Many options will work better in different contexts, e.g. in different farming systems. This is discussed in more detail in relation to varying efficacy of CS options on birds in Section 2.4.3 below.

In contrast, the insect taxa scored (butterflies, moths, bumblebees) had a greater proportion of action scores attributed that were based on expert judgement / understanding of species ecology. Overall, more scores for the insect taxa were attributed with lower confidence than for birds (Table 3, e.g. counts of score 3 vs. score 1). There were fewer regional-scale and fewer composite studies of AES efficacy on insects, linked to the amount of empirical evidence available as well as the likely smaller spatial scales over which some insect taxa travel. Moth are the group with most species in the abundance indicator (446, 37.9% of indicator species Table 1), yet fewer QEIA actions could be scored with confidence (green or amber) for moths than for birds, butterflies, bumblebees or plants. The shortage of empirical results for moth responses to AES options or management types results in high uncertainty around how AES is likely to affect abundance indicator species.

It is important to note that a significant source of uncertainty in the review process was the lack of specificity or explanation of the QEIA actions, which often had an element of ambiguity. Future programmes collecting such information would benefit from either more explicit links to established management measures or description of what is meant beyond a short title.

Despite the uncertainty, and differences in the amount and type of evidence across the species groups, most of the 313 QEIA actions were scored as likely to be beneficial for one or more of the species groups scored.

3.3 Linking QEIA actions to ELMS (Countryside Stewardship and Sustainable Farming Incentive) options

3.3.1 Approach

An existing (development stage) spreadsheet detailing the links between QEIA and AES options (including Environmental Stewardship; Countryside Stewardship and Sustainable Farming Incentive) was provided by Defra. QEIA option links to AES were reviewed and edited where appropriate. AES options that were equivalent to existing AES codes were added.

QEIA reports were scrutinised to ensure accurate reflection and aim of the actions were matched with AES option descriptions and aims. AES option descriptions, aims and details were scanned online to ensure links were sensible. A link strength was allocated to each match based upon the following score 0 = no known link; 1 = tentative link (some attributes or aims in common); 2 = moderate link (many attributes and aims in common); 3 = strong link (direct match in attributes and aims). Table 4 has examples of QEIA and AES action link strengths.

Table 4. Examples of link strength between QEIA and AES options

Link strength	QEIA action	AES option code	AES option description
Strong	Plant and establish appropriate species of field boundary trees	TE1	Planting Standard Hedgerow trees
Moderate	Restore peatland vegetation	UP3	Management of moorland*
Weak	Create areas of scrubby flower-rich grassland	GS1	Take small areas out of management

* An example where the AES option may cover much more than the QEIA action, and the latter is not specific

3.3.2 Case Study examples

Arable_01: Extended stubble – unharvested crop stubble followed by a one-year fallow

There are three possible matches for this QEIA with similar aims:

1) AB2 - Basic overwinter stubble - After the harvest there will be stubble until mid-February.

2) AB6 - Enhanced overwinter stubble - After harvest, the stubble from the summer's crop will be left until the 31 July of the following year providing important seed and forage for farmland birds during the autumn and winter.

3) AB7 - Whole crop spring cereals and overwinter stubble - Establish a spring cereal crop (not maize) and harvest as a whole crop. Leave the stubble until the following spring. The stubble will provide a habitat throughout the autumn and winter, until the following spring

Match with AB6 but only with moderate confidence score. In the QEIA Arable_01 action the crop is left unharvested vs harvested in AB6, and stubble is left for 1 year vs until 31 July for AB6. While AB6 is the best match available, the differences reduce confidence.

3.3.3 ***ETPW-116: Provide a flower rich habitat for wild pollinators with a range of flowering times and flowering structures***

Two possible CS & SFI options:

1) AB1/ AHL1 Pollen and nectar flower mix – Management will ensure there is sustained flowering throughout the spring and summer; with list of species which need to be established
2) AB8 - Flower-rich margins and plots - Once established, the margin/plot will flower throughout the summer to provide an abundant supply of pollen and nectar. The seed mix will contain a minimum of 4 grass species and 10 wildflower species. No individual flower species will exceed 25% of the total wildflower species component by weight.

All options match the QEIA action with strong confidence; QEIA action is general across both permanent and rotational approaches to providing floral resources.

For this action, AB1 has been attributed. AB8 was linked to another QEIA action that was more specific to flower-rich and species-rich margins, field corners and plots (ETPW-205c) and is also considered within the summaries of CS scoring and uptake data.

3.3.4 QEIA action to ELMS option matching outcomes

Countryside Stewardship and Sustainable Farming Incentive (Pilot, 2023 and 2024) options were each matched to a QEIA action. The information for SFI pilot was only available on broad standards, these could not be used to link to specific QEIA actions to attribute scores. SFI 2024 (also referred to as SFI extended offer) actions were matched to QEIA actions but there are no available uptake data on these, so no further analysis was done using those pairings. Environmental Stewardship options were also matched; they were also not used in analysis but provided useful information when looking at gaps. Table 5 provides the number of QEIA actions, with a link strength, to CS and SFI 2023 options and actions.

Table 5. Number of QEIA actions with, no, weak, moderate or strong link to CS and SFI 2023 options.

QEIA to CS and SFI link strength	Number of QEIA action matches
No link	84
Weak link	15
Moderate link	22
Strong link	192
Total	313

Missing within this are 84 QEIA actions, e.g. Create agroforestry systems, precision systems for fertiliser and pesticide application, which don't link to CS or SFI 2023 options. However, most of these QEIA actions do link to updated options within SFI 2024. Three existing ES options also match to QEIA actions where CS and SFI do not, e.g. an option specifically to collect and sow locally sourced grass and wildflower seed.

One high-scoring QEIA action did not match with any confidence to CS or SFI 2023 actions; "Adapt mowing or first grazing dates on improved or semi-improved grassland; use mowing techniques to reduce mortality". This was a high scoring QEIA action for bumblebees, plants and birds. Whilst there are many AES grazing options which are designed with the aim of providing diverse sward structure e.g. GS17 & GS15: Lenient grazing supplement along with other options for haymaking, there do not appear to be any specific options which detail the management of this QEIA action.

Some scored QEIA actions that did not match to current options in CS or SFI 2023 do match to new actions in the SFI 2024 scheme, that at the time of this analysis was not yet open for applications. Upcoming actions with SFI 2024, without comparable options in current schemes, include two agroforestry actions (AGF1, AGF2) and four actions for precision farming (PRF1, PRF2, PRF3, PRF4). Many of the other SFI 2024 actions are similar to those in SFI 2023, or to ongoing CS options. SFI 2024 includes actions targeted at priority habitats, priority species and heritage features. These will require endorsement from a Natural England or Historic England advisor in the SFI 2024 application process, as they are targeted. Further details of SFI 2024 see this link.

3.4 Likely effectiveness of CS and SFI for species groups in the abundance indicator

3.4.1 CS and SFI 2023 scoring results

Scores were attributed to QEIA actions (Section 2.2), which were then matched to CS and SFI 2023 option codes (Section 2.3). Tables 6 and 7 give the counts of scores for 166 CS and 21 SFI 2023 options, using the same scoring system as for QEIA actions in Table 3.

Table 6. Count of scores across 166 CS actions for each species group.

Countryside Stewardship (CS) scoring	Score (max)	Number of CS options						
		Butterflies	Moths	Bumblebees	Birds	Bats	Mammals (terrestrial)	Plants
A. Main score for benefit, disbenefit or no likely effect:								
Clear evidence of benefit, empirical evidence	1	24	20	15	29	0	11	29
Benefit, at least 1 empirical study showing result	2	5	3	17	40	8	14	6
Likely benefit, expert judgement / species ecology	3	72	79	65	59	82	58	70
Disbenefit (main rating for species group)	4	1	1	1	2	0	5	1
No likely effect	5	63	43	52	36	76	75	45
No evidence found	X	1	20	16	0	0	3	15
Likely benefit regardless of confidence	1-3 above	101	102	97	128	90	83	105
Likely disbenefit for one or more species in group (4 above is a likely disbenefit for most species)	4 OR 1-3 with 'D'	8	10	4	62	12	6	7
B. Likely size of effect if action scored as beneficial:								
-large likely effect size	1-3, with **	26	22	33	48	32	26	38
- small likely effect size	1-3, with *	52	54	47	80	57	39	44
C. Characteristics of evidence:								
Evidence for population change / abundance change over time	Contains 'P'	4	0	0	15	0	0	0
Evidence from composite studies of multiple actions - lower confidence attributing effect to specific action	Contains 'C'	8	7	6	6	4	6	6
Evidence from regional or national studies (otherwise only from smaller scale studies)	Contains 'R'	5	15	4	40	5	3	15
D. Spatial targeting required for action to be effective	Contains 'T'	0	0	5	81	15	0	1

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Table 7. Count of scores across 21 SFI 2023 actions for each species group.

Sustainable Farming Incentive (SFI) scoring	Score (max)	Number of SFI actions						
		Butterflies	Moths	Bumblebees	Birds	Bats	Mammals (terrestrial)	Plants
A. Main score for benefit, disbenefit or no likely effect:								
Clear evidence of benefit, empirical evidence	1	6	4	7	8	0	4	5
Benefit, at least 1 empirical study showing result	2	2	1	2	1	2	2	2
Likely benefit, expert judgement / species ecology	3	8	11	7	9	14	9	5
Disbenefit (main rating for species group)	4	0	0	0	0	0	0	0
No likely effect	5	4	2	2	2	4	5	6
No evidence found	X	0	2	2	0	0	0	2
Likely benefit regardless of confidence	1-3 above	16	16	16	18	16	15	12
Likely disbenefit for one or more species in group (4 is a likely disbenefit for most species)	4 OR 1-3 with 'D'	0	0	0	9	2	0	0
B. Likely size of effect if action scored as beneficial:								
-large likely effect size	1-3, with **	7	6	9	8	6	6	7
- small likely effect size	1-3, with *	5	4	3	9	8	5	1
C. Characteristics of evidence:								
Evidence for population change / abundance change over time	Contains 'P'	0	0	0	4	0	0	0
Evidence from composite studies of multiple actions - lower confidence attributing effect to specific action	Contains 'C'	2	3	2	1	1	1	2
Evidence from regional or national studies (otherwise only from smaller scale studies)	Contains 'R'	2	2	3	9	1	2	2
D. Spatial targeting required for action to be effective	Contains 'T'	0	0	2	11	1	0	0
Total number SFI actions scored		20	20	20	20	20	20	20

The majority of CS and SFI 2023 actions were likely to benefit the species groups reviewed (Tables 6 and 7). Confidence in the scores attributed and the characteristics of empirical studies on AES efficacy both varied across the species groups, following the same broad patterns as for scores initially attributed to QEIA actions (Section 2.2.3 above).

3.4.2 Priority CS and SFI 2023 options

Of the 187 CS and SFI 2023 options which matched to QEIA actions scored for benefit, only 20 CS options were scored as no likely effect or no evidence found (scores of 5 or 6) across all the species groups. These 20 CS options were mainly capital and supplementary options that do not benefit biodiversity in themselves (e.g. FG5 Fencing supplement – difficult sites or LV7 Livestock troughs) but are likely to be combined with main CS options that do support biodiversity.

The high proportion of CS and SFI 2023 options scored as likely to benefit the species groups is not surprising, given that conservation of biodiversity is a key objective of AES schemes, and that many of the species groups on which AES management was focussed have been included in the species abundance indicator. The 167 CS and SFI 2023 actions that scored as beneficial for at least one species group were considered priority actions and were used in work under Task B for this project.

3.4.3 Spatial targeting - variation in AES option efficacy across landscapes

AES effects on species groups may vary with landscape type and farming system. There was insufficient evidence to attribute separate scores by landscape / farming type for the main scoring exercise (Sections 3.2 and 3.4.1). However, the scoring summaries of bird responses to AES showed a substantial number of QEIA actions and CS/SFI actions require spatial targeting to be effective for birds (e.g. 109 of the 313 QEIA actions scored, Table 3).

For birds, analysis of Breeding Bird Survey (Heywood et al. 2024) data has shown responses to grouped AES options can differ for some species, depending on whether the option is applied in an arable, grassland or mixed farming system (Ward and Siriwardena, unpublished, following Baker et al. 2012). Tests led to a wide range of results for individual species, with both positive and negative effects of an AES option group detected depending on the background landscape in which the management was applied (Table 8). The study involved running many statistical tests, so it is possible that several significant results appeared by chance, and it is likely that some patterns reflect uncontrolled landscape or land-use biases. However, the inclusive approach taken to the species selected for the study means that any real effects of AES on species population growth rates should have been detected. Thus, individual positive or negative results should not be over-interpreted, but clear balances of effects in one or other direction for a given species or option are unlikely to occur by chance and can be considered to indicate reliable evidence for an overall benefit or disbenefit of the management involved.

Table 8. Summary of significant responses of growth rate tests on individual bird species to AES option types in three different landscapes (arable, mixed, pastoral) from 2002-2022 (Ward and Siriwardena, unpublished).

Option category	CS option codes	Landscape	Total number of tests	Percentage of tests		
				Significant	Significant positive	Significant negative
Stubble management	AB2, AB6, AB7, OP1	Arable	36	47	22	25
		Mixed	36	61	50	11
		Pastoral	34	56	38	18
Extended stubbles	AB6	Arable	36	58	31	28
		Mixed	36	61	33	28
		Pastoral	36	47	31	17
Wild bird seed mix	AB9, AB10, AB13, AB16, GS3, OP2	Arable	42	50	10	40
		Mixed	42	50	29	21
		Pastoral	40	60	35	25
Supplementary food	AB12, OP3	Arable	13	46	15	31
		Mixed	13	69	23	46
		Pastoral	13	15	0	15

The overall effectiveness of AES management was, in general, highly variable between bird species that might conceivably benefit, and all option categories featured combinations of positive and negative effects on individual species, although variable net effects (Table 8). Note also that this approach treats all species as equal; in reality, the importance of individual options depends on the ecology, conservation status and distribution of individual species, so a focus on, say, priority species might yield different results.

Fewer actions were identified as needing spatial targeting to be effective for the other taxa scored (Sections 3.2.2 and 3.4.1). This may reflect a difference in the type and amount of available evidence between the taxa. Most evidence was available for birds, and also more actions were scored as having evidence of population change and studies conducted at regional scales. The greater availability of evidence for birds makes identification of spatial targeting more likely. Where spatial targeting is identified as necessary for an action, this has sometimes been delivered through advice to land managers from specialist advisors, for example working for Natural England or for conservation NGOs (Mills et al. 2021). SFI schemes with uptake data available (SFI 2023 and precursors) did not include an element of advice in their application process. However, the upcoming SFI 2024 scheme does include tailored options that require input from an advisor.

3.4.4 National patterns in CS option uptake

An ArcGIS Dashboard was created, combining spatial uptake patterns of CS options in England with scores attributed to CS options (Sections 2.2-2.41), with a separate tab for each of the seven species groups scored. Each of these tabs included two different panels to visualise predominant scores and total of beneficial options summarised at National Character Area and 10km OS grid level. Further information was displayed through click-on pop-ups showing detailed scores for each area. The Dashboard is hosted in UKCEH's ArcGIS portal. Access to the dataset describing the location of all scheme options land under management within the CS Agri-Environment Scheme was obtained from the Natural England Open Data service at (https://defra.maps.arcgis.com/home/item.html?id=a1d134a1747040faa8709776ad8f22c4).

Dashboard link

https://www.arcgis.com/apps/dashboards/0a7636faf9d540a49d75b059dd7f7ffc

Map images below (Figures 2-9) show examples of the dashboard outputs. Please use the link to dashboard to explore the patterns in more detail.

For each species group in Figures 2-9 below, the left dashboard panel shows predominant benefit scores (scores 1=green, 2=amber and 3=yellow) attributed to CS option, at OSGB 10km and National Character Areas level. Grey pixels represent areas where data is not available or no score predominance can be identified. The right-hand panel shows total uptake of options scored as beneficial to the species group (OSGB 10km only). Separate layers show predominant score and uptake of options applied to land parcels (measured in hectares) vs. options applied to linear features (uptake measured in metres).

We were unable to include SFI uptake in the dashboard, as spatially referenced SFI uptake data were not publicly available.

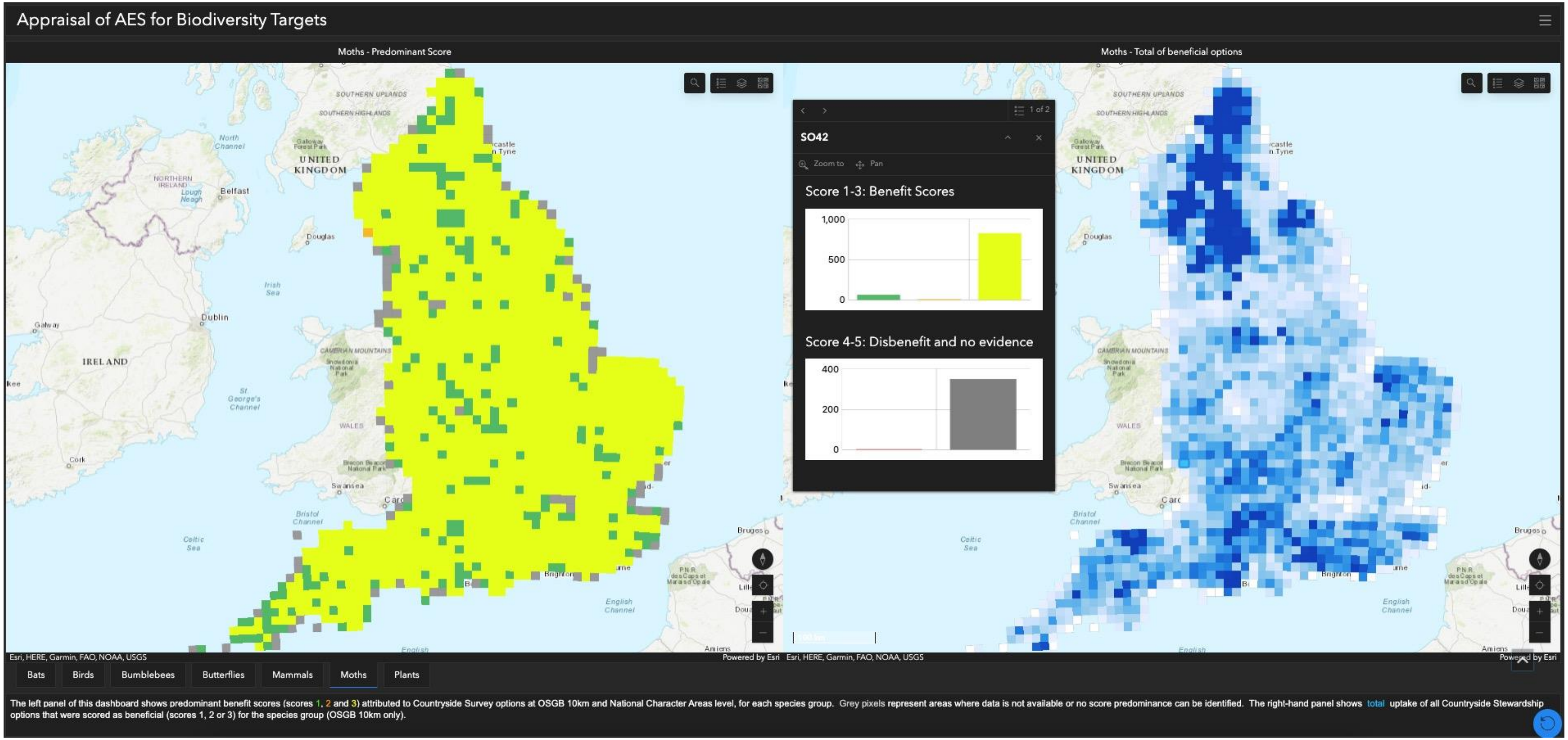

Figure 2. Dashboard pop-ups show uptake of beneficial options per scoring category for each cell.

