CENTRE FOR EVIDENCE-BASED CONSERVATION

SYSTEMATIC REVIEW No. 11

THE EFFECTIVENESS OF LAND-BASED SCHEMES (INCL. AGRI-ENVIRONMENT) AT CONSERVING FARMLAND BIRD DENSITIES WITHIN THE U.K.

REVIEW REPORT

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COVER SHEET

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Systematic Review Summary

BACKGROUND

Farmland bird species have suffered considerable population declines and range restrictions over the past three decades. This has been highlighted as an issue of major concern, throughout many western European countries. Numerous studies have focused on the possible causes for the decline of farmland bird species, however, it was not until the 1990s that the full scale and of this problem became apparent. The combination of agricultural intensification, especially after the U.K. joined Europe and the Common Agricultural Policy, weed control through the increased use of herbicides, the change from spring sown crops to autumn cropping systems and increased stock densities are all agreed to be primary causes of this dramatic decline (Donald *et al*. 2001; Vickery *et al*. 2001; Berendse *et al.* 2004).

Based on large scale monitoring across Europe the value of agri-environment schemes have been questioned due to mixed results across plant, invertebrates and bird species (Kleijn, *et al.* 2006). This systematic review seeks to clarify the situation within the UK, by assessing the available evidence within the public domain on the effectiveness of land-based schemes (incl. agri-environment schemes), at the prescription level, when possible, at conserving farmland bird species densities.

OBJECTIVES

What effects do the different land-based schemes (especially agri-environment) and their prescriptions have on (a) total farmland bird densities and (b) individual species densities within the U.K.?

SEARCH STRATEGY

Electronic databases
ISI Web of Knowledge (WoK), Science Direct (Agricultural and Biological Sciences), JSTOR, Blackwell Synergy, Index to Theses, COPAC, Royal Agricultural College, Wildlink, Countryside Council of Wales (CCW) WebCat, Centre for Ecology & Hydrology (CEH) web catalogue, Directory of Open Access Journals.

Other searches
In addition further internet searches using www.alltheweb.com, and http://scholar.google.com/ (Google Scholar Beta). The following U.K. statutory bodies and NGOs were contacted and/or libraries searched: EN