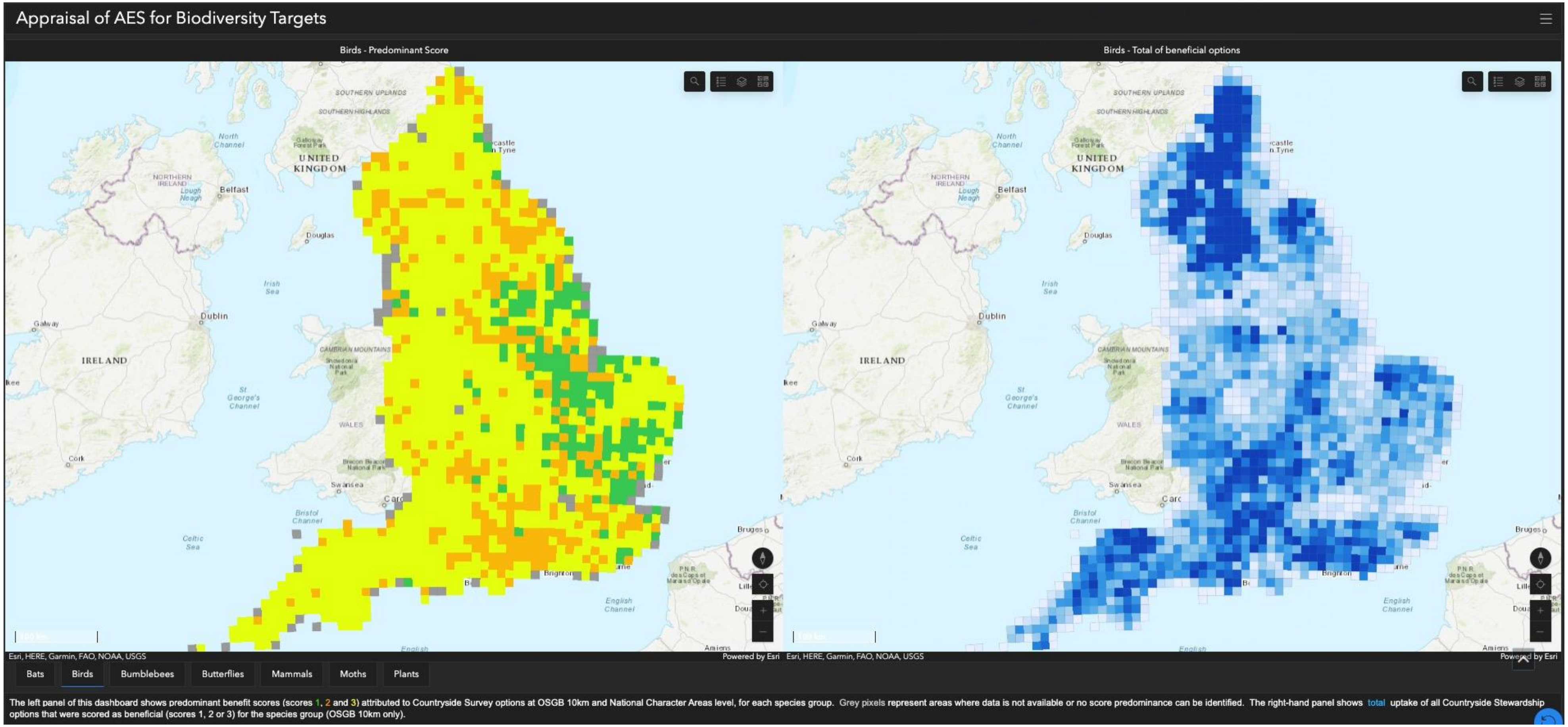

Figure 3. Map of beneficial option scores (left) and uptake (right) for birds.

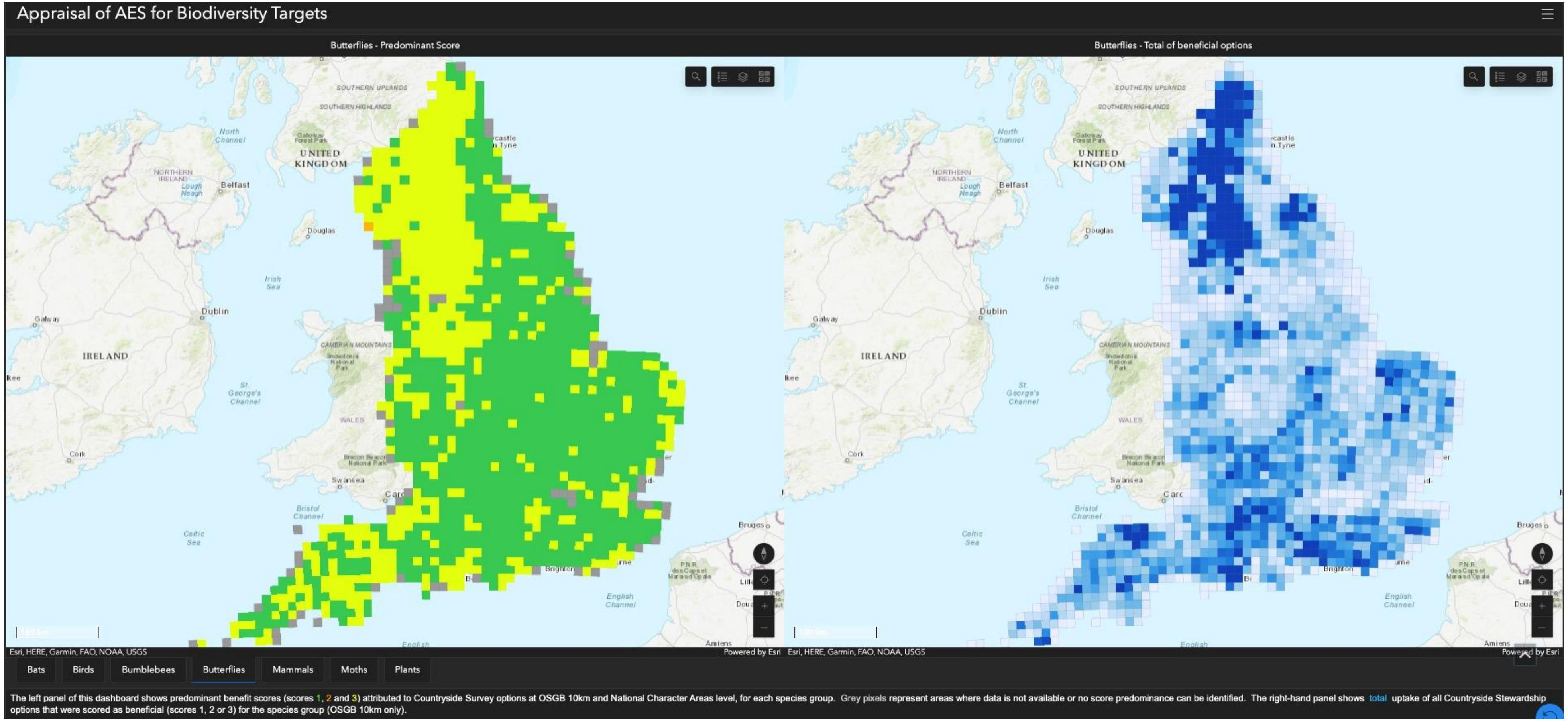

Figure 4. Map of beneficial option scores (left) and uptake (right) for butterflies.

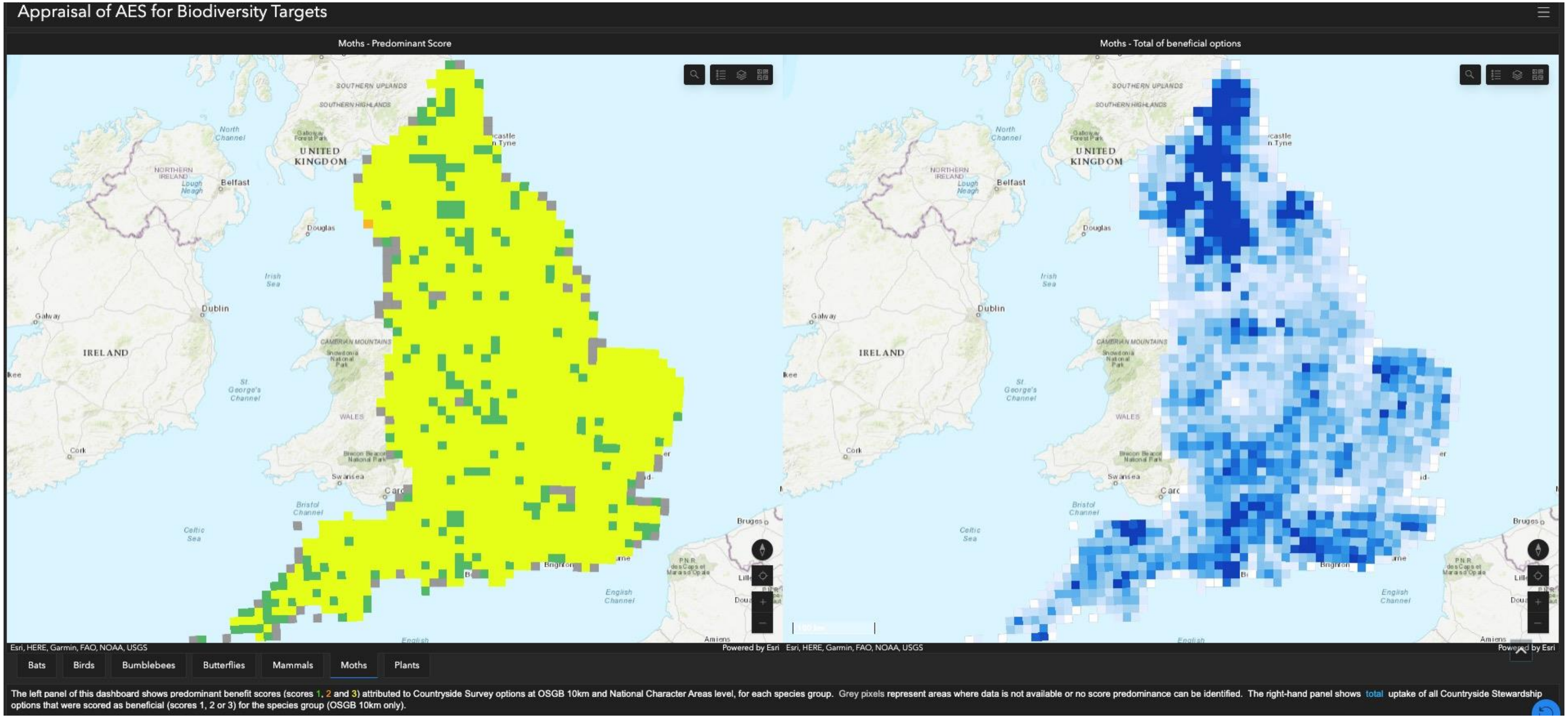

Figure 5. Map of beneficial option scores (left) and uptake (right) for moths.

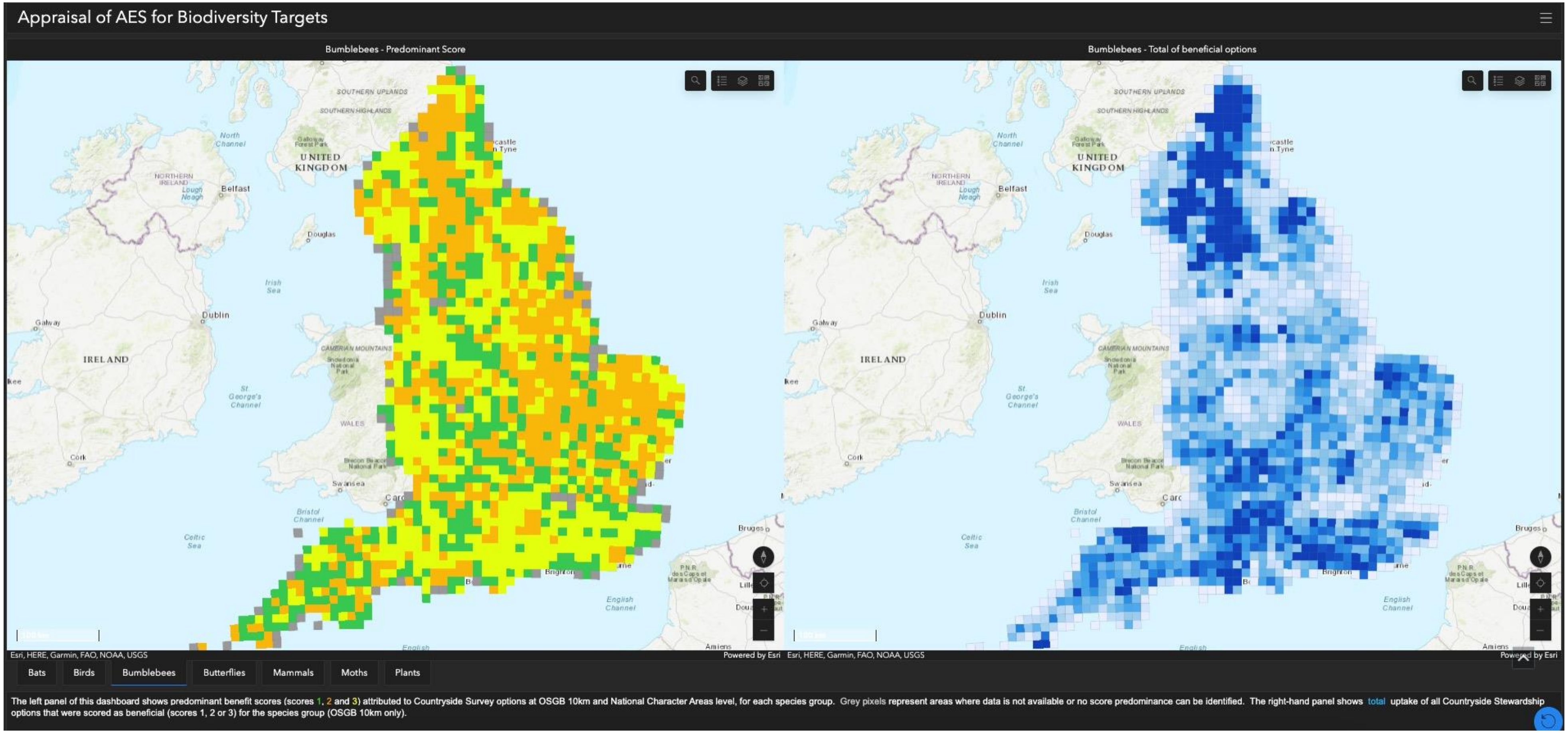

Figure 6. Map of beneficial option scores (left) and uptake (right) for bumblebees.

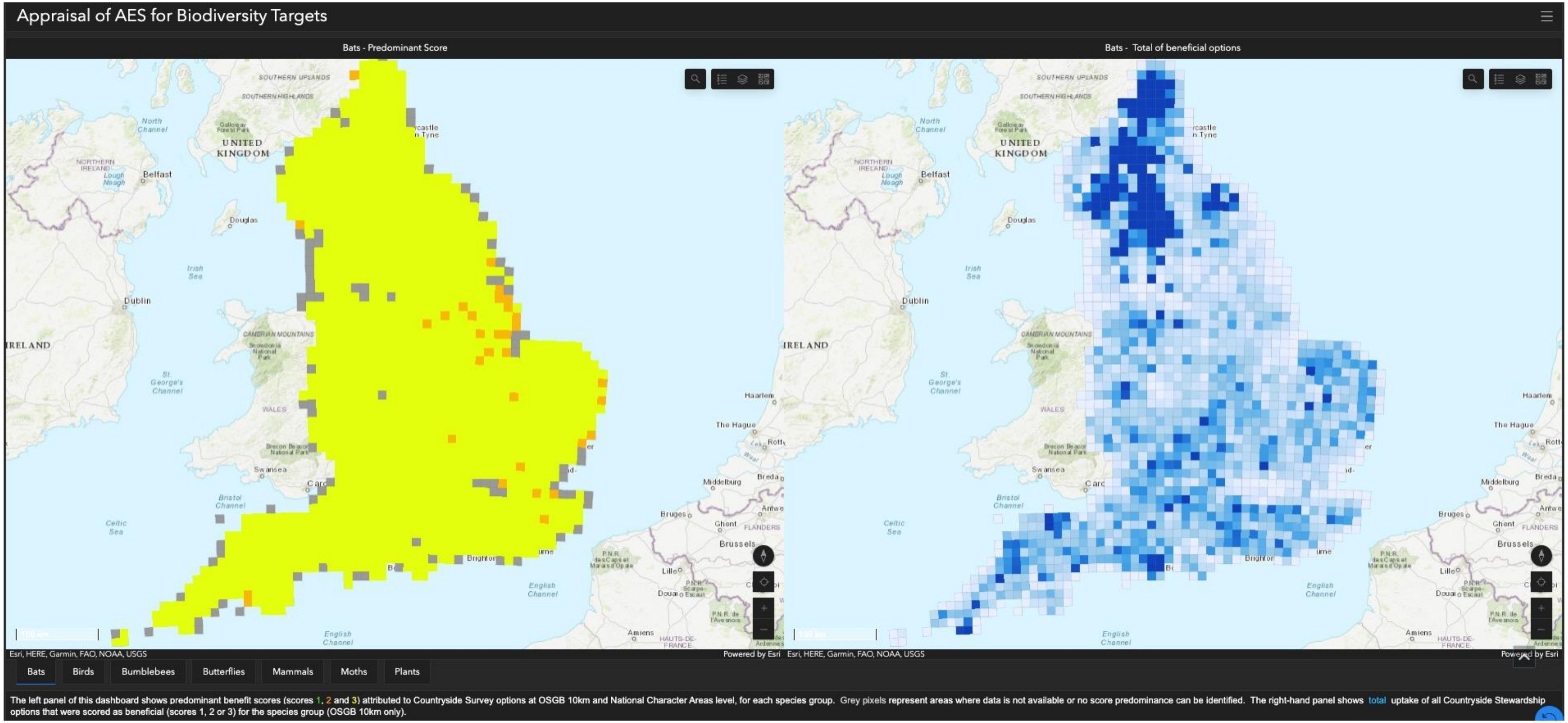

Figure 7. Map of beneficial option scores (left) and uptake (right) for bats.

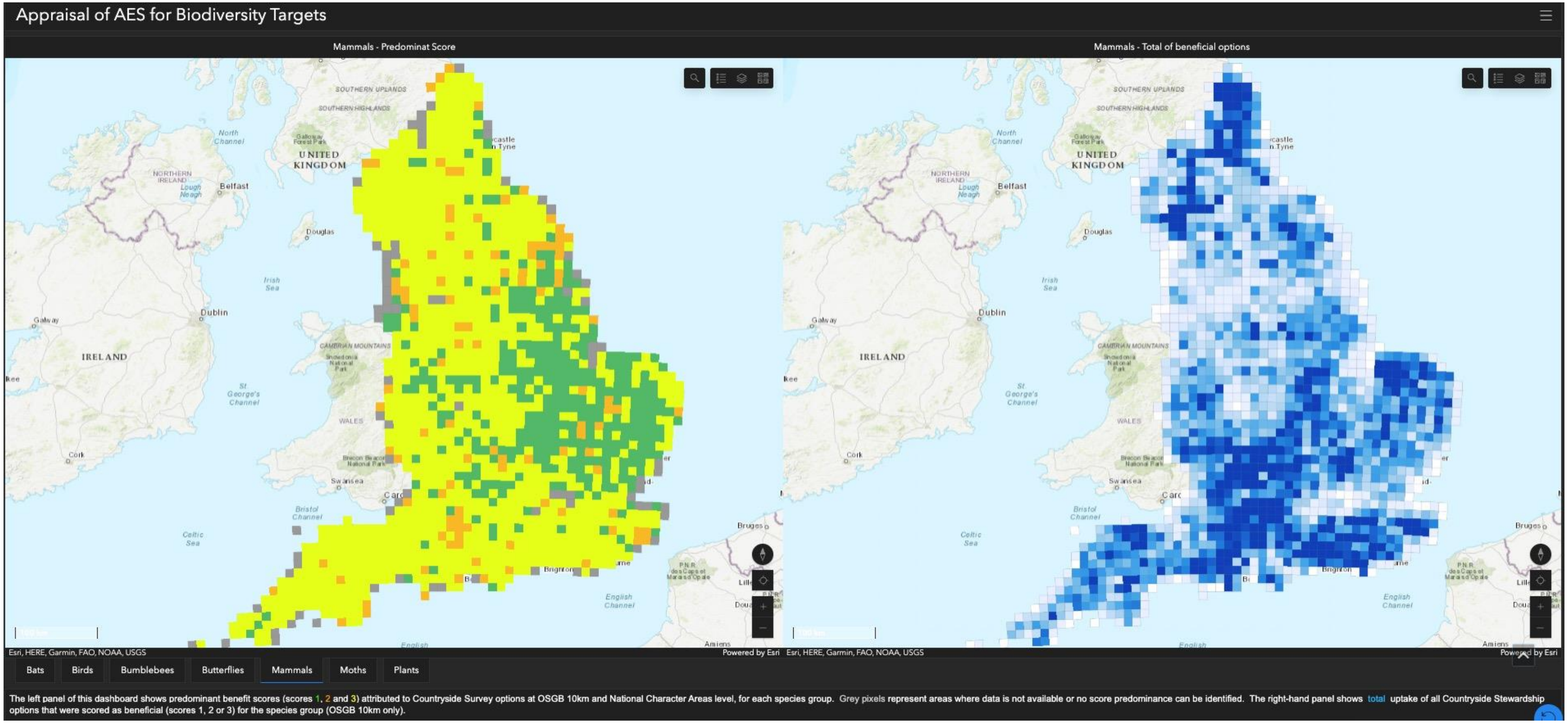

Figure 8. Map of beneficial option scores (left) and uptake (right) for other mammals.

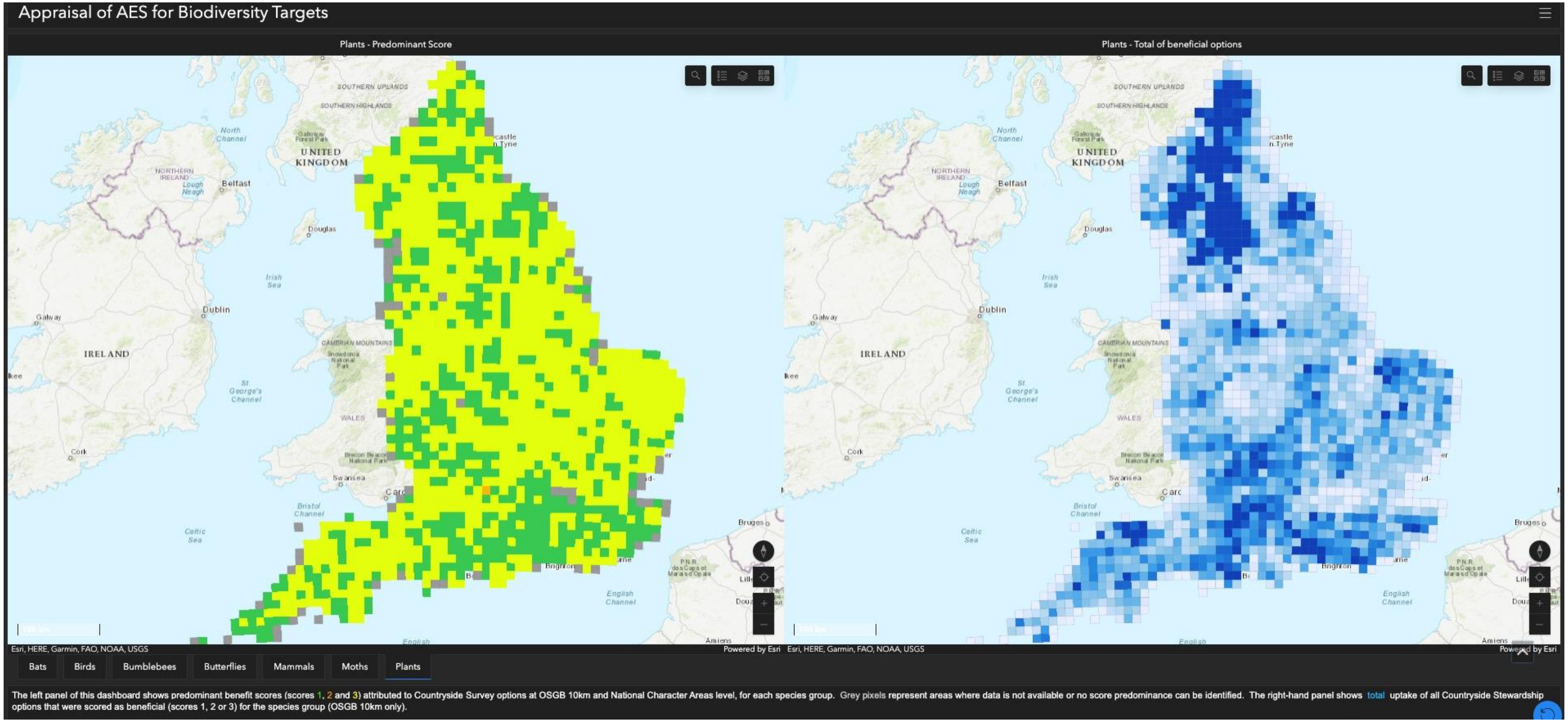

Figure 9. Map of beneficial option scores (left) and uptake (right) for plants.

3.4.5 Total uptake of CS and SFI 2023 options by scoring categories

Total uptake data as of 1st April 2024 were publicly available from Defra (https://www.gov.uk/government/statistics/cs-es-and-sfi-option-uptake-data-2024, accessed June 2024). These uptake data were summarised per scoring category for the 167 priority CS and SFI 2023 options (Section 2.4.2), for each species group. Options with uptake measured in parcels (ha) were summarised separately (Tables 9 & 10) from options applied to linear features (e.g. hedgerow management) with uptake measured in kms (Tables 11 & 12).

For CS parcel options, uptake of options likely to be beneficial (scored 1-3, i.e. regardless of evidence base) for birds (~2 million ha or 20,000 km^2) was greater than for other taxa. As noted in relation to the QEIA scoring summary (Section 2.2.4), bird conservation has been a focus of AES option design for decades and the evidence base is also largest for birds, both of which may have contributed to this. Within CS, uptake of options likely to be beneficial for butterflies, moths, bumblebees and plants was also substantial (1.1 – 1.3 million ha or 11,000-13,000 km2), although the benefit score varied across taxa. There was more uptake scored as 1 (clear evidence of benefit from empirical evidence) for butterflies and plants than for moths or bumblebees.

The lower uptake of beneficial options for bats and other mammals may reflect less focus on mammals in the design of AES options, and less evidence on which to base a score as being beneficial. Mammals make up <2% of species in the abundance indicator (Table 1).

Uptake of SFI 2023 parcel options likely to be beneficial varies less between the insect taxa than CS uptake, due to the small number of scored SFI 2023 options (16 options with uptake data for parcels). The national uptake data available for both schemes was for uptake as of April 2024. SFI 2023 uptake is likely to have increased since April until the scheme closed for new applicants in summer 2024, thus the SFI 2023 uptake here is likely to be an underestimate. SFI 2024 was not open for applicants while Task A work was ongoing, this will increase overall SFI uptake, showing the potentially critical role for this scheme in delivering for biodiversity.

We were only able to look at uptake for a single year of SFI actions due to the availability of uptake data and the broad nature of SFI 2022 standards, which could not be linked to individual QEIA actions to attribute scores. Due to this and to uncertainty in the extent to which SFI options will have similar effects to their CS counterparts, it is critical to ensure that the effects of SFI on biodiversity are monitored effectively, as SFI develops and uptake is likely to increase.

Table 9. Total uptake of 105 priority CS actions applied to land parcels, per scoring category and species group.

Countryside Stewardship option uptake per score – options applied to parcels (hectares)	Score (max)	CS option uptake (ha)						
		Butterflies	Moths	Bumblebees	Birds	Bats	Mammals (exc. bats)	Plants
Main score for benefit, disbenefit or no likely effect:								
Clear evidence of benefit, empirical evidence	1	527,300	429,400	315,500	271,290	0	228,700	581,090
Benefit, at least 1 empirical study showing result	2	3,800	3,500	464,000	653,200	73,000	133,000	8,800
Likely benefit, expert judgement / species ecology	3	738,293	835,393	362,593	1,085,140	1,257,790	516,193	723,793
Disbenefit (main rating for species group)	4	40,200	40,200	40,200	16,800	0	127,600	40,200
No likely effect	5	755,740	192,250	332,640	48,203	743,843	1,058,740	172,250
No evidence found	X	700	563,490	549,300	0	0	0	532,900
Likely benefit regardless of confidence	1-3 above	1,269,393	1,268,293	1,142,093	2,009,630	1,330,790	877,893	1,313,683
Likely disbenefit for one or more species in group (4 is a likely disbenefit for most species)	4 OR 1-3 with 'D'	195,900	196,100	40,200	468,780	180,600	127,600	187,600
Spatial targeting required for action to be effective	'T'	0	0	219,800	1,538,630	249,100	0	8,200

Table 10. Total uptake of 16 priority SFI 2023 actions applied to land parcels, per scoring category and species group.

Sustainable Farming Incentive (SFI) 2023 option uptake per score – options applied to parcels (ha)	Score (max)	SFI option uptake (ha)						
		Butterflies	Moths	Bumblebees	Birds	Bats	Mammals (exc. bats)	Plants
A. Main score for benefit, disbenefit or no likely effect:								
Clear evidence of benefit, empirical evidence	1	295,500	120,800	389,500	309,900	0	195,700	131,000
Benefit, at least 1 empirical study showing result	2	3,400	0	174,700	500	10,700	1,600	3,400
Likely benefit, expert judgement / species ecology	3	709,400	887,500	444,100	461,700	912,100	717,300	780,200
Disbenefit (main rating for species group)	4	0	0	0	0	0	0	0
No likely effect	5	193,800	61,600	61,600	430,000	279,300	287,500	155,300
No evidence found	X	0	132,200	132,200	0	0	0	132,200
Likely benefit regardless of confidence	1-3 above	1,008,300	1,008,300	1,008,300	772,100	922,800	914,600	914,600
Likely disbenefit for one or more species in group (4 is a likely disbenefit for most species)	4 OR 1-3 with 'D'	0	0	0	433,900	10,700	0	0
Spatial targeting required for action to be effective	'T'	3,400	0	445,500	0	10,200	0	0

Table 11. Total uptake of 12 priority CS actions applied to linear features, per scoring category and species group.

Countryside Stewardship (CS) option uptake per score - options applied to linear features (kms)	**Score (max)**	**CS linear option uptake (km)**						
		Butterflies	**Moths**	**Bumblebees**	**Birds**	**Bats**	**Mammals (exc. bats)**	**Plants**
Main score for benefit, disbenefit or no likely effect:								
Clear evidence of benefit, empirical evidence	1	9,134	6,534	69,300	73,630	0	6,534	6,534
Benefit, at least 1 empirical study showing result	2	69,300	69,300	6,534	0	2,600	69,300	71,900
Likely benefit, expert judgement / species ecology	3	1,789	4,389	4,389	67,593	77,564	4,389	0
Disbenefit (main rating for species group)	4	0	0	0	0	0	0	0
No likely effect	5	64,877	3,877	3,877	3,877	64,936	3,877	5,666
No evidence found	X	0	61,000	61,000	0	0	61,000	61,000
Likely benefit regardless of confidence	1-3 above	80,233	80,233	80,233	141,224	80,164	80,223	78,434
Likely disbenefit for one or more species in group (4 is a likely disbenefit for most species)	4 OR 1-3 with 'D'	2,600	2,600	2,600	138,623	2,600	0	0
Spatial targeting required for action to be effective	‘T'	0	0	0	77,564	2,600	0	0

Table 12. Total uptake of priority SFI 2023 actions applied to linear features, per scoring category and species group.

Sustainable Farming Incentive (SFI) 2023 option uptake per score - options applied to linear features (kms)	**Score (max)**	**SFI option uptake (km)**						
		Butterflies	**Moths**	**Bumblebees**	**Birds**	**Bats**	**Mammals (exc. bats)**	**Plants**
Main score for benefit, disbenefit or no likely effect:								
Clear evidence of benefit, empirical evidence	1	0	0	55,200	55,200	0	0	0
Benefit, at least 1 empirical study showing result	2	55,200	55,200	0	0	0	55,200	55,200
Likely benefit, expert judgement / species ecology	3	32,200	32,200	32,200	32,200	87,400	32,200	0
Disbenefit (main rating for species group)	4	0	0	0	0	0	0	0
No likely effect	5	0	0	0	0	0	0	32,200
No evidence found	X	0	0	0	0	0	0	0
Likely benefit regardless of confidence	1-3 above	87,400	87,400	87,400	87,400	87,400	87,400	55,200
Likely disbenefit for one or more species in group (4 is a likely disbenefit for most species)	4 OR 1-3 with 'D'	0	0	0	55,200	0	0	0
Spatial targeting required for action to be effective	T'	0	0	0	55,200	0	0	0

3.5 Task A conclusions

The ambition for widespread uptake of ELMS (SFI and CS) across 70% of farmland in England makes it one of the major policy levers for the species abundance indicator targets. The scoring of QEIA actions in Task A showed gaps in the empirical evidence base for the effects of AES on biodiversity. Empirical evidence across a range of taxa was only available for a few AES actions / options.

Evidence for specific ELMS options was sought largely through links to evidence previously collated for the QEIA project, which was time-efficient. However, this approach introduced additional uncertainty by filtering the evidence for well-defined management prescriptions through sometimes vague and unclear named actions in QEIA.

The majority of actions in QEIA, and options within CS or SFI 2023, were scored as likely to be beneficial. However, for all taxa scored, more of the actions and options scored as beneficial were in a category with low confidence (3, score based on expert judgement / species ecology) than in a high confidence category (1, score based on empirical evidence). Birds had the most AES actions / options with category 1 scores for QEIA, CS and SFI 2023.

Only one high-scoring QEIA action, which related to adapting mowing and first grazing dates to reduce mortality of biodiversity taxa, was found not to link to any current ELMS options (CS or any SFI scheme). This QEIA action did link to a former ES option. This is a minor gap in the option coverage of the current ELMS schemes. Other potential gaps in the coverage of the current ELMS options as assessed here, are likely to be met by the SFI 2024 scheme that was not open to applicants at the time of this analysis.

The species abundance indicator contains many Lepidoptera (moth and butterfly) species (41% of the total species, Table 1). Given their dominance, the lack of empirical evidence for AES effects on moths is particularly important. Of the 187 QEIA actions scored as likely to benefit moths, 154 of the scores had low confidence (score based on expert judgement / species ecology).

The abundance indicator fundamentally considers change in species abundance, but much of the empirical evidence does not inform about this specific parameter in species ecology, especially at the national or landscape scale. In general, there was less evidence for AES effects on individual species than for community response variables (e.g. total abundance or species richness of a taxon), in particular for moths and plants. Species-specific evidence is considered in more detail in Task B of this project. However, despite the paucity of empirical evidence there may not necessarily be knowledge gaps in all cases, because AES management approaches are often informed by expert knowledge and species ecology has been taken into account. The rapid nature of this review has limited the extent to which wider expert judgement could be considered, particularly in respect of the likely value of management at large scales and the interaction of multiple, potentially conflicting measures. Such consultation would be an important part of a comprehensive review of scheme coverage of target taxa. Given the difference in the breadth of SFI 2024 actions compared to previous SFI schemes, a future review of SFI 2024 actions in relation to abundance of indicator species could be useful, and should include wider expert consultation.

There is a clear need for ongoing monitoring of AES, with feedback into option design, in particular as option details for future SFI are still being developed. Monitoring and evaluation of AES should focus on the taxa that dominate the species abundance indicator (e.g. moths, birds, plants), if the role of AES in contributing to these targets is to be better understood.

Established schemes such as CS were not designed to benefit all species that feature in the abundance indicator targets. The scoring results indicate CS is likely to benefit the indicator taxa considered here, but with low confidence in much of the scoring. Significant additional actions that could be added to ELMS have not been found, further research might usefully be conducted to identify interventions for less well-known taxa.

Task B – Assess priority ELMS actions for likely effect on species in abundance indicator

4.1 Introduction

4.1.1 Context and objectives

The objective for Task B was to score the ELMS priority actions for likely effects on changes in the abundance of individual species in the indicator, using available evidence. Priority ELMS actions in this context were the146 CS (Countryside Stewardship) and 20 SFI 2023 (Sustainable Farming Incentive) actions that were linked to QEIA actions scored during Task A, as likely to benefit one or more taxa (Section 2.4.2).

4.1.2 Broad approach

Scoring the likely responses of the abundance indicator species to the priority ELMS actions focussed on species responses in Task B, in contrast to Task A which included community responses for species groups (e.g. species richness of butterflies). A simplified version of the Task A scoring system was used in Task B, which captured the likely response of a species to the action, and the certainty associated with the response scores. Where no published evidence was available for a particular species and priority ELMS action, no score was attributed for Task B. This differs to Task A, where project team expert judgement was used to attribute likely scores to all actions for each species group if no evidence was found.

4.2 Methods

4.2.1 Scoring system

Scores were attributed for each priority action to capture the likely effect of the action on species abundance (first scores of 1-6), and the associated confidence in the first score (second score of 1-3, details in Table 10). Species scores were based on the available evidence, and where no evidence was available, the species was not scored for that action. Expert opinion was included where this was published and available (e.g. species factsheets for CS options).

Table 10. Main scoring codes for species evidence review

	Main score	Confidence score
1	Major benefit	1 High confidence
		2 Medium confidence
		3 Low confidence / uncertain
2	Minor benefit	1 High confidence
		2 Medium confidence
		3 Low confidence / uncertain
3	Minor disbenefit	1 High confidence
		2 Medium confidence
		3 Low confidence / uncertain
4	Major disbenefit	1 High confidence
		2 Medium confidence
		3 Low confidence / uncertain
5	No likely effect on this species	1 High confidence
		2 Medium confidence
		3 Low confidence / uncertain
6	Mixed effects on this species, no clear consensus	1 High confidence
		2 Medium confidence
		3 Low confidence / uncertain

4.2.2 Available evidence for species response scores

The evidence available to support attribution of scores for species-level effects of AES actions varied across the species groups reviewed.

For butterflies, the evidence reviewed in order to attribute scores included over 25 peer-reviewed published studies (e.g. Feber et al. 1996; Curtis et al. 2015; Kolkman et al. 2022), a Butterfly Conservation (BC) report on *Landscape-scale conservation for butterflies and moths* (Ellis et al. 2012), a recent *Conservation Evidence* report (Bladon et al. 2023), priority species and regional butterfly factsheets produced by BC (e.g. https://butterfly-conservation.org/our-work/species-and-habitat-factsheets/butterfly-factsheets) and Countryside Stewardship Prescription Sets as part of the Farmland Butterfly and Moth Initiative (FBMI) also produced by BC (https://butterfly-conservation.org/our-work/conservation-projects/england/the-farmland-butterfly-and-moth-initiative).

Scores for moth species were attributed using a handful of published papers where data was provided for a limited number of species in some of the supporting documentation (e.g. Merkcx et al. 2012; Froidevaux et al. 2019). In addition, a few BC priority species factsheets provided information on habitat management for a very small number of moth species that could be linked to actions: the species abundance indicator contains very few of these species as they are rare and often lack standardised long-term abundance data.

For bumblebees, the evidence for scoring was sourced from the published literature, including 23 peer-reviewed studies and technical reports (e.g. Carvell et al. 2004, 2007, 2011; Pywell et al. 2005; Redhead et al. 2016). Species-level evidence was generally scarce, as bumblebees are often treated as composite groups in the literature, but scores could be derived for almost all species.

The species-level evidence for mammals (excluding bats) was also very sparse, and no evidence was found for one species: the non-native invasive Fallow Deer. The best-evidenced species among the 14 peer-reviewed studies were focused on species of conservation concern, specifically the Hazel Dormouse (Trout et al. 2012; Scopes et al. 2024) and Brown Hare (e.g. Smith et al. 2004, 2005; Zellweger-Fischer et al. 2011).

There was very little species-level evidence for bats available for review under Task B. Scores were based on evidence from five published studies, and two species factsheets from the Bat Conservation Trust (BCT). The factsheets provided information on likely beneficial CS options for Greater and Lesser Horseshoe bats. BCT also completed a brief expert opinion-based review of the assessments. The evidence presented in this main report focuses on published evidence for bats, as for the other taxa. Scores from the BCT expert opinion-based review are in Appendix 1, for comparison to the evidence-based scores for bat species.

Scoring for birds was based on extensive published literature, including 48 peer-reviewed papers and two technical reports. Many of these studies focused on CS and SFI options that target farmland birds, and often considered more than one management option at a time (i.e., composite studies). Given the quantity and quality of this evidence base, additional evidence from other sources (non-peer-reviewed factsheets or websites) was not investigated.

A large amount of evidence was available for vascular plants, reflecting the very large number of species, habitats, actions and corresponding botanical studies. In addition to over 70 peer-reviewed studies, other available evidence for scoring was taken from the online documentation for Countryside Stewardship grants where these list native plant species in prescribed seed mixes, planting or species removal (e.g. https://www.gov.uk/countryside-stewardship-grants/nectar-flower-mix-ab1). However, no species-level evidence was found for 21% of the plant species.

4.2.3 Scoring summary tables

Summary tables of the scores that had been attributed to the species in each group are in Section 3.3 (Table 11-18). Note that options may be counted more than once in the Task B summary table for those options where multiple species were scored. For example, the confidence scores are summarised as number of actions scored as either high vs medium vs low for at least one species. If multiple species are scored with differing levels of confidence for any given option, the option will be counted in more than one confidence category (row) in the summary table.

4.3 CS and SFI 2023 species scoring results

4.3.1 Butterflies

Table 11. Counts of options per scoring category for butterfly species, for CS and SFI 2023 options.

BUTTERFLIES - 55 species in abundance indicator	Number of Countryside Stewardship options (out of 146)	Number of Sustainable Farming Incentive actions (out of 20)
No species level evidence (no score attributed for any species)	106	14
Scored beneficial for at least 1 species	40	6
Major benefit for at least 1 species	40	6
- major benefit for 1-2 species	16	2
- major benefit for 3-5 species	9	1
- major benefit for 6-10 species	7	2
- major benefit for 11-57 species	8	1
Minor benefit for at least 1 species	7	3
- minor benefit for 1-2 species	7	2
- minor benefit for 3-5 species	0	1
- minor benefit for 6-10 species	0	0
- minor benefit for 11-57 species	0	0
Scored disbenefit for at least 1 species	5	1
Major disbenefit	0	0
Minor disbenefit	5	1
Confidence in the main scores attributed		
- high confidence for at least 1 species	12	3
- medium confidence for at least 1 species	21	2
- low confidence for at least 1 species	37	6
Scored as no likely effect for at least 1 species	0	0
Scored as mixed effects / no consensus for at least 1 species	2	0

Species-level evidence for butterflies was not found for the majority of CS or SFI 2023 priority actions (Table 11), but more evidence was available for butterflies than for the other insect taxa (moths or bumblebees). Scores were attributed for at least one action for 45 butterfly species, out of 55 in the abundance indicator.

More than half of the butterfly species for which evidence of AES effects were found are priority species, and due to their specific habitat requirements require spatial targeting to achieve benefits from the suitable AES management options. This reflects the bias of evidence towards priority species that are generally rarer, have specialised habitat requirements and exhibit limited geographical distributions in the UK. They have been disproportionately studied in order to implement appropriate conservation management to mitigate and reverse declines in their populations. Where studies have focused on more generalised AES management it is rare that specific options are tested or that individual species are assessed. This is particularly the case with regards to population abundance where few species have high enough abundances to assess changes in the limited time of most academic studies and thus most evidence is limited to a small number of highly abundant species e.g. *Maniola jurtina*.

Only six actions were scored as likely to disbenefit one or more butterfly species. This largely reflects the type of studies/evidence that predominates the literature: many, such as the priority species fact sheets, focus entirely on a single species and the management options that will positively affect it. However, it is clear that some species must show disbenefits of those options that conflict with the suitable options, for example species that require short sward heights and areas of bare ground versus those that require longer sward heights, scrub and reduced grazing.

4.3.2 Moths

All of the moth species scored using priority species factsheets have restricted distributions, these actions would need to be spatially targeted to be effective. Spatial targeting was scored for all species groups in Task A.

Little evidence of AES efficacy was found for moths at the level of individual species. Only 40 (out of 446) indicator moth species were scored for one or more actions. Most (131 of the 145) of the CS actions could not be scored for any moth species. Confidence in those scores that could be attributed for moth species was generally low, with most scores in the low confidence category for both CS and SFI actions.

Actions scored as beneficial for more than one moth species related to woodland improvement, scrub control and reduced grazing intensity. No actions were scored as likely to disbenefit one or more moth species. This probably reflects the small evidence base for AES effects on moths and that in the few studies available, generally only positive effects are highlighted at species level.

Table 12. Counts of options per scoring category for moth species, for CS and SFI 2023 options.

MOTHS - 446 species in abundance indicator	**Number of Countryside Stewardship options (out of 146)**	**Number of Sustainable Farming Incentive actions (out of 20)**
No species level evidence (no score attributed for any species)	131	18
Scored beneficial for at least 1 species	15	2
Major benefit for at least 1 species	15	2
- major benefit for 1-2 species	11	2
- major benefit for 3-10 species	3	0
- major benefit for 11-100 species	1	0
- major benefit for 101-446 species	0	0
Minor benefit for at least 1 species	0	0
- minor benefit for 1-2 species	0	0
- minor benefit for 3-10 species	0	0
- minor benefit for 11-100 species	0	0
- minor benefit for 101-446 species	0	0
Scored disbenefit for at least 1 species	0	0
Confidence in the main scores attributed		
- high confidence for at least 1 species	1	0
- medium confidence for at least 1 species	4	0
- low confidence for at least 1 species	15	2
Scored as no likely effect for at least 1 species	0	0
Scored as mixed effects / no consensus for at least 1 species	0	0

4.3.3 Bumblebees

Table 13. Counts of options per scoring category for bumblebee species, for CS and SFI 2023 options.

BUMBLEBEES - 11 species in abundance indicator	**Number of Countryside Stewardship options (out of 146)**	**Number of Sustainable Farming Incentive actions (out of 20)**
No species level evidence (no score attributed for any species)	136	14
Scored beneficial for at least 1 species	8	6
Major benefit for at least 1 species	4	3
- major benefit for 1-2 species	1	2
- major benefit for 3-5 species	1	0
- major benefit for 6-8 species	1	0
- major benefit for 9-11 species	4	1
Minor benefit for at least 1 species	8	6
- minor benefit for 1-2 species	1	1
- minor benefit for 3-5 species	2	0
- minor benefit for 6-8 species	1	2
- minor benefit for 9-11 species	4	3
Scored disbenefit for at least 1 species	0	0
Confidence in the main scores attributed		
- high confidence for at least 1 species	5	4
- medium confidence for at least 1 species	7	5
- low confidence for at least 1 species	8	6
Scored as no likely effect for at least 1 species	7	5
Scored as mixed effects / no consensus for at least 1 species	0	0

Many (150) of the CS and SFI 2023 actions could not be scored for bumblebees. Confidence in scores that could be attributed for bumblebee species was moderate, with similar numbers of priority actions scored as high or medium confidence (9-12), but slightly more as low confidence (14), for at least one species.

Actions scored as beneficial for bumblebee species related to provision of floral resources (e.g. flower-rich margins and plots) and management and restoration of species-rich grassland. No actions were scored as likely to disbenefit bumblebee species. Seven actions were scored as likely to have no effect on bumblebee species, these included arable options such as whole crop cereals.

4.3.4 Mammals (excluding bats)

Table 14. Counts of actions per scoring category for mammal species (excluding bats), for CS and SFI 2023 options.

MAMMALS - 6 species in abundance indicator	**Number of Countryside Stewardship options (out of 146)**	**Number of Sustainable Farming Incentive actions (out of 20)**
No species level evidence (no score attributed for any species)	124	16
Scored beneficial for at least 1 species	20	4
Major benefit for at least 1 species	12	2
- major benefit for 1-2 species	11	2
- major benefit for 3-4 species	1	0
- major benefit for 5-6 species	0	0
Minor benefit for at least 1 species	9	2
- minor benefit for 1-2 species	9	2
- minor benefit for 3-4 species	0	0
- minor benefit for 5-6 species	0	0
Scored disbenefit for at least 1 species	2	0
Major disbenefit	2	0
- major disbenefit for 1 species	2	0
- major disbenefit for 2 or more species	0	0
Minor disbenefit	0	0
Confidence in the main scores attributed		
- high confidence for at least 1 species	1	0
- medium confidence for at least 1 species	16	2
- low confidence for at least 1 species	8	2
Scored as no likely effect for at least 1 species	0	0
Scored as mixed effects / no consensus for at least 1 species	0	0

Evidence scores were attributed for at least one mammal species for relatively few of the priority actions (20 CS actions and 4 SFI 2023). Confidence in those scores that could be attributed for mammal species was moderate to low overall, with more priority actions scored as medium confidence than either of the other two categories, but a substantial number of low confidence scores also attributed.

Actions scored as beneficial for mammal species in the abundance indicator included woodland and hedgerow management, and some sown arable options. Two actions were scored as likely to disbenefit at least one mammal species.

4.3.5 Bats

Table 15. Counts of actions per scoring category for bat species, for CS and SFI 2023 options.

BATS - 10 species in abundance indicator	**Number of Countryside Stewardship options (out of 145)**	**Number of Sustainable Farming Incentive actions (out of 20)**
No species level evidence (no score attributed for any species)	121	15
Scored beneficial for at least 1 species	22	4
Major benefit for at least 1 species	1	0
- major benefit for 1-2 species	1	0
- major benefit for 3-5 species	0	0
- major benefit for 6-10 species	0	0
Minor benefit for at least 1 species	21	4
- minor benefit for 1-2 species	19	3
- minor benefit for 3-5 species	2	1
- minor benefit for 6-10 species	0	0
Scored disbenefit for at least 1 species	0	0
Confidence in the main scores attributed		
- high confidence for at least 1 species	2	0
- medium confidence for at least 1 species	5	4
- low confidence for at least 1 species	16	0
Scored as no likely effect for at least 1 species	11	5
Scored as mixed effects / no consensus for at least 1 species	0	0

Few of the CS and SFI 2023 actions had evidence scores attributed for at least one bat species. Most of the actions scored as beneficial for one or more bat species were scored as having minor rather than major benefit, and thus may have limited effects on bat population growth, which may be driven more by other factors. Confidence in scores that could be attributed for bat species was mostly low; there was only high confidence for two CS options, and for no SFI options.

Actions scored as beneficial for bat species in the abundance indicator included hedgerow and tree-related options, grassland managements, and nectar/flower sown mixes. No actions were scored as likely to disbenefit bat species. This may be linked to the small amount of published evidence available for bat species responses to AES.

4.3.6 Birds

Table 16. Counts of actions per scoring category for bird species, for CS and SFI 2023 options.

BIRDS - 168 species in abundance indicator	Number of Countryside Stewardship options (out of 146)	Number of Sustainable Farming Incentive actions (out of 20)
No species level evidence (no score attributed for any species)	15	3
Scored beneficial for at least 1 species	129	17
- benefit for 1-2 species	7	0
- benefit for 3-5 species	12	1
- benefit for 6-10 species	34	2
- benefit for 11-20 species	55	11
- benefit for 21-30 species	21	3
- benefit for 31+ species	0	0
Scored disbenefit for at least 1 species	39	8
- disbenefit for 1-2 species	35	7
- disbenefit for 3-5 species	4	1
- disbenefit for 6+ species	0	0
Confidence in the main scores attributed		
- high confidence for at least 1 species	34	9
- medium confidence for at least 1 species	83	13
- low confidence for at least 1 species	129	17
Scored as no likely effect for at least 1 species	40	9
Scored as mixed effects / no consensus for at least 1 species	29	9

Evidence was found for 52 bird species during initial scoping. There was no evidence for the remaining 116 bird species on the abundance indicator. Species with the most evidence were farmland specialists, birds that are targets for CS and SFI options, including

Skylark (*Alauda arvensis,* 24 studies), Yellowhammer (*Emberiza citrinella*, 19), Reed Bunting (*Emberiza schoeniclus,* 15) and Linnet (*Linaria cannabina,* 14).

Most priority actions were scored for at least one bird species. Only 15 of the priority CS actions and three of the SFI actions did not have an evidence score attributed for any bird species. Just under a third of actions were scored as likely to disbenefit at least one bird species. There is more species-specific evidence for birds than for other groups, including more species-level evidence of disbenefits.

Despite the larger evidence base, scores attributed to birds were more frequently classed as low confidence, than medium or high confidence. In some instances, published evidence was for general management of a group of options (e.g. arable margins) such that the effects of individual options on birds could not be teased apart. In these cases, confidence was lower in attributing the results to specific CS or SFI actions.

Table 17. Major benefits and disbenefits for birds, scored with high confidence, with management actions grouped by habitat feature.

Habitat group	Number of actions	Total number of scores	Major benefit with high confidence (11)	% of scores	Major disbenefit with high confidence (41)	% of scores
Coastal	7	364	2	0.55	0	0
Pond	8	416	0	0	0	0
Crop cover	2	104	0	0	0	0
Food (Invertebrates)	15	780	12	1.54	1	0.13
Food (Seed)	8	416	14	3.37	0	0
Skylark	1	52	0	0	0	0
Stubble	4	208	8	3.85	0	0
Margins	5	260	7	2.69	5	1.92
Hedgerow	9	468	3	0.64	1	0.21
Grassland	24	1248	12	0.96	0	0
Grassland Wet	13	676	6	0.89	0	0
Lapwing	1	52	0	0	0	0
Upland	6	312	0	0	0	0
Heathland	3	156	0	0	0	0
Woodland	16	832	6	0.72	0	0
Tree	14	728	0	0	0	0
General environment	6	312	0	0	0	0
Other	24	1248	1	0.08	0	0

With a greater evidence base for birds, more detailed summaries regarding habitat features that are most beneficial for species could be generated. Management actions (CS and SFI, combined) were first grouped by habitat feature (Table 17), and the total number of scores within each feature were calculated (i.e. number of actions multiplied by the 52 species that were scored). Of these scores the number (and percentage of the total number of scores) which were assigned as a major benefit with high confidence (1,1) or a major disbenefit with high confidence (4,1) were determined. Overall, management actions pertaining to features in arable habitats were most frequently studied and have had the greatest benefit to birds, including: the provision of bird seed for granivorous species (14 scores were '1,1', 3.37 % of the total scores for the habitat feature), stubble retention (8 scores, 3.85 %) and the management of field margins (7 scores, 2.69 %). Conversely, actions pertaining to field margins were also found to have had the greatest disbenefits for bird species, with five instances (1.92 % of the total) scored as '4,1' (Table 17).

4.3.7 Plants

Most (165 of 209) of the indicator plant species were scored for at least one CS or SFI 2023 action (Table 18 below). Around half of the CS and SFI 2023 actions had evidence scores attributed for at least one plant species. Confidence in scores that could be attributed for plant species was moderate, with more priority actions scored as high or medium confidence for at least one species compared to a smaller number scored as low confidence.

Actions scored as beneficial for plant species in the abundance indicator included grass buffer strips and flower margins / patches, arable reversion to grassland, woodland management and restoration, and grassland management. Twenty actions were scored as likely to disbenefit at least one plant species. These were mainly habitat management actions that by their nature would disbenefit a species from another habitat – for example a scrub clearance action would inevitably reduce blackthorn (*Prunus spinosa*) abundance.

Table 18. Counts of actions per scoring category for plant species, for CS and SFI 2023 options.

PLANTS - 209 species in abundance indicator	**Number of Countryside Stewardship options (out of 146)**	**Number of Sustainable Farming Incentive actions (out of 20)**
No species level evidence (no score attributed for any species)	74	6
Scored beneficial for at least 1 species	68	14
Major benefit for at least 1 species	66	11
- major benefit for 1-10 species	54	9
- major benefit for 11-20 species	12	2
- major benefit for 21-50 species	0	0
- major benefit for 51-209 species	0	0
Minor benefit for at least 1 species	54	10
- minor benefit for 1-10 species	27	6
- minor benefit for 11-20 species	8	0
- minor benefit for 21-50 species	19	4
- minor benefit for 51-209 species	0	0
Scored disbenefit for at least 1 species	18	2
Major disbenefit	16	2
Minor disbenefit	8	0
Confidence in the main scores attributed		
- high confidence for at least 1 species	44	11
- medium confidence for at least 1 species	61	9
- low confidence for at least 1 species	11	3
Scored as no likely effect for at least 1 species	45	7
Scored as mixed effects / no consensus for at least 1 species	10	3

4.4 Conclusions

Across the seven species groups scored, the available evidence for efficacy of priority SFI and CS actions at species level was relatively sparse. More than half (580 out of 905) of the abundance indicator species did not have scores attributed for any action. This was due to a combination of lack of evidence, and AES management not being relevant for all species considered.

This should not be interpreted as meaning SFI 2023 and CS actions are unlikely to benefit abundance indicator species. In general, there is a gap between evidence of a general benefit to a species, or expert opinion to that effect, and evidence of specific relationship between management implementation and an abundance response. Task A scoring showed that when expert opinion is included, the majority of actions were scored as likely to be beneficial for one or more species in each group, or for community responses. This is also reflected in the specific expert-opinion-based review of the bat species scores that was conducted by the Bat Conservation Trust (Appendix 2 in Section 8.2 below).

The lack of available species-level evidence of CS and SFI action effects on many abundance indicator species may be a risk to delivery of the indicator targets, given that ELMS is a major conservation lever. Monitoring of ELMS is discussed in Section 5 below.

Task C – Assess the coverage of broader biodiversity targets by the ELMS priority actions

5.1 Introduction

5.1.1 Context and objective

The objective for Task C was to assess the coverage of broader biodiversity targets by the ELMS priority actions. The UK's Environmental Targets (Biodiversity) (England) Regulations 2022 include a legally binding wildlife-rich habitat restoration or creation target, and woodland and trees outside woodland cover target. Both these targets do not have a formal monitoring or reporting structure in place at the time of this project (Gov.UK[a] 2024). Here, we have developed a data collation process which is not an official method, to combine data sources for reporting progress to these targets. It must be noted that this methodology can only provide a rough estimate of the contribution of AES to meeting the targets. A more structured approach will be possible once an official reporting and monitoring structure is developed.

5.2 The wildlife-rich habitat restoration or creation target

The wildlife-rich habitat restoration or creation target aims to restore or create more than 500,000 hectares of a range of wildlife-rich habitats outside of protected sites by 2042. With an interim target to restore or create 140,000 hectares of a range of wildlife-rich habitats outside protected sites by 2028. Within this target ELMS actions are specifically mentioned as forming one component of habitat creation, along with other mechanisms of creation and restoration, such as Biodiversity Net Gain. Hall et al (2024) provide a detailed list of habitats included within this target. Agri-environment schemes or government grants are mentioned as counting towards the target because they are ‘reasonably expected to lead’ to the creation or restoration of wildlife-rich habitat that is of sufficient quality for the purpose of measuring progress towards the target (Hall et al 2024).

5.2.1 Broad approach

ELMS actions (from CS and SFI), where the principle objective was for habitat creation were matched to the habitats listed in the wildlife-rich habitat definitions and descriptions document (Hall et al 2024) (See appendix Table A8.3). Wildlife-rich habitats listed in the document, but not considered part of AES, were excluded e.g. 36 marine habitats (e.g. sub littoral zone, seagrass beds, gravel beds, intertidal boulder communities). While we report on uptake of current ELMS actions to create habitat that may contribute to this target, we cannot report on the likelihood of the target being met given the unknown effects of the other mechanisms considered in delivery of the target, e.g. Biodiversity net gain, grassroots rewilding projects etc and the absence of an official comprehensive monitoring and reporting approach for this target.

Improving the condition or quality of existing habitats is not included in the wildlife-rich habitat target requirements. ELMS management and maintenance actions that are specifically designed to improve habitat condition or prevent degradation of existing wildlife-rich habitats have therefore been excluded. However, features of some ELMS actions are agreement-specific in terms of the mechanism of delivery of either creating a new habitat or the improvement of an existing habitat. For example, when considering the restoration of upland moorland, both creation of a new habitat and the improved condition of an existing habitat may occur simultaneously within a habitat mosaic often on the same land parcel. Land management practices are similar to achieve both creation and restoration outcomes. Such options have not been included when considering the habitat target here, as accurate accounting of the areas is difficult. It does mean for some specific habitats (e.g. where a wildlife rich habitat occurs as a mosaic) AES may appear to have less contribution towards increasing the cover of such habitats in our summaries, than for other more spatially distinct habitat types.

Many options popular in AES that arise from environmentally friendly/regenerative practices, e.g. multi-species leys, overwinter stubble and those adopted to support an integrated pest management approach, are also not included in the metric as they do not appear within the wildlife-rich habitats in the target documentation. However, they are recognised as being important for biodiversity and other environmental policies.

In certain contexts, creation of wildlife-rich habitats will be to the detriment of other biodiverse and priority habitats, or be detrimental to archaeological or historical features, i.e. scrub creation. AES options do exist for scrub removal which may count against the habitat target, e.g. SB1; but it must be recognised that a balance is necessary between different priorities. Creation of successional areas and scrub has been included in calculations here for wildlife-rich habitats as this particular option is specifically designed to deliver for biodiversity and is not allowed to be implemented on other priority habitats.

Publicly available ELMS uptake data (Gov.UK[b] 2024) (as of 1st April 2024) for CS and SFI were used for relevant options with area uptake reported in hectares (ha). Hedgerow uptake was converted to hectares from metres (assumption of hedge width 1.5m). This dataset contains all ELMS options valid and under agreement at this time. Historical uptake data in the same format are not publicly available and therefore a comparison for those wildlife-rich habitat creation options pre and post 2023 legislation has not been possible. The resulting figure may therefore be an overestimate of the contribution of AES to the target as some habitat will have been in place before 2023 (although the quality of this habitat and if it reached wildlife-rich status is unknown). Comprehensive mapping and monitoring of these habitats is required to gain more accurate figures, plans are being developed by Natural England and Defra to address this.

Options that may contribute towards the target but are without an area coverage within the uptake data are not considered here (e.g. Pond management (less than 100 square metres) WN5), as payment is made per item and therefore not recorded as an area payment. In terms of area coverage these ponds and water bodies are likely to be small in comparison of whole land parcels. However, within 1500 CS agreements there are currently 4300 ponds under construction with a capital works grant. These ponds and other water bodies also reported as units will contribute towards total area of wildlife rich habitats in the future; other methods of recording their actual size contribution will need to be devised to include them appropriately when calculating final areas in 2042.

5.2.2 Results – Wildlife-rich habitat target

Table 19 outlines the total uptake in hectares for the wildlife rich habitats that are to be created through ELMS (SFI 2023 and CS) actions and would be reasonably assumed to contribute towards the target. Woodland and arable margin habitats make up the highest proportion of habitats supported by agri-environment scheme creation. Table A8.3 has breakdown of which AES actions have been attributed to each wildlife-rich habitat.

Table 19. Area of ELMS (CS and SFI 2023) options that are designed to create wildlife-rich habitats (uptake data taken in July 2024). This table excludes existing ES creation options which would fall outside the time frame for contribution towards the target.* hedgerow data are converted from meters to hectares based on average hedgerow width of 1.5m.

Wildlife rich habitat	Scheme	Uptake (ha)
Arable field margins	CS	132400
	SFI 23	86000
Broadleaved, Mixed and Yew Woodland	CS	145900
Coastal and floodplain grazing marsh	CS	700
Coastal Saltmarsh and saline reedbeds	CS	10
Grassland	CS	2400
Hedgerows *	CS	975
Lowland fens	CS	400
Lowland heathland	CS	100
Neutral grassland – peat	CS	40
Standing open waters	CS	90
Traditional orchards	CS	200
Wood-pasture and parkland	CS	2900
Total		372115

Table 20. Wildlife-rich habitats and SFI 2024 actions that could contribute towards the wildlife-rich habitat target.

Wildlife-rich habitat	SFI 2024 Action
Arable field margins	Beetle banks
	Cultivated areas for arable plants
	Flower-rich grass margins, blocks, or in-field strips
	Pollen and nectar flower mix
	Winter bird food on arable and horticultural land
	Winter bird food on improved grassland
Broadleaved, Mixed and Yew Woodland	Creation of successional areas and scrub

There is no mention of duration within target supporting documents, e.g. how long a habitat should be in the ground for before it is deemed suitable for the wildlife rich-habitat target. This is especially important when thinking of ephemeral habitats such as bird seed, pollen and nectar margins, or those harder to create e.g. Species-rich grassland/Heathland. CS agreements run for 5 years, SFI 2023 agreements for 3 years. Margins will be in ground for that time period, after which future Government agriculture funding structure, farming economics or global changes may alter the area contributing to the target.

5.3 The environmental targets (woodland and trees outside woodland) (England)

5.3.1 Context

The target for woodland and trees outside woodland aims to increase the combined canopy cover of woodlands and trees outside woodlands in England to 16.5% by 31 December 2050. Current values of woodland in England in 2024 as a good baseline for the target to work from are calculated and reported through National Forest Inventory Statistics 2024 (NFI) (Brady 2024). Brady (2024) estimates this to be 1338 thousand hectares which accounts for 10% canopy cover. Around 16 thousand hectares of publicly funded woodland restocking were reported in the UK in 2023/24.

Canopy cover is calculated for NFI statistics. It is calculated by combining the measurements collected during field survey with the area and general woodland composition data derived from the NFI woodland map; and reports all woodland over 0.5 ha in size and at least 20 m width. 3,128 hectares reported as planted in England in 2022/23 – which is a 40 percent increase on the previous year (Brady 2024).

5.3.2 Broad approach - Canopy cover in England

AES option and actions were selected if their specific objective or aim was to create new woodland or to plant trees outside of woodland (including those within hedgerows, but not

hedgerows themselves) see full list in Appendix 8.4. Restoration options have been included for this target (unlike for the wildlife-rich habitat target) as the aims often align with increasing canopy cover or number of trees e.g. WD5 Restoration of lowland wood pasture and parkland -
*"If successful there will be many of the following - **Additional** semi-mature or mature trees that will provide continuity of the tree population, **Newly planted** trees, spaced evenly with open crowns or patches of regeneration with space to allow open grown crowns to develop".*

Including the uptake data for this option and other restoration options in the analysis here might result in a slight over-estimate of woodland canopy cover if such areas are already accounted for in national canopy statistics. However, it was thought important to be inclusive as these habitats are important and will make important contributions when additional trees reach maturity.

Some wooded areas within an agricultural landscape may be smaller than those used in the national calculations (e.g. areas of scrub, shelter belts etc. may fall under the 20m width and 0.5ha in size), however we have included all areas in the following calculations as uptake data are provided in totals for England format. Breaking down total uptake data for AES into those areas that are large enough to feature within the woodland canopy targets would be time consuming and costly.

Total values in either numbers of trees (units) or hectares have been summarized using publicly available AES uptake data (Gov.UK[b] 2024) (Table 21). A stocking density of an average broad-leaved newly planted woodland is 1600 trees per hectare, this planting density has been used to calculate the approximate area for all AES trees outside of woodland as if they were planted as one block. Trees planted within hedgerows have been estimated cover using a tree every 2.5m. Survival rates for individual trees and their eventual canopy cover depend on species specific attributes, planting characteristics and site selection elements, and therefore the figure given for the area of trees is only an approximation.

5.3.3 Results – Woodlands and trees outside woodland target

Table 21. Uptake area from Countryside Stewardship (CS), Legacy Environmental Stewardship (ES) woodland creation options and Environmental land management scheme (ELMS) tree planting options converted to area. **an approximate area based on stocking density of 1200 trees per hectare.

Description	Area (ha)	Scheme
Woodland Creation	165000	CS
Woodland Creation	19680	ES
Tree planting	3035**	ELMS (CS and SFI)
Total	188315	

ELMS SFI 2024 options are not included as no current uptake data is available. There is potential for SFI 2024 options such as agro-forestry to contribute towards the total canopy cover.

The potential 188315 ha of combined woodland creation and tree planting is a 14% potential increase of woodland area under AES, which would see agri-environment schemes contribute towards the canopy 2050 target. There are other government initiatives which will also aid movement towards this target e.g. uplifts in England Woodland Creation Offer (EWCO) payments, these offer farmers and land managers more targeted tree-planting incentives, there is also a Woodland Creation Fast Track initiative to speed up tree planting rates.

5.4 Summary

(1) Wildlife-rich habitat interim EIP23 target

Current uptake of relevant ELMS (CS and SFI 2023) actions is likely to substantially contribute to meeting the interim Wildlife-rich habitat EIP23 target, to restore or create 140,000 hectares of a range of wildlife-rich habitats outside protected sites by 2028. The longer-term, 2042, target cannot be assessed with current ELMS and ES uptake, as agreements last 3-10 years.

(2) Woodland and trees outside woodland target

The contribution of ELMS (CS and SFI 2023) actions to meeting this target is difficult to assess without data on the tree species being planted, where they are being planted and relevant survival rates. However, given current uptake rates, CS woodland creation and tree planting options are likely to contribute to meeting the target to increase the combined canopy cover of woodlands and trees outside woodlands in England to 16.5% by 31 December 2050.

6. Discussion

6.1 Wider factors affecting AES uptake and implementation

AES uptake is affected by a wide range of factors, including social factors (e.g. Mills 2023, Coyne et al. 2021, Ingram et al. 2013), the advice and training offered to farmers (Mills et al. 2021), spatial factors (Wool et al. 2023), how straightforwardly the AES management fits into existing farm operations (Staley et al.2018), AES payment rates and farm incomes (Harkness et al. 2021). There is a substantial evidence base on AES uptake rates, a full review of which is outside the scope of this study. A brief summary of a key review paper is given here, followed by a detailed case study for a particular CS option (AB14).

Social factors that may contribute to engagement with were reviewed recently, through a systematic literature review of 352 articles and additional grey literature (Mills et al. 2021). This review led to the development of 20 indicators for evaluations of social dimensions of agri-environment schemes, including the social wellbeing impact of scheme engagement (Mills et al. 2021). The indicators were clustered in three groupings (Mills et al. 2021). Willingness to Engage indicators included Interest in / Awareness of Environment; Attitudes and Beliefs about Farming (Self-Identity); Engagement with Advice and Training and Level of AES Experience. Capacity to Engage Indicators included Succession Status; Lifecycle; Land Manager Education, Farm Tenure and Financial Security. Indicators in the Farmer Relations with Others grouping included Bonding Social Capital; Bridging Social Capital; Linking Social Capital and Cultural (Symbolic) Capital (Mills et al. 2021). This detailed review demonstrates the range of social factors that can affect engagement with AES, and are therefore likely to impact uptake rates.

Payment rates and mechanisms are critical to the attractiveness of specific options and will affect both uptake and outcomes (Tyllianakis et al. 2021). In particular, calculations of income foregone that underpin payments have necessarily been imperfect in terms of accuracy for some management contexts, for example as input and crop prices vary, so using an option can move from being welcome insurance of income to an opportunity cost from an inability to exploit favourable market conditions. As a result, it is difficult to predict AES effectiveness at the scheme level, regardless of the evidence base at the option level and any evidence that is available for the quantities of option-based resources that are expected to be needed to meet scheme targets. Moreover, the extent to which such issues affect individual options will vary with the specific economic and social context, as they are relevant to the particular management involved.

Much of the established literature reviewed by Mills et al. (2021) addresses AES scheme engagement at a broad level, with less literature on social factors at the option scale. Detailed investigations of these issues are limited, to date, to a small number of options within Countryside Stewardship. Projects are currently in progress investigating, first, AB9 Winter Bird Food (Defra Project LM04154), and, second, winter stubble management options (AB2 Basic Overwintered Stubble, AB6 Extended Stubble and SW6 Cover Crops; Defra Project LM04188). The former was expected to report in time to contribute to this report, but a second season of agronomy surveys was conducted in 2024 and analyses are still in progress. The second will report in 2025. However, a previous project considered AB14 Harvested Low Input Cereal Plots (Siriwardena et al. 2023, Defra Project LM04135), this is detailed in the following paragraphs as a case study.

For AB14, attitude surveys were conducted for all AB14 farmers in the chosen sample and also for a sample of non-AB14 CS agreement-holders, to consider why others did not take up the option. Most agreement holders interviewed with the AB14 option had a positive attitude to the option and intended to include it in future agreements. Organic agreement holders, in particular, felt that the AB14 fitted well with their existing farming system and the payment rate was adequate. The main reasons selected in the online survey for not taking up the AB14 option were inadequate financial payments to cover losses, weeds issues and lack of fit with the existing farm system/crop rotations. It is not surprising that fit to farming systems is a key driver of uptake, but AB14 is an arable option and the popularity with organic and livestock farmers reflects use of the crop for whole-crop silage, not as an arable (grain) product. A quarter of agreements with AB14 were at least part-organic; 46% of farms were in arable farms, 14% grass-dominated farms and 40% mixed farms, reflecting a disproportionate selection by non-arable farmers. Overall, it was clear that arable farmers have not taken up the option to a wide extent, despite the overall aim of the option to enhance arable farmland for wildlife. More favourable payments might increase uptake by arable farmers, but it is likely that the option would be viewed as taking land out of production, as opposed to subsidising a less profitable crop.

Some responses in the online survey showed a lack of awareness of the AB14 option and its requirements; for example, there was unawareness that the option is available for organic farms. Better promotion of the AB14 option would help here, and potentially with other options too, clarifying rules and benefits in ways that communicate effectively with time-poor and perhaps disinterested farmer audiences. The use of case studies and peer-to-peer exchange could be helpful. Issues with compliance with option guidelines indicate that improved guidance is required, or at least better communication of existing guidance, making a clear distinction between advisory and mandatory requirements and providing management guidance on achieving the target number of tillers and effective weed control options on different soil types.

Conventional farmers are deterred from taking up the AB14 option due to concerns about increasing the weed burden of the more pernicious weeds. Availability of some form of minor temporary adjustment to control pernicious weed problems, such as black-grass and sterile brome, could encourage uptake. This would entail a revision of the option prescription.

For conventional farmers, the AB14 option requires an adjustment in mindset to the ‘messy’ appearance of the crop due to the presence of weeds. This concern is partly exacerbated by fear of judgement by others as part of the ‘roadside’ farming mentality. Low input cereal options, such as AB14, need to become more accepted as part of ‘good farming’ practice. Currently, other options are perceived as an easier fit for the farm system and to be more environmentally effective. This kind of cultural shift is likely to be difficult to achieve, however.

Not all of the issues with AB14 are likely to be relevant to the uptake of other options, but the principles of fit to farming system and economics will be general, while enhancing awareness of option rules and benefits is likely to provide general benefits.

The quality of AES implementation can also be affected by social factors. For example, McCracken et al. (2015) found that the quality of wild bird food and pollen and nectar habitats created under AES were affected by farmers previous experience of environmental management, their motivations and confidence in their ability to carry out the AES management. A resurvey of Higher Level Stewardship AES found agreement holder characteristics were linked to environmental outcomes in some grassland and woodland options, but not across all the HLS options surveyed (Staley et al. 2018).

There is potential for the creation of additional habitats under AES to lead to trade-offs with farm productivity, if land is taken out of production for AES management. However, many AES options are focussed on improving the quality of existing habitats, rather than creating new ones. Wool et al. (2023) investigated spatial factors in relation to the position of a range of Countryside Stewardship (CS) options. Most of the CS options analysed were placed in unproductive areas of fields or farms, which will minimise any trade-offs with crop production (Wool et al. 2023). In addition, there is potential for management under AES to support ecosystem services linked to productivity. Pywell et al. (2015) found that implementing arable AES options that support both pollination and pest control (wild-flower strips for pollinators and grass margins to support over-wintering predators) on 3% or 8% of land did not reduce crop yield, and for some crops yield was increased, on an arable farm in Oxfordshire. Apart from this study there is little direct evidence on trade-offs between AES and productivity, and as Pywell et al. (2015) demonstrated relationships may be crop-specific and complex to predict. There is a need for more research in this area, to provide empirical evidence on whether trade-offs do exist between AES and production across a wider range of farming systems and crops.

6.2 Monitoring of AES

There are various options for monitoring the performance of AES options and entire agreements or schemes, and past evaluation work reflects this range. Important considerations in monitoring design include spatial scale, temporal change versus spatial association and choice of counterfactual. There is no single, best design, but it is important that the type of inference that particular approaches support is understood. The history of use of these approaches means that appropriate statistical methods for analyses are well-developed.

Agri-environment schemes are monitored within England to assess the quality of option implementation and for biodiversity, the effects of AES on key target taxa (Waygood 2024). National option and agreement implementation surveys have been carried out for Countryside Survey and earlier AES (Environmental Stewardship). In some cases both baseline and resurveys to assess change under AES were conducted (e.g. Higher Level Stewardship agreement and option monitoring at baseline and a resurvey after 5 years, Mountford et al. 2013, Staley et al. 2018). These option and agreement surveys are usually focussed on whether the option has been created or managed as per the AES option prescriptions, and on the resulting habitat quality (condition) and plant communities (e.g. Jones et al. 2019). The quality of AES habitats may have an effect on species groups within the abundance indicator, where they are the target of AES options, but the response of these species groups has not always been monitored within projects focussed mainly on AES implementation.

In addition to AES agreement and option implementation monitoring, several projects have investigated the effect of AES on key species groups that are the target of AES management. Several of these key species groups are included in the abundance indicator, hence AES monitoring is likely to inform on AES effects on abundance indicator species. Perhaps the simplest approach is to measure biodiversity responses on option patches (typically managed fields or part-fields), typically by comparison to non-scheme counterfactuals. This can involve purely spatial responses, i.e. comparing at a single time point, or tracking changes in patches over time. Note that these alternatives may be effectively the same thing for less mobile species, when it can be assumed that AES patches and counterfactuals had the same starting state. This approach is attractive because the effects of individual management options can be seen clearly. Its weaknesses are that it may only record a redistribution of mobile species, as opposed to a genuine increase in local populations, that the scale is often small relative to animal home ranges, such that option use is difficult to separate from the effects of landscape context, and that meaningful counterfactuals (i.e. the land-use that would be in place if the option were not used) can be difficult to find or to access. Nevertheless, this approach has been taken in many projects, including recent evaluations of CS options WD2, AB14 and AB9, as well as ongoing study of AB6, AB2 and SW6.

In order to account for the spatial scale and mobility issues described above, as well as to minimise dependence on unmanaged counterfactuals (of which researchers and agencies typically have no control), monitoring can consider larger areas, comparing those with higher and lower quantities of taxon-relevant management, as are determined along pre-determined gradients. This approach should be realistic in terms of fit to the scales at which many target taxa use landscapes and also robust to variations in AES uptake along the gradient, i.e. changes at the levels of individual farms or fields will have little effect. The approach can be used spatially or to evaluate temporal changes, but weaknesses include a vulnerability to wholesale changes in management over time, such as scheme revisions, and an intrinsic lack of specificity with respect to individual options, which limits applicability to evaluation at the option level (as opposed to whole schemes). The counter-argument to the latter is that, given the scale issue described above, it may not be meaningful to evaluate at the option level, without integration with management and habitat at the landscape scale. This approach has been used for the Defra-funded LandSpAES project, with monitoring of multiple taxa, as well as for AES monitoring projects in Wales (ERAMMP) and Northern Ireland (bird monitoring funded by DAERA).

The Landscape-scale species monitoring (LandSpAES, Staley et al. 2022) baseline survey monitored species of birds, bats, butterflies, moths, bees and hoverflies in response to AES management at local and landscape scales (Staley et al. 2022). A potential resurvey of the same sites would allow change in abundance of these species to be analysed in relation to the AES management at these two scales. Other AES monitoring studies have focussed on one or two species, or species groups relevant to the abundance indicator. For example, Brereton et al. (2017) studies the effects of grazing management under Higher Level Stewardship on the Chalkhill Blue butterfly (*Polyommatus coridon*), and Staley et al. (2018) investigated the effects of AES hedgerow options on Brown Hairstreak butterflies.

Long-term national monitoring schemes, while not designed to monitor the effects of AES, have in some instances been used to assess AES effects on species groups within the abundance indicator. For example, Baker et al. (2012) used data from the substantial Breeding Bird Survey, which covers around 2000 km squares, to assess population change in bird species in response to uptake of Environmental Stewardship AES at multiple spatial scales. Strong associations were found between uptake of options to provide winter food resources for birds and population growth of granivorous birds (Baker et al. 2012). However, not all national monitoring schemes are suitable for assessing the impacts of AES on species, either due to the smaller size of the scheme or there not being sufficient contrast in AES uptake across the sites being monitored (Oliver 2014, Jarvis et al. 2021). The issue of a lack of specificity to individual options also applies here and a major constraint is that sampling is independent of AES uptake, meaning that contrasts between quantities of management cannot be guaranteed and that such evaluations will only ever be feasible for widespread management that is commonly sampled by chance and, indeed, for species that are sufficiently widespread to generate sample sizes that support robust analyses. Bespoke monitoring that is designed to assess the impacts of AES on the abundance indicator species groups is needed.

Across all of the monitoring approaches described above, a further consideration is the choice of metrics for evaluation. Data are typically collected at the species level and provide information on abundance or a proxy thereof. Variation in ecology means that responses to management and other environmental variation will generally be species-specific, so it is ideal if evaluation can be at the species level. However, species responses may be too numerous to be tractable for policy purposes or so variable that a ‘signal’ for management effects cannot readily be extracted. In these cases, multi-species metrics such as a diversity index or total abundance for a guild may be more useful. As with the choice of field sampling approach, there is no right or best metric to use, but it is important that the properties of metrics are understood. For example, higher diversity may not be desirable, depending on the system concerned, and total abundance of a guild could be increased via the numbers of an undesirable species. The same issues affect multispecies indicators, such as the species abundance indicator, and these are also likely not to be rapidly responsive to management effects, because some species will decline while others increase, leading to a tendency towards little change, even if desirable species are responding positively in the short or medium term.

6.3 Conclusions

Scoring under Task A showed the likely benefit of the majority of the ELMS (CS and SFI 2023) options assessed to terrestrial species groups within the abundance indicator, despite considerable variation between species groups in the amount and types of empirical evidence available to support the scoring. Scoring under Task B was carried out to capture likely effects of ELMS options on abundance change in individual species within the indicator, and was more stringent in that it was based on published evidence (peer-reviewed empirical studies and grey literature / species factsheets where available), without the addition of project team expert opinion. Task B scoring results showed substantial gaps in the available evidence for AES effects on abundance of individual species, for many of the species groups in the indicator. This lack of evidence is a risk, in relation to how ELMS may help to deliver the abundance indicator targets.

The species abundance indicator scoring in this project focussed on terrestrial species, due to the links to the QEIA project (Section 2.3 above). A future assessment of the likely effects of AES on the abundance of freshwater species within the abundance indicator is needed to fill this gap.

Uptake of some options under ELMS was shown to contribute substantially to two other EIP targets, wildlife-rich habitat interim target and woodland and trees outside woodland target. However, these results need to be caveated, as some of the current option uptake may have started before 2023.

Ongoing and upcoming monitoring, such as a resurvey of the Landscape-scale species monitoring of AES sites (if confirmed), will help to fill some of the gaps in understanding of how ELMS may affect abundance change for a substantial number of indicator species. However, additional modelling would need to be carried out to assess the contribution of ELMS to abundance indicator targets, potentially including data from some of the long-term, national species monitoring schemes.

7. References

Aebischer N.J., Green R.E. & Evans A.D. (2000) From science to recovery: four case studies of how research has been translated into conservation action in the UK. In: J.A. Vickery, P.V. Grice, A.D. Evans & N.J. Aebischer (eds.) *The Ecology and Conservation of Lowland Farmland Birds*. British Ornithologists' Union, Tring. 140-150.

Albrecht, H., Cambecedes, J., Lang, M. & Wagner, M. (2016) Management options for the conservation of rare arable plants in Europe. *Botany Letters*, 163, 389-415. https://doi.org/10.1080/23818107.2016.1237886

Amar, A., Davies, J., Meek, E., Williams, J., Knight, A. &Redpath, S. (2011) Long-term impact of changes in sheep *Ovis aries* densities on the breeding output of the hen harrier *Circus cyaneus*. *Journal of Applied Ecology*, 48, 220-227.

Aschwanden, J., Holzgang, O. & Jenni, L. (2007) Importance of ecological compensation areas for small mammals in intensively farmed areas. *Wildlife Biology*, 13, 150-158.

Aviron, S., Herzog, F., Klaus, I., Schüpbach, B. and Jeanneret, P. (2011), Effects of wildflower strip quality, quantity, and connectivity on butterfly diversity in a Swiss arable landscape. *Restoration Ecology*, 19, 500-508. https://doi.org/10.1111/j.1526-100X.2010.00649.x

Baker, D. J., S. N. Freeman, P. V. Grice, and G. M. Siriwardena. 2012. Landscape-scale responses of birds to agri-environment management: a test of the English Environmental Stewardship scheme. *Journal of Applied Ecology* 49:871-882. https://doi.org/10.1111/j.1365-2664.2012.02161.x

Batáry, P., Báldi, A., Sárospataki, M., Kohler, F., Verhulst, J., Knop, E., Herzog, F. & Kleijn, D. (2010) Effect of conservation management on bees and insect-pollinated grassland plant communities in three European countries. *Agriculture Ecosystems and Environment*, 136, 36-39.

Blumgart, D. (2021) *Investigating the Mechanisms Behind Moth Declines: Plants, Land-use and Climate*. PhD thesis. Lancaster University (United Kingdom).

Braby, D. (2024) *Forestry Statistics 2024*. https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2024/

Breitsameter, L, Kayser, M, Strodthoff, J, Müller, J &Isselstein, J (2017) Performance of extensive cattle stocking on a reclaimed minerotrophic wet grassland. *Mires and Peat*, 19, 1-10.

Brereton, T. M., M. S. Warren, D. B. Roy, and K. Stewart. 2007. The changing status of the Chalkhill Blue butterfly *Polyommatus coridon* in the UK: the impacts of conservation policies and environmental factors. *Journal of Insect Conservation*, 12, 629-638. https://doi/org/10.1007/s10841-007-9099-0

Broughton, R.K., Bullock, J.M., George, C., Hill, R.A., Hinsley, S.A., Maziarz, M., Melin, M., Mountford, J.O., Sparks, T.H. & Pywell, R.F. (2021) Long-term woodland restoration on lowland farmland through passive rewilding. *PLOS ONE*, 16, e0252466. https://doi.org/10.1371/journal.pone.0252466

Broughton, R.K., Bullock, J.M., George, C., Gerard, F., Maziarz, M., Payne, W.E., Scholefield, P.A., Wade, D., Pywell, R.F. (2022) Slow development of woodland vegetation and bird communities during 33 years of passive rewilding in open farmland. *PLOS ONE*, 17, e0277545. https://doi.org/10.1371/journal.pone.0277545

Broughton, R. K., Parry, W., & Maziarz, M. (2020) Wilding of a post-industrial site provides a habitat refuge for an endangered woodland songbird, the British Willow Tit *Poecile montanus kleinschmidti*. *Bird Study*, 67, 269–278. https://doi.org/10.1080/00063657.2020.1863333

Bubova T., Vrabec V., Kulma M. & Nowicki P. (2015) Land management impacts on European butterflies of conservation concern: A review. *Journal of Insect Conservation*, 19, 805-821

Buckingham, D.L, Evans, A.D., Morris, A.J., Orsman, C.J. & Yaxley, R. (1999) Use of set-aside land in winter by declining farmland bird species in the UK. *Bird Study*, 46, 157-169. https://doi.org/10.1080/00063659909461127

Buri, P, Humbert, J-Y and Arlettaz, R (2014) Promoting pollinating insects in intensive agricultural matrices: field-scale experimental manipulation of hay-meadow mowing regimes and its effects on bees. *PLoS ONE*, 1, e85635.

Burns, F., M. A. Eaton, I. J. Burfield, A. Klvaňová, E. Šilarová, A. Staneva, and R. D. Gregory (2021). Abundance decline in the avifauna of the European Union reveals cross-continental similarities in biodiversity change. *Ecology and Evolution*, 11, 16647-16660.

Carvell, C. (2000) *Studies of the distribution and habitat requirements of Bombus sylvarum (the Shrill Carder Bee) and other bumblebees at Castlemartin Range, Pembrokeshire and Kenfig National Nature Reserve, Glamorgan and surrounding areas*. Countryside Council for Wales, Bangor, UK.

Carvell, C., Meek, W.R., Pywell, R.F. & Nowakowski, M. (2004) The response of foraging bumblebees to successional change in newly created arable field margins. *Biological Conservation*, 118, 327-339. https://doi.org/10.1016/j.biocon.2003.09.012

Carvell, C., Meek, W.R., Pywell, R.F., Goulson, D. & Nowakowski, M. (2007) Comparing the efficacy of agri-environmental schemes to enhance bumblebee abundance and diversity on arable field margins. *Journal of Applied Ecology*, 44, 29-40. https://doi.org/10.1111/j.1365-2664.2006.01249.x

Carvell, C., Osborne, J.L., Bourke, A.F.G., Freeman, S.N., Pywell, R.F. & Heard, M.S. (2011) Bumble bee species' responses to a targeted conservation measure depend on landscape context and habitat quality. *Ecological Applications*, 21, 1760 - 1771. https://doi.org/10.1890/10-0677.1

Carvell, C., Pywell, R.F., Heard, M.S. & Meek, B. (2006) The potential value of Environmental Stewardship Schemes for the BAP bumblebee, *Bombus ruderatus* (Fabricius) (Hymenoptera: Apidae). *Entomologist's Gazette*, 57, 91-97.

Carvell, C., Bourke, A.F.G., Dreier, S., Freeman, S.N., Hulmes, S., Jordan, W.C., Redhead, J.W., Sumner, S., Wang, J. & Heard, M.S. (2017) Bumblebee family lineage survival is enhanced in high-quality landscapes. *Nature*, 543, 547-549. https://doi.org/10.1038/nature21709

Casey, D., Fuller, R., Baker, J., Hawkins, J. & Roughton, J. (2020) Opportunities for wildlife through small-scale wilding in lowland farmed landscapes. *British Wildlife*, 31, 179-187.

Clarke, J.H., Jones, N.E., Hill, D.A. & Tucker, G.M. (1997) The management of set-aside within a farm and its impact on birds. *Proceedings - Brighton Crop Protection Conference*, Brighton, 1, 1179-1184.

Clarke, J.H., Cook, S.K., Harris, D., Wiltshire, J.J.J., Henderson, I.G., Jones, N.E., Boatman, N.D., Potts, S.G., Westbury, D.B., Woodcock, B.A., Ramsay, A.J., Pywell, R.F., Goldsworthy, P.E., Holland, J.M., Smith, B.M., Tipples, J., Morris, A.J., Chapman, P. and Edwards, P. (2007). *The SAFFIE Project Report*. ADAS, Boxworth, UK.

Clarke, S.A., Robertson, P.A. (1993). The relative effects of woodland management and pheasant *Phasianus colchicus* predation on the survival of the pearl-bordered and small pearl-bordered fritillaries *Boloria euphrosyne* and *B. selene* in the south of England. *Biological Conservation*, 65, 199-203. https://doi.org/10.1016/0006-3207(93)90053-4.

Critchley, C.N.R., Fowbert, J.A., Sherwood, A.J. & Pywell, R.F. (2006) Vegetation development of sown grass margins in arable fields under a countrywide agri-environment scheme. *Biological Conservation*, 132, 1-11. https://doi.org/10.1016/j.biocon.2006.03.007

Curtis, R.J., Isaac, N.J.B. (2015) The effect of temperature and habitat quality on abundance of the Glanville fritillary on the Isle of Wight: implications for conservation management in a warming climate. *Journal of Insect Conservation* 19, 217–225. https://doi.org/10.1007/s10841-014-9738-1

Defra (2024). *Landscape Recovery: building long-term agreements.* Defra Farming Blog, Feb 2024. https://defrafarming.blog.gov.uk/2024/02/12/landscape-recovery-building-long-term-agreements/

Defra (Department for Environment, Food and Rural Affairs), Defra (Northern Ireland), Welsh Government, Knowledge and Analytical Services, The Scottish Government, Rural and Environment Science and Analytical Services. 2023a. *Agriculture in the United Kingdom 2022*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1170953/auk-2022-13jul23i.pdf

Defra (2023b) *Environmental Land Management (ELM) update: how government will pay for land-based environment and climate goods and services*. Policy paper. https://www.gov.uk/government/publications/environmental-land-management-update-how-government-will-pay-for-land-based-environment-and-climate-goods-and-services/environmental-land-management-elm-update-how-government-will-pay-for-land-based-environment-and-climate-goods-and-services

Defra (2023c). *Qualitative impact assessment of land management interventions on Ecosystem Services - AQ0858*. UK Centre for Ecology and Hydrology and partners. Final report to Defra. https://randd.defra.gov.uk/ProjectDetails?ProjectId=21327

Defra (2022). *Biodiversity Terrestrial and Freshwater Targets - Detailed Evidence Report*. https://consult.defra.gov.uk/natural-environment-policy/consultation-onenvironmentaltargets/supporting_ documents/Biodiversity%20 terrestrial%20and%20freshwater%20targets%20%20Detailed%20evidence%20report.pdf

Defra (2020). *The path to sustainable farming: an agricultural transition plan 2021 to 2024.* https://assets.publishing.service.gov.uk/media/60085334e90e073ec94cc80b/agricultural-transition-plan.pdf

Delattre, T., Vernon, P., & Burel, F. (2013). An agri-environmental scheme enhances butterfly dispersal in European agricultural landscapes. *Agriculture, Ecosystems & Environment*, 166, 102-109. https://doi.org/10.1016/j.agee.2011.06.018

de Snoo G.R., van der Poll R.J. & Bertels J. (1998) Butterflies in sprayed and unsprayed field margins. *Journal of Applied Entomology* (formerly Zeitschrift für angewandte Entomologie), 122, 157-161.

Dicks, L.V., Ashpole, J., Danhardt, J., James, K., Jonsson, A., Randall, N., Showler, D., Smith, R., Turpie, S., Williams, D. & Sutherland, W. (2013) *Farmland Conservation: Evidence for the effects of interventions in northern and western Europe*. Pelagic Publishing, Exeter, UK.

Donald, P.F., Evans, A.D., Muirhead, L.B., Buckingham, D.L., Kirby, W.B. & Schmitt, S.I.A. (2002) Survival rates, causes of failure and productivity of skylark *Alauda arvensis* nests on lowland farmland. *Ibis*, 144, 652-664.

Dover, J.W., Rescia, A., Fungariño, S. et al. (2011) Land-use, environment, and their impact on butterfly populations in a mountainous pastoral landscape: species richness and family-level abundance. *Journal of Insect Conservation*, 15, 523–538

Dover, J.W., Sotherton, N. and Gobbett, K. (1990), Reduced pesticide inputs on cereal field margins: the effects on butterfly abundance. *Ecological Entomology*, 15: 17-24. https://doi.org/10.1111/j.1365-2311.1990.tb00779.x

Ellis, S., Bourn, N. A. D. and Bulman, C. R. (2012) *Landscape-scale conservation for butterflies and moths: lessons from the UK.* Butterfly Conservation, Wareham, Dorset. https://butterfly-conservation.org/sites/default/files/landscape-scale-conservation-for-butterflies-and-moths-low-resolution.pdf

Feber, R.E., Smith, H. & Macdonald, D.W. (1996) The effects on butterfly abundance of the management of uncropped edges of arable fields. *Journal of Applied Ecology*, 33, 1191-1205. DOI: 10.2307/2404698

Feber R. E., Smith H. and MacDonald D.W., (1994) The effects of field margin restoration on the meadow brown butterfly (*Maniola jurtina*). In *Field margins: integrating agriculture and conservation*, pp. 295-300. Proceedings of a symposium held at the University of Warwick, 1994, Boatman, N. (Editor). British Crop Protection Council Registered Office (BCPC).

Field, R., Gardiner, T., Mason, C. et al. (2005) Agri-environment schemes and butterflies: the utilisation of 6 m grass margins. *Biodiversity and Conservation* 14, 1969–1976. https://doi.org/10.1007/s10531-004-2125-6

Firbank, L.G., Smart, S.M., Crabb, J., Critchley, C.N.R., Fowbert, J.W., Fuller, R.J., Gladders, P., Green, D.B., Henderson, I. & Hill, M.O. (2003) Agronomic and ecological costs and benefits of set-aside in England. *Agriculture, Ecosystems and Environment*, 95, 73-85. https://doi.org/10.1016/S0167-8809(02)00169-X

Froidevaux, J.S., Broyles, M. & Jones, G. (2019) Moth responses to sympathetic hedgerow management in temperate farmland. *Agriculture, Ecosystems & Environment*, 270, 55-64. https://doi.org/10.1016/j.agee.2018.10.008

Fuentes-Montemayor, E., Goulson, D. & Park, K.J. (2011) The effectiveness of agri-environment schemes for the conservation of farmland moths: assessing the importance of a landscape-scale management approach. *Journal of Applied Ecology*, 48, 532-542. https://doi.org/10.1111/j.1365-2664.2010.01927.x

Fuentes-Montemayor, E., Watts, K., Sansum, P., Scott, W. & Park, K.J. (2022) Moth community responses to woodland creation: The influence of woodland age, patch characteristics and landscape attributes. *Diversity and Distributions*, 28, 1993-2007. https://onlinelibrary.wiley.com/doi/pdf/10.1111/ddi.13599

Gov.UK a (2024) *Environmental Improvement Plan: annual progress report 2023 to 2024.* https://www.gov.uk/government/publications/environmental-improvement-plan-annual-progress-report-2023-to-2024

Gov.UK b (2024) *Agri-environment scheme uptake data.* https://www.gov.uk/government/collections/annual-countryside-stewardship-and-environmental-stewardship-summary-data

Haaland, C., Bersier, LF. What can sown wildflower strips contribute to butterfly conservation?: an example from a Swiss lowland agricultural landscape. *Journal of Insect Conservation* 15, 301–309 (2011). https://doi.org/10.1007/s10841-010-9353-8

Hall, R., Jones, R., Hurford, L., Edwards, J., (2024) *Environment Act Habitat Target – Definitions and Descriptions.* Natural England Technical Information Note TIN219. https://publications.naturalengland.org.uk/publication/6427187599900672

Harkness, C., F. J. Areal, M. A. Semenov, N. Senapati, I. F. Shield, and J. Bishop (2021). Stability of farm income: The role of agricultural diversity and agri-environment scheme payments. *Agricultural Systems*, 187, 103009. https://www.sciencedirect.com/science/article/pii/S0308521X20308702

Heard, M.S., Botham, M, Broughton, R., Carvell, C., Hinsley, S., Woodcock, B., Pywell, R.F. (2011) *Quantifying the effects of Entry Level Stewardship (ELS) on biodiversity at the farm scale: the Hillesden Experiment*. NERC Centre for Ecology and Hydrology. Final report to Natural England on project MA01031 https://publications.naturalengland.org.uk/publication/5764018810650624

Henderson, I.G., Vickery, J.A. & Fuller, R.J. (2000) Summer bird abundance and distribution on set-aside fields on intensive arable farms in England. *Ecography*, 23, 50-59. https://doi.org/10.1111/j.1600-0587.2000.tb00260.x

Henderson, I.G., Holland, J.M., Storkey, J., Lutman, P., Orson, J. & Simper, J. (2012) Effects of the proportion and spatial arrangement of un-cropped land on breeding bird abundance in arable rotations. *Journal of Applied Ecology*, 49, 883-891. https://doi.org/10.1111/j.1365-2664.2012.02166.x

Henderson, I. G., Paul Bellamy P., Barton, M., and Siriwardena G. M. (2023) *An analysis of the impact of the CS woodland improvement option WD2: the potential of field monitoring of option-managed woodlands and existing data sets to evaluate option efficacy*. Report to Department for Environment Food and Rural Affairs.

Henly, L., and P. Henrys. 2024. *Review of Evidence: Assessing and Monitoring Species Abundance and Extinction Risk for Biodiversity Conservation and Environmental Protection*. Final report to Office for Environmental Protection. DOI: 10.13140/RG.2.2.31449.08809

Heywood, J.J.N., Massimino, D., Balmer, D.E., Kelly, L., Marion, S., Noble, D.G., Pearce-Higgins, J.W., White, D.M., Woodcock, P., Wotton, S. & Gillings, S. 2024. *The Breeding Bird Survey 2023.* BTO Research Report 765. British Trust for Ornithology, Thetford. Published by the British Trust for Ornithology, the Joint Nature Conservation Committee and the Royal Society for the Protection of Birds, May 2024. © British Trust for Ornithology, Joint Nature Conservation Committee and Royal Society for the Protection of Birds, 2024.

Hinsley, S.A. & Bellamy, P.E. (2019) Birds of hedgerows and other field boundaries. In: J. Dover (Ed.), *The Ecology of Hedgerows and Field Margins*, Earthscan/Routledge, Abingdon, UK, pp. 210-232.

Hof, A.R. & Bright, P.W. (2010) The value of agri-environment schemes for macro-invertebrate feeders: hedgehogs on arable farms in Britain. *Animal Conservation*, 13, 467-473. https://doi.org/10.1111/j.1469-1795.2010.00359.x

Holt, C. A., Fraser, K. H., Bull, A. J., and Dolman, P. M. (2012) Habitat use by Nightingales in a scrub–woodland mosaic in central England. *Bird Study* 59, 416-425.

Ingram, J., P. Gaskell, J. Mills, and C. Short. 2013. Incorporating agri-environment schemes into farm development pathways: A temporal analysis of farmer motivations. *Land Use Policy* 31:267-279. https://www.sciencedirect.com/science/article/pii/S0264837712001317

Isselstein, J., Jeangros, B., and Pavlu, V.(2005) Agronomic aspects of biodiversity targeted management of temperate grasslands in Europe – A review. *Agronomy Research,* 3(2), 139-151 https://www.researchgate.net/publication/255584120

Janova, E. & Heroldova, M. (2016) Response of small mammals to variable agricultural landscapes in Central Europe. *Mammalian Biology*, 81, 488-493. https://doi.org/10.1016/j.mambio.2016.06.004

Jarvis, S.G., Staley, J.T., Siriwardena, G., Seaton, F. M., Redhead, J. W., Ward, C., Upcott, E., Botham, M.S. and Henrys, P. (2021). *Modelling Landscape-scale Species Response to Agri-Environment Schemes.* UK Centre for Ecology and Hydrology and British Trust for Ornithology. Final report for Natural England project LM04109 https://sciencesearch.defra.gov.uk/ProjectDetails?ProjectId=20552

Jones, N., S. Conyers, A. Crowe, J. Elliott, Y. Cao, P. Newell-Price, R. Gooday, D. O'Seanechain, D. Haigh, C. Forster Brown, and I. Adams. (2019). *The Environmental Effectiveness of the Countryside Stewardship scheme; Establishing a baseline agreement monitoring sample.* Final report to Natural England, project LM0458https://randd.defra.gov.uk/ProjectDetails?ProjectId=19728

Karmiris, I. & Nastis, A. (2007) Intensity of livestock grazing in relation to habitat use by brown hares (Lepus europaeus). *Journal of Zoology*, 271, 193-197.

Kolkman, A., Dopagne, C. & Piqueray, J. (2022) Sown wildflower strips offer promising long-term results for butterfly conservation. *Journal of Insect Conservation*, 26, 387–400 https://doi.org/10.1007/s10841-021-00347-2

Korpela, E.L., Hyvönen, T., Lindgren, S. & Kuussaari, M. (2013) Can pollination services, species diversity and conservation be simultaneously promoted by sown wildflower strips on farmland? *Agriculture, Ecosystems & Environment*, 179, 18-24. https://doi.org/10.1016/j.agee.2013.07.001

Kuussaari, M., Hyvönen, T. & Härmä, O. (2011) Pollinator insects benefit from rotational fallows. *Agriculture, Ecosystems & Environment*, 143, 28-36. https://doi.org/10.1016/j.agee.2011.03.006

Macdonald, D.W., Tattersall, F.H., Service, K.M., Firbank, L.G. & Feber, R.E. (2007) Mammals, agri-environment schemes and set-aside – what are the putative benefits? *Mammal Review*, 37, 259-277.

MacDonald, M.A., Angell, R., Dines, T.D., Dodd, S., Haysom, K.A., Hobson, R., Johnstone, I.G., Matthews, V., Morris, A.J., Parry, R., Shellswell, C.H., Skates, J., Tordoff, G.M. &

Wilberforce, E.M. (2019) Have Welsh agri-environment schemes delivered for focal species? Results from a comprehensive monitoring programme. *Journal of Applied Ecology*, 56, 812-823.
McCracken, M. E., B. A. Woodcock, M. Lobley, R. F. Pywell, E. Saratsi, R. D. Swetnam, S. R. Mortimer, S. J. Harris, M. Winter, S. Hinsley, and J. M. Bullock. 2015. Social and ecological drivers of success in agri-environment schemes: the roles of farmers and environmental context. *Journal of Applied Ecology*, 52, 696-705. https://doi.org/10.1111/1365-2664.12412
Meek, B., Loxton, D., Sparks, T., Pywell, R., Pickett, H. & Nowakowski, M. (2002) The effect of arable field margin composition on invertebrate biodiversity. *Biological Conservation*, 106, 259-271. https://doi.org/10.1016/S0006-3207(01)00252-X
Merckx, T., L. Marini, R. E. Feber, and D. W. Macdonald. 2012. Hedgerow trees and extended-width field margins enhance macro-moth diversity: implications for management. *Journal of Applied Ecology*, 49, 1396-1404.
Metera, E, Sakowski, T, Sloniewski, K and Romanowicz, B (2010) Grazing as a tool to maintain biodiversity of grassland - a review. *Animal Science Papers and Reports* No 28, 315-334.
Mills, Jane (2023) *The missing social dimensions of agri-environment schemes in the UK and lessons for a post-Brexit era*. PhD thesis, University of Gloucestershire. doi:10.46289/BB52Z6H3
Mills, J., H. Chiswell, P. Gaskell, P. Courtney, B. Brockett, G. Cusworth, and M. Lobley. 2021. Developing farm-level social indicators for agri-environment schemes: A focus on the agents of change. *Sustainability*, 13, 7820. https://www.mdpi.com/2071-1050/13/14/7820
Mládková, P., Mládek, J., Hejduk, S., Hejcman, M., Cruz, P., Jouany, C. & Pakeman, R. J. (2015) High-nature-value grasslands have the capacity to cope with nutrient impoverishment induced by mowing and livestock grazing. *Journal of Applied Ecology*, 4, 1073-1081.
Mountford, J. O., A. I. Cooke, S. R. Amy, A. Baker, P. D. Carey, H. J. Dean, V. G. Kirby, A. Nisbet, J. M. Peyton, R. F. Pywell, J. W. Redhead, and S. M. Smart (2013). *Monitoring the outcomes of Higher Level Stewardship: Results of a 3-year agreement monitoring programme*. Final report to Natural England http://publications.naturalengland.org.uk/publication/11462046
NERC Centre for Ecology & Hydrology (2007) *Comparison of new and existing agri-environment scheme options for biodiversity enhancement on arable land*. Defra Research Project Final Report BD1624. Centre for Ecology & Hydrology. http://randd.defra.gov.uk/Document.aspx? Document=BD1624_7310_FRP.pdf
Oliver, T. H. 2014. *Assessing the importance of spatial location of agri environment options within the landscape to butterflies: Correlative analysis of datasets to assess the degree of success in the delivery of Environmental Stewardship objectives*. NERC Centre for Ecology and Hydrology. Final report for Natural England NECR157. https://publications.naturalengland.org.uk/publication/5487886094827520
Olmeda, C, Šefferová, V, Underwood, E, Milan, L, Gil, T and Naumann, S (eds) (2019) *EU Habitat Action Plan to maintain and restore to favourable conservation status the habitat type 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates*

*(Festuco Brometalia) (*important orchid sites*). European Commission Technical Report, Brussels.
Ouvrard, P., Transon, J. & Jacquemart, A.-L. (2018) Flower-strip agri-environment schemes provide diverse and valuable summer flower resources for pollinating insects. *Biodivers Conserv* 27: 2193–2216.
Perrin, W, Moretti, M, Vergnes, A, Borcard, D and Jay-Robert, P (2020) Response of dung beetle assemblages to grazing intensity in two distinct bioclimatic contexts. *Agriculture, Ecosystems & Environment* No 289, 106740.
Petrovan, S.O., Ward, A.I. & Wheeler, P.M. (2013) Range selection for AES measures of brown hare. *Animal Conservation*, 16, 344-352. https://doi.org/10.1111/acv.12002
Pinches, C E, Gowing, D J G, Stevens, C J, Fagan, K and Brotherton, P N M (2013) Natural England review of upland evidence - Upland Hay Meadows: what management regimes *Natural England Evidence Review* 005.
Powney, G. D., C. Carvell, M. Edwards, R. K. A. Morris, H. E. Roy, B. A. Woodcock, and N. J. B. Isaac, 2019. Widespread losses of pollinating insects in Britain. *Nature Communications*, 10, 1018.
Potts, S.G., Woodcock, B.A., Roberts, S.P.M., Tscheulin, T., Pilgrim, E.S., Brown, V.K. & Tallowin, J.R. (2009) Enhancing pollinator biodiversity in intensive grasslands. *Journal of Applied Ecology*, 46, 369-379. https://doi.org/10.1111/j.1365-2664.2009.01609.x
Poulsen, J.G., Sotherton, N.W. and Aebischer, N.J. (1998), Comparative nesting and feeding ecology of skylarks *Alauda arvensis* on arable farmland in southern England with special reference to set-aside. *Journal of Applied Ecology*, 35: 131-147. https://doi.org/10.1046/j.1365-2664.1998.00289.x
Putnam, R.J. (1986) Foraging by Roe Deer in agricultural areas and impact on arable crops. *Journal of Applied Ecology*, 23, 91-99. https://www.jstor.org/stable/2403083
Pywell, R., Warman, E., Sparks, T., Greatorex-Davies, J., Walker, K., Meek, W., Carvell, C., Petit, S. & Firbank, L. (2004) Assessing habitat quality for butterflies on intensively managed arable farmland. *Biological Conservation*, 118, 313-325. https://doi.org/10.1016/j.biocon.2003.09.011
Pywell, R.F., Warman, E.A., Carvell, C., Sparks, T.H., Dicks, L.V., Bennett, D., Wright, A., Critchley, C.N.R. & Sherwood, A. (2005) Providing foraging resources for bumblebees in intensively farmed landscapes. *Biological Conservation*, 121, 479–494. https://doi.org/10.1016/j.biocon.2004.05.020
Pywell, R.F., Warman, E.A., Hulmes, L., Hulmes, S., Nuttall, P., Sparks, T.H., Critchley, C.N.R. & Sherwood, A. (2006) Effectiveness of new agri-environment schemes in providing foraging resources for bumblebees in intensively farmed landscapes. *Biological Conservation*, 129, 192-206. http://dx.doi.org/10.1016/j.biocon.2005.10.034
Pywell, R. & Nowakowski, M. (2008) *Farming for Wildlife Project: Annual Report 2007/8*. NERC report, no. 6366. http://nora.nerc.ac.uk/id/eprint/6366/1/Jordans_Project_Annual_Report_2007_8_1.pdf
Pywell, R., Amy, S., Carvell, C., Nowakowski, M. & Woodcock, B. (2017) *Developing Multi-functional Enhanced Fallows* Project BD5203. NERC Centre for Ecology & Hydrology. Final Report to the Department for Environment, Food & Rural Affairs.
Ramos, R. F., Diogo, J. A., Santana, J., Silva, J. P., Reino, L., Stefan Schindler, S., Pedro Beja, P., Angela Lomba, A., and Francisco Moreira, F. (2021) Impacts of sheep versus

cattle livestock systems on birds of Mediterranean grasslands. *Scientific Reports* 11,10827.
Redhead, J.W.,Pywell, R.F., Bellamy, P.E., Broughton, R.K., Hill, R.A. & Hinsley, S.A. (2013) Great tits Parus major and blue tits *Cyanistes caeruleus* as indicators of agri-environmental habitat quality. *Agriculture, Ecosystems & Environment*, 178, 31-38. https://doi.org/10.1016/j.agee.2013.06.015
Redhead, J.W., Dreier, S., Bourke, A.F.G., Heard, M.S., Jordan, W.C., Sumner, S., Wang, J. & Carvell, C. (2016) Effects of habitat composition and landscape structure on worker foraging distances of five bumble bee species. *Ecological Applications*, 26, 726-739. http://dx.doi.org/10.1890/15-0546
Redhead, J.W., Hinsley, S.A., Botham, M.S., Broughton, R.K., Freeman, S.N., Bellamy, P.E., Siriwardena, G., Randle, Z., Nowakowski, M., Heard, M.S. & Pywell, R.F. (2022) The effects of a decade of agri-environment intervention in a lowland farm landscape on population trends of birds and butterflies. *Journal of Applied Ecology*, 59, 2486–2496. https://doi.org/10.1111/1365-2664.14246
Roberts, P.D. & Pullin, A.S. (2007) The effectiveness of land-based schemes (incl. agri-environment) at conserving farmland bird densities within the UK. CEE Review 05-005. *CEE (Collaboration for Environmental Evidence) Systematic Reviews*, SR11. www.environmentalevidence.org/SR11.html
Saarinen, K., Jantunen, J. (2005) Grassland butterfly Fauna under Traditional Animal Husbandry: Contrasts in Diversity in Mown Meadows and Grazed Pastures. *Biodiversity & Conservation* 14, 3201–3213 https://doi.org/10.1007/s10531-004-0387-7
Schmidt, A., Fartmann, T., Kiehl, K., Kirmer, A. & Tischew, S. (2022) Effects of perennial wildflower strips and landscape structure on birds in intensively farmed agricultural landscapes. *Basic and Applied Ecology*, 58, 15-25. https://doi.org/10.1016/j.baae.2021.10.005
Schwarzwälder B., Lörtscher M., Erhardt A. & Zettel J. (1997) Habitat utilizations by the heath fritillary butterfly, *Mellicta athalia* ssp. *celadussa* (Rott.) (Lepidoptera: Nymphalidae) in montane grasslands of different management. *Biological Conservation*, 82, 157-165. https://doi.org/10.1016/S0006-3207(97)00023-2
Scopes, E.R., Bennie, J.J., Broome, A., Walsh, K., & McDonald, R.A. (2024) Variation in hazel dormouse (*Muscardinus avellanarius*) presence in hedge and scrub habitats. *Ecological Solutions and Evidence*, 5, e12329. https://doi.org/10.1002/2688-8319.12329
Siriwardena et al (2023) *Management and Performance of AB14 Harvested Low Input Cereal Plots.* Defra Project LM04135
Slamova I., Klecka J. & Konvicka M. (2013) Woodland and grassland mosaic from a butterfly perspective: Habitat use by *Erebia aethiops* (Lepidoptera: Satyridae). *Insect Conservation and Diversity*, 6, 243-254
Smith, R.K., Jennings, N.V., Robinson, A. & Harris, S. (2004) Conservation of European hares *Lepus europaeus* in Britain: is increasing habitat heterogeneity in farmland the answer? *Journal of Applied Ecology*, 41, 1092-1102.
Smith, R.K., Vaughan Jennings, N. & Harris, S. (2005) A quantitative analysis of the abundance and demography of European hares *Lepus europaeus* in relation to habitat type, intensity of agriculture and climate. *Mammal Review*, 35, 1-24. https://doi.org/10.1111/j.1365-2907.2005.00057.x

Staley, J. T., S. G. Jarvis, J. W. Redhead, G. M. Siriwardena, M. E. McCracken, M. S. Botham, K. Howell, E. Upcott, H. Dean, C. Harrower, C. Ward, G. J. Conway, I. Henderson, H. Pringle, S. Newson, K. Turvey, J. Christelow, S. Falk, T. Mondain-Monval, S. Amy, and R. F. Pywell (2022). *Landscape-scale species monitoring of agri-environment schemes*. Final report to Natural England, project LM0465. https://sciencesearch.defra.gov.uk/ProjectDetails?ProjectId=20012

Staley, J. T., M. Lobley, M. McCracken, H. Chiswell, J. W. Redhead, S. M. Smart, O. L. Pescott, M. Jitlal, S. Amy, H. J. Dean, L. E. Ridding, R. K. Broughton, and J. O. Mountford (2018). *The environmental effectiveness of the Higher Level Stewardship scheme; Resurveying the baseline agreement monitoring sample to quantify change between 2009 and 2016*. Full technical final report. Natural England project ECM 6937 / LM0445. UK Centre for Ecology and Hydrology, https://randd.defra.gov.uk/ProjectDetails?ProjectID=19360&FromSearch=Y&Publisher=1&SearchText=LM0445&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description.

Staley, J. T., M. S. Botham, S. R. Amy, S. Hulmes, and R. F. Pywell (2018). Experimental evidence for optimal hedgerow cutting regimes for Brown hairstreak butterflies. *Insect Conservation & Diversity,* 11, 213-218. http://doi.org/10.1111/icad.12239

Tattersall, F.H., Fagiano, A.L., Bembridge, J.D., Edwards, P., Macdonald, D.W. & Hart, B.J. (1999) Does the method of set-aside establishment affect its use by wood mice? *Journal of Zoology*, 249, 472-476.

Taylor M.E. & Morecroft M.D. (2009) Effects of agri-environment schemes in a long-term ecological time series. *Agriculture, Ecosystems & Environment*, 130, 9-15. https://doi.org/10.1016/j.agee.2008.11.004

Thomas, J.A., Simcox D.J. and Clarke R.T. (2009). Successful conservation of a threatened *Maculinea* butterfly. *Science*, 325,80-83. DOI:10.1126/science.1175726

Toivonen, M., Herzon, I. & Kuussaari, M. (2015) Differing effects of fallow type and landscape structure on the occurrence of plants, pollinators and birds on environmental fallows in Finland. *Biological Conservation*, 181, 36-43. https://doi.org/10.1016/j.biocon.2014.10.034

Toivonen, M., Herzon, I. & Kuussaari, M. (2016) Community composition of butterflies and bumblebees in fallows: niche breadth and dispersal capacity modify responses to fallow type and landscape. *Journal of Insect Conservation*, 20, 23-34. https://doi.org/10.1007/s10841-015-9836-8

Trout, R.C., Langton, S., Smith, G.C. & Haines-Young, R.H. (2000) Factors affecting the abundance of rabbits (*Oryctolagus cuniculus*) in England and Wales. *Journal of Zoology*, 252, 227-238. https://doi.org/10.1111/j.1469-7998.2000.tb00617.x

Trout, R.C., Brooks, S.E., Rudlin, P. & Neil, J. (2012) The effects of restoring a conifer Plantation on an Ancient Woodland Site (PAWS) in the UK on the habitat and local population of the Hazel Dormouse (*Muscardinus avellanarius*). *Eur J Wildl Res* 58: 635–643.

Turney, C., A.-G. Ausseil, and L. Broadhurst (2020). Urgent need for an integrated policy framework for biodiversity loss and climate change. *Nature Ecology & Evolution*, 4, 966. 10.1038/s41559-020-1242-2

Van Buskirk J. & Willi Y. (2004) Enhancement of farmland biodiversity within set-aside land. *Conservation Biology*, 18, 987-994.
Vickery, J.A., Feber, R.E. & Fuller, R.J. (2009) Arable field margins managed for biodiversity conservation: a review of food resource provision for farmland birds. *Agriculture, Ecosystems & Environment*, 133, 1-13. https://doi.org/10.1016/j.agee.2009.05.012
Waddell, E.H., Fuentes-Montemayor, E., Park, K.J., Carey, P., Guy, M., Macgregor, N.A. & Watts, K. (2024) Larger and structurally complex woodland creation sites provide greater benefits for woodland plants. *Ecological Solutions and Evidence*, 5, e12339. https://doi.org/10.1002/2688-8319.12339
Walker, K.J. (2005) An extra 10 acres? Botanical research in the Monks Wood Wilderness. In: Gardiner C, Sparks T, editors. Ten years of change: Woodland research at Monks Wood NNR, 1993–2003. *English Nature Research Report* 613. Peterborough: English Nature. pp. 48–58.
Walker, K.J., Critchley, C.N.R., Sherwood, A.J., Large, R., Nuttall, P., Hulmes, S., Rose, R. & Mountford, J.O. (2007) The conservation of arable plants on cereal field margins: an assessment of new agri-environment scheme options in England, UK. *Biological Conservation*, 136, 260-270. https://doi.org/10.1016/j.biocon.2006.11.026
Wallis de Vries, M.F. and Raemakers, I. (2001), Does extensive grazing benefit butterflies in coastal dunes?. *Restoration Ecology*, 9: 179-188. https://doi.org/10.1046/j.1526-100x.2001.009002179.x
Ward, C.V., Siriwardena, G.M. 2024. *Impacts of Agri-environment Schemes on Bird Populations in Farmland 2005-2022.* Unpublished manuscript.
Warren, M. S. (1987). The ecology and conservation of the Heath Fritillary butterfly, *Mellicta athalia*. III. Population dynamics and the effect of habitat management. *Journal of Applied Ecology*, 24(2), 499–513. https://doi.org/10.2307/2403889
Waygood, U.A. (2024). *Agri-Environment Evidence Annual Report 2023. A summary of recently published projects*. Natural England Research Report, NERR138. Natural England. https://publications.naturalengland.org.uk/publication/5416943646146560
Wilson, P.J. (1992) The natural regeneration of vegetation under set-aside in southern England. In J. Clarke (Ed.) *Set-aside*. (pp. 73-78). MCPC Monograph No. 50. British Crop Protection Council.
Wool, R., G. Breckenridge, G. Ziv, and A. S. Gosal. 2023. Delineating the spatial drivers of agri-environment scheme adoption at field and farm levels. *Journal of Environmental Management* 348:119407. https://doi.org/10.1016/j.jenvman.2023.119407
Woodcock, B.A., Westbury, D.B., Potts, S.G., Harris, S.J. & Brown, V.K. (2005) Establishing field margins to promote beetle conservation in arable farms. *Agriculture Ecosystems & Environment*, 107, 255-266. https://doi.org/10.1016/j.agee.2004.10.029
Woodcock, B.A., Westbury, D.B., Harrison-Cripps, J., Tscheulin, T., Harris, S.J., Ramsay, A.J., Brown, V.K. & Potts, S.G. (2008a) Effects of seed mixture and management on beetle assemblages of arable field margins. *Agriculture Ecosystems & Environment*, 125, 246–254. https://doi.org/10.1016/j.agee.2008.01.004
Woodcock, B.A., Redhead, J., Vanbergen, A.J., Hulmes, L., Hulmes, S., Peyton, J., Nowakowski, M., Pywell, R.F. & Heard, M.S. (2010) Impact of habitat type and landscape structure on biomass, species richness and functional diversity of ground

beetles. *Agriculture Ecosystems & Environment*, 139, 181-186 https://doi.org/10.1016/j.agee.2010.07.018

Zellweger-Fischer, J., Kéry, M. & Pasinelli, G. (2011) Population trends of brown hares in Switzerland: The role of land-use and ecological compensation areas. *Biological Conservation,* 44, 1364-1373.

8. Appendix

8.1 Case studies of Task A scoring applied to QEIA actions

The case studies below are included to further illustrate the application of the Task A scoring system to response variables for each species group, for each of three QEIA actions. Details of the Task A scoring system, and a single case study example for a QEIA action are in Section 3.2.1 above.

1. *ETPW-116: Provide a flower rich habitat for wild pollinators with a range of flowering times and flowering structures [Habitat creation / Cropland]*

Birds:

No classification (B)	1 ** D P R T
Farmland (F)	1 ** D P R T
Upland (U)	5 X
Woodland (W)	5 X
Coastal (C)	5 X
Wetlands/waterbodies (WW)	5 X

The impact of strips, margins and corners of wildflowers or flower-rich grass on farmland birds has been found to be mixed, with effects ranging from negligible to highly positive (Vickery et al. 2009) [**B/F:1****]. Yellowhammer and Linnet counts were found to be higher on wildflower margins than grassy margins in Clarke et al. 1997, and Schmidt et al. (2021) found that there were positive effects of wildflower strips on Corn Bunting, Skylark, Yellowhammer and Whitethroat, though effects on Lapwing, Tree Sparrow and Yellow Wagtail were negative [**B:1**DPR;F:1**PR**]. Henderson et al. (2012) found positive effects of wildflower areas on priority bird species, and found that effects were context dependent, with Linnet abundance greater on contiguous blocks of habitat, with Skylark abundance associated with a larger edge effect [**B/F:1**T**].

Invertebrates:

Bumblebees	1 ** R
Butterflies (Farmland)	1 ** R
Butterflies (Woodland)	5 X
Moths	1 ** R

Bumblebees: There are multiple studies proving very strong evidence **[1 **]** on a regional scale **[R]** that flower-rich habitats installed on arable farmland is associated with increased abundance and richness bumblebees (Meek et al. 2002; Carvell et al. 2004, 2006, 2007, 2011; Pywell et al. 2005). However, one study indicated that ETPW-116 alone was insufficient in generating population-level effects for bumblebees, and so enhancement and combination with other options (e.g. ETPW-205C, ETPW-189) could provide better results via a more diverse flower resources over a long (whole-season) timeframe (Carvell et al. 2017). There is further evidence that scarce bumblebee species benefit from floral habitats created in or adjacent to their ranges (Carvell 2000; Carvell et al. 2006; Pywell et al. 2006; Redhead et al. 2016).

Butterflies (Farmland): There is very strong empirical evidence **[1]** that provision of wildflowers in arable farmland has substantial benefits **[**]** for butterfly species richness and abundance via resource (e.g. nectar) provision (Feber 1996; Pywell et al. 2004). Multiple controlled studies from different regions [R] have found significant positive effects of wildflower margins or pollinator flower mixes on butterflies, with most finding significant positive effects with regard to adult abundance (e.g. Meek et al. 2002; Potts et al. 2009; Korpela et al. 2013; Redhead et al. 2022). Other studies found significant positive effects on butterfly species richness (Meek et al. 2002; Potts et al. 2009).

Butterflies (Woodland): It remains untested whether nearby woodland butterflies may benefit from floral resources on nearby farmland, but population-level effects are likely to be negligible **[5 X]**.

Moths: There is good evidence from multiple studies and regions **[1 ** R]** that wildflower-sown field margins on farmland are positively associated with greater abundance and species richness of moths (Fuentes-Montemayor et al. 2011; Blumgart 2021; Defra/NE Hillesden Project https://assist.ceh.ac.uk/hillesden). Significant differences were found in the same study for micro-moths for both abundance and diversity when compared to standard cross-compliance margins and also for abundance when compared to standard grass margins. Supporting evidence comes from a controlled study showing a significant positive effect on the abundance and richness of moths in species-rich grasslands created under AES, compared to conventional farmland, further demonstrating the positive effects of floral enhancement (Fuentes-Montemayor et al. 2011).

Bats: 3**

Although the effects of wildflower strips on bat species have not been substantially or specifically tested, there is an expectation that such management will benefit species through increased abundance and diversity of prey **[3]**. The diet of bats varies by species, but often includes insects such as moths and beetles. Blumgart (2021) found moth species richness to be positively associated with wildflower margins, and Fuentes-Montemayor et al. (2011) found a significant positive effect on the abundance and richness of micro-moths, and on the species richness of macro-moths in botanically enriched farmland. There is substantial evidence that a range of beetle species have increased richness in floristically enhanced and diverse margins (Woodcock et al. 2005; Woodcock et al. 2008a; Woodcock et al. 2010; Clarke et al. 2007; NERC Centre for Ecology and Hydrology 2007; Heard et al. 2011). The increase of both moth and beetle species in flower-rich grass margins could hence provide a key source of prey for bat species **[**]**.

Mammals (excluding bats):

Mammals (Farmland)	3 **
Mammals (Farmland, Priority)	1 ** R
Mammals (Woodland)	3 *
Mammals (Woodland, Priority)	5 X

Mammals (Farmland): There is good evidence that wildflower margins and plots benefit small mammals (mice, voles), and hold a greater abundance than in cropped areas (Tattersall et al. 1999; Aschwanden et al. 2007). The logic chain is that such habitats and prey abundance would be strongly beneficial **[3 **]** to larger rodents, like Rabbits, and also to the predators of small mammals, such as Red Foxes.
Mammals (Farmland, Priority): There is strong evidence from multiple, widespread studies **[1 ** R]** that diversification of in-field habitats, including with margins or plots of wildflowers, is strongly beneficial to priority Brown Hares and Western European Hedgehogs by providing foraging habitat and cover, resulting in increased abundance, usage or population persistence (Hof & Bright 2010; Petrovan et al. 2012).
Mammals (Woodland): Although direct evidence is lacking, there is an assumption of a minor potential benefit **[3 *]** to woodland mammals (such as deer) of a diversification of cropland habitats by the creation of uncropped margins, which may act as foraging sites, cover and corridors between woodland patches.
Mammals (Woodland, Priority): There is no evidence, and no reason to assume **[5 X]**, that flower-rich habitats would benefit woodland priority mammals, like the Hazel Dormouse.

Plants:

Plants	1 ** R
Plants (Rare arable)	3 **

Plants: There is substantial evidence of greater plant abundance and richness **[1 **]** from 16 of 21 studies **[R]** looking at outcomes of wildflower strips creation; the remaining five studies mostly found negligible, or rarely negative, effects on plant diversity or species richness (Dicks et al. 2013). A further large-scale study found that sown margins had greater species richness of grasses, forbs and perennials than cropped areas (Critchley et al. 2006).
Plants (Rare arable): Wildflower margins or plots sown with mixes containing rare arable plants, and managed for these species, have the potential to produce significant benefits **[3 **]** for these species (Albrecht et al. 2016), although formal evidence is still lacking.

2. *ECCM-049: Create woodland through natural regeneration [Natural regeneration / Woodland]*

Birds:

No classification (B)	2 ** D L P
Farmland (F)	2 ** D L P
Upland (U)	3 * D T
Woodland (W)	2 ** L P
Coastal (C)	5 X
Wetlands/waterbodies (WW)	2 ** D L P

The creation of woodland through natural regeneration is a long-term passive rewilding tool with the potential to play an important role in increasing biodiversity and increasing bird species richness/abundance. However, due to differences in the habitat preferences of different bird species, effects will be mixed for certain species groups [**B/F/U/WW:D**]. Restoration of woody habitats has been shown to benefit rare species such as the Willow Tit (Broughton et al. 2020) [**B/W:2**LP**], and Broughton et al. (2022) found an increase in woodland and wetland species [**W/WW:2**LP**] at a site of former farmland left to passive rewilding over a 33-year period. However, the community of farmland bird species decreased, but there were observed increases in abundance for species such as Goldfinch, Linnet and Whitethroat [**F:2**DLP**]. The effects of natural regeneration on bird species have not been tested in the Uplands, though we anticipate a similarly mixed response depending on the landscape context and species preferences [**U:3*DT**].

Invertebrates:

Bumblebees	3 **
Butterflies (Farmland)	3 **
Butterflies (Woodland)	3 **
Moths	3 **

Bumblebees: Direct evidence is so far lacking, but there is a strong basis to infer that the habitats and resources created by natural colonisation/regeneration with have a substantial positive **[3 **]** impact on bumblebee abundance and diversity, via the provision of long-duration floral resources (flowers in herb layer, blossom on shrub layer) and nest sites (tussocky/undisturbed grassland) (Broughton et al. 2021, 2022). The spatial scale of such benefits (local vs regional) is not clear, so cannot be estimated without relevant studies.
Butterflies (Farmland): As with bumblebees, direct evidence is so far lacking for butterflies for the effects of natural colonisation/regeneration of woodland. However, typical farmland or grassland species (e.g. Marbled White, Common Blue, Orange Tip) are expected to benefit significantly (abundance and richness **[3 **]**) through the creation of abundant nectaring opportunities on wildflowers and blossom, and breeding/overwintering opportunities in an undisturbed grassland matrix with emerging shrubs/trees (Broughton et al. 2021, 2022).

Butterflies (Woodland): The abundance and richness of woodland butterflies are expected to significantly increase **[3 **]** with the establishment of shrub, trees and foodplant herbs on natural colonisation/regeneration sites. A range of shrub and/or tree species can colonise natural regeneration sites within a few decades, initially creating a shrubland-grassland matrix, and, under preferential conditions, eventually a naturalistic young woodland within 50 years, benefitting woodland species such as the Comma and Speckled Wood (Broughton et al. 2021, 2022).

Moths: The general lack of evidence for moths mirrors that for butterflies, although some research on planted woodland creation allows an inference that that new, structurally diverse woodland, especially near to existing woodland, would be associated with a high abundance and richness **[3 **]** of moth species (Fuentes-Montemayor et al. 2022). The most beneficial structure indicated for moths has been shown to be delivered by natural colonisation/regeneration of woodland near to existing mature woodland (Broughton et al. 2021), which provides a good basis for the inference of a positive response, in the absence of direct evidence for the action/options.

Bats: 3 **

Woodland is an important habitat for most UK bat species, providing roosting sites and foraging opportunities, as well as safe cover for commuting. Therefore, bat species have the potential to majorly benefit from creation of new woodland habitat [**3****], though specific evidence to demonstrate this does not yet exist in the literature.

Mammals (excluding bats):

Mammals (Farmland)	3 **
Mammals (Farmland, Priority)	3 **
Mammals (Woodland)	3 **
Mammals (Woodland, Priority)	3 ** T

Mammals (Farmland): Farmland generalist mammals, like Rabbits (e.g. Trout et al. 2000) are expected to significantly benefit **[3 **]** from woodland creation in arable landscapes, due to the increase in cover and undisturbed breeding sites.

Mammals (Farmland, Priority): Direct evidence is lacking for woodland creation by natural colonisation/regeneration specifically, but there is a strong basis for concluding that farmland priority species, like Brown Hares and Western European Hedgehogs, will benefit **[3 **]** from the provision of increased woody cover for shelter and foraging (Smith et al. 2005; Hof & Bright 2010; Broughton et al. 2021).

Mammals (Woodland): Mammals associated with woodland habitats, such as Roe Deer, Fallow Deer, Red Fox are expected to benefit **[3 **]** from the greater cover and breeding sites offered by natural colonisation/regeneration of woodland (e.g. Casey et al. 2020, Broughton et al. 2021).

Mammals (Woodland, Priority): There is a good basis for presuming that woodland creation would significantly benefit **[3 **]** priority woodland mammals, such as the Hazel Dormouse, by expanding its habitat extent and connectivity when targeted **[T]** within and adjacent to its current range (Scopes et al. 2024).

Plants:

Plants	3 ** D
Plants (Rare arable)	3 * D

Plants and **Rare arable plants:** To date there are no studies providing definitive evidence, but some studies allow an inference of major benefits **[3 **]** for generalists and minor benefits **[3 *]** for rarer specialists that woodland creation via natural colonisation/regeneration benefits plants by allowing a diverse flora to develop as a mosaic of grassy, shrubby and (sometimes) wetland communities as new woodland develops (Walker 2005; Casey et al. 2020; Broughton et al. 2021, 2022; Waddell et al. 2024). Some disbenefits **[D]** are also likely to occur as arable or open-landscape plant communities are replaced by woodland plant communities.

3. *ETPW-104: Reduce stocking rate (grazing) to restore structure and flowering, maintain ground cover, and reduce poaching [Restoration, management and enhancement / Grassland]*

Birds:

No classification (B)	2 ** L T
Farmland (F)	3 ** C T
Upland (U)	2 ** L T
Woodland (W)	5 X
Coastal (C)	5 X
Wetlands/waterbodies (WW)	5 X

[F] Reduced stocking rates in grassland habitats can have a direct impact on plant composition, improving species diversity and structural complexity.
[C] Where this action has been assessed, studies have considered several grazing strategies combined, including low-intensity grazing, mixed live-stock grazing, and altered timing or duration of grazing, and so it is difficult to isolate the impacts of this specific action (Breitsameter et al. 2017; Perrin et al. 2020).
[3] From the outputs of these composite studies (and using expert judgement), we have assumed that farmland birds, ground-nesting species, and breeding waders benefit from reduced stocking rates, with lower nest failure from trampling and improved habitat quality (in comparison to higher stocking rates, Ramos. 2021; Pinches et al. 2013).
[**] This action can be implemented across a broad geographical area, including lowland arable and upland habitats and so, if implemented appropriately, could have a major impact on target species.
[U:2L]** For example, in upland grassland habitats in the UK, reduced stocking rates of sheep led to greater reproductive success of Hen Harriers (Amar et al. 2011).
[T] Developing a recommended ('rule-of-thumb') stocking rate to ensure grassland biodiversity is enhanced (rather than degraded) is difficult because the impacts of this

action have been found to vary among habitats (Metera et al. 2010, Olmeda et al, 2019, Isselstein et al., n.d.). As such, this action requires a highly targeted approach, tailored to the climate, habitat, and species in question.

Invertebrates:

Bumblebees	2 * T
Butterflies (Farmland)	3 *
Butterflies (Woodland)	5 X
Moths	3 *

Bumblebees: Evidence is generally sparse, but there is some evidence of reduced stocking rates of grazing animals benefitting bumblebees **[2 *]** under a targeted **[T]** less-intensive grazing system, compared to higher density grazing (Batáry et al. 2010; Dicks et al. 2013).
Butterflies (Farmland): Before-and-after evidence of reducing stocking rates is lacking, but broad options of lower-intensity grazing provide a firm basis for inferring (at least minor) benefits for farmland butterflies (Dicks et al. 2013), but at least minor benefits can be inferred from expert opinion **[3 *]**, due to likely improvements in vegetation structure and floral resources.
Butterflies (Woodland): Any benefits of reduced grazing on open land for woodland specialist butterflies were considered to be negligible, and were untested **[5 X]**.
Moths: Scoring for moths followed the same logic chain as for farmland butterflies, of an inferred minor (at least) benefit of reduced grazing rates **[3 *]**.

Bats: 3 * D
Minimal evidence was found for the impacts of stocking rates on bats, however several factsheets suggest that reducing grazing intensity affects species in different ways **[D].** The management option appears to benefit the Greater-horseshoe bat but disbenefit the Lesser-horseshoe. Given that this information was found in non-peer-reviewed, draft fact-sheets, we assigned a low confidence to the scores with minor effect size **[3*]**.

Mammals (excluding bats):

Mammals (Farmland)	X
Mammals (Farmland, Priority)	3 *
Mammals (Woodland)	5 X
Mammals (Woodland, Priority)	5 X

Mammals (Farmland): No evidence was found for benefits or disbenefits of reduced grazing for generalist farmland mammals on the species indicator. Because of this uncertainty and lack of evidence, where species like deer or rabbits could show varying responses, it was left unscored.
Mammals (Farmland, Priority): Studies for priority Brown Hares are conflicting, with a preference for moderate grazing rather than light grazing in one study (Karmiris & Nastis

2007), a preference for extensively grazed grassland in another (Zellweger-Fischer et al. 2011), and also for heterogeneous pastures (Smith et al. 2004). On this basis, we have inferred likely minor benefits [3 *] for this priority species from reduced grazing rates.
Mammals (Woodland): In the absence of direct evidence, reduced stocking rates of grazing animals was considered to have negligible effects on woodland mammals, including **Woodland Priority Mammals**, like Hazel Dormice, based on the species' ecology.

Plants:

Plants	3 *
Plants (Rare arable)	X

Plants: Specific direct evidence for benefits of this option on plants is lacking, although reduced grazing intensity is shown in studies to improve vegetation structure (e.g. MacDonald et al. 2019). From this, it can be inferred that there should be at least some (minor) benefits [3 *].
Plants (Rare arable): There is no specific evidence of benefits or disbenefits of reduced grazing on rare arable plants, such as in a mob-grazing regime, and so both outcomes are possible but remain untested and unknown, so could not be inferred.

8.2 Bat species scores: comparison of published evidence and the addition of expert opinion

Bat Conservation Trust (BCT) contributed to the bat scores per QEIA action under Task A (Section 2.2). BCT also provided scores for the 10 abundance indicator bat species in Task B, based on their expert judgement and detailed knowledge of the ecology of these bat species. These are summarised alongside the bat scores based on available evidence (Table 20), the latter results are in Section 3.3 with the Task B results for other taxa. Bat species scores including BCT expert opinion were similar to the bat scores for Task A.

BATS - 10 species in abundance indicator	**Number of Countryside Stewardship options (out of 145)**		**Number of Sustainable Farming Incentive actions (out of 20)**	
Scoring based on:	**Available evidence**	**Evidence plus expert BCT opinion**	**Available evidence**	**Evidence plus expert BCT opinion**
No species level evidence (no score attributed for any species)	121	54	15	4
Scored beneficial for at least 1 species	22	85	4	16
Major benefit for at least 1 species	1	26	0	4
- major benefit for 1-2 species	1	19	0	3
- major benefit for 3-5 species	0	7	0	1
- major benefit for 6-10 species	0	0	0	0
Minor benefit for at least 1 species	21	84	4	16
- minor benefit for 1-2 species	19	9	3	0
- minor benefit for 3-5 species	2	0	1	0
- minor benefit for 6-10 species	0	56	0	16
Scored disbenefit for at least 1 species	0	4	0	0
Confidence in the main scores attributed				
- high confidence for at least 1 species	2	1	0	1
- medium confidence for at least 1 species	5	12	4	4
- low confidence for at least 1 species	16	83	0	16
Scored as no likely effect for at least 1 species	11	0	5	0
Scored as mixed effects / no consensus for at least 1 species	0	9	0	1

8.3 AES option contribution to Wildlife-rich target

Table A8.3. Table of specific AES action names, codes and the wildlife-rich target habitat that they have been assigned to for purposes of calculating the potential amount of contribution of AES to wildlife-rich area targets. *** hedgerow data are converted from meters to hectares based on average hedgerow width of 1.5m.

Scheme	Wildlife rich habitat	Scheme action code	Option Name	Uptake in 2024	Unit
CS	Arable field margins	AB1	Nectar flower mix	14900	ha
CS	Arable field margins	AB11	Cultivated areas for arable plants	6300	ha
CS	Arable field margins	AB16	Autumn sown bumblebird mix	5200	ha
CS	Arable field margins	AB3	Beetle banks	200	ha
CS	Arable field margins	AB8	Flower-rich margins and plots	49700	ha
CS	Arable field margins	AB9	Winter bird food	54500	ha
CS	Arable field margins	OP2	Wild bird seed mixture	1600	ha
CS	Broadleaved, Mixed and Yew Woodland	WD1	Woodland creation - maintenance payments	4900	ha
CS	Broadleaved, Mixed and Yew Woodland	WD2	Woodland improvement	137000	ha
CS	Broadleaved, Mixed and Yew Woodland	WD3	Woodland edges on arable land	300	ha
CS	Broadleaved, Mixed and Yew Woodland	WD8	Creation of successional areas and scrub	3700	ha
CS	Coastal and floodplain grazing marsh	CT2	Creation of coastal sand dunes and vegetated shingle on arable land and improved grassland	0	ha
CS	Coastal and floodplain grazing marsh	CT4	Creation of inter-tidal and saline habitat by non-intervention	0	ha
CS	Coastal and floodplain grazing marsh	CT6	Creation of inter-tidal and saline habitat on intensive grassland	700	ha

Scheme	Wildlife rich habitat	Scheme action code	Option Name	Uptake in 2024	Unit
CS	Coastal Saltmarsh and saline reedbeds	WT7	Creation of reedbed	10	ha
CS	Grassland	GS11	Creation of wet grassland for breeding waders	600	ha
CS	Grassland	GS12	Creation of wet grassland for wintering waders and wildfowl	400	ha
CS	Grassland	GS8	Creation of species-rich grassland	1400	ha
CS	Hedgerows	BN11	Planting new hedges	975	ha***
CS	Lowland fens	WT9	Creation of fen	400	ha
CS	Lowland heathland	LH3	Creation of heathland from arable or improved grassland	100	ha
CS	Neutral grassland - peat	SW18	Raised water levels on grassland on peat soils	40	ha
CS	Standing open waters	SW12	Making space for water	90	ha
CS	Traditional orchards	BE5	Creation of traditional orchards	200	ha
CS	Wood-pasture and parkland	WD12	Creation of upland wood pasture	2900	ha
SFI 23	Arable field margins	AHL1	Pollen and nectar flower mix	11600	ha
SFI 23	Arable field margins	AHL2	Winter bird food on arable and horticultural land	38200	ha
SFI 23	Arable field margins	AHL4	4m to 12m grass buffer strip on arable and horticultural land	3400	ha
SFI 23	Arable field margins	IGL2	Winter bird food on improved grassland	23400	ha
SFI 23	Arable field margins	IPM2	Flower-rich grass margins, blocks, or in-field strips	9400	ha

8.4 AES contribution to woodland and tree outside of woodland canopy cover target

Table A8.4 Table of specific AES action names, codes that have been assigned for purposes of calculating the potential amount of contribution of AES to the woodland and trees outside of woodland canopy cover target. Units were converted to areas based on average broadleaf species planting densities of 1500 per ha and density of 2.5m for hedgerow trees.

Scheme	Scheme action code	Option Name	Uptake	Units
CS	BE5	Creation of traditional orchards	200	ha
CS	TE1	Planting standard hedgerow tree	64700	units
CS	TE2	Planting standard parkland tree	67400	tree
CS	TE3	Planting fruit trees	44300	tree
CS	TE4	Supply and plant tree	4680000	tree
CS	WD1	Woodland creation - maintenance payments	4900	ha
CS	WD11	Restoration of upland wood pasture and parkland	700	ha
CS	WD12	Creation of upland wood pasture	2900	ha
CS	WD2	Woodland improvement	137000	ha
CS	WD3	Woodland edges on arable land	300	ha
CS	WD5	Restoration of lowland wood pasture and parkland	6900	ha
CS	WD6	Creation of lowland wood pasture	9000	ha
CS	WD8	Creation of successional areas and scrub	3700	ha
ES	HC10	Creation of woodland outside of the SDA & ML	80	ha
ES	HC13	Restoration of wood pasture and parkland	11700	ha
ES	HC14	Creation of wood pasture	400	ha
ES	HC16	Restoration of successional areas and scrub	2800	ha
ES	HC17	Creation of successional areas and scrub	2900	ha
ES	HC21	Creation of traditional orchards	100	ha
ES	HC8	Restoration of woodland	1600	ha
ES	HC9	Creation of woodland in the SDA	100	ha
SFI 23	HRW3	Maintain existing hedgerow trees, or establish new hedgerow trees	32200000	m

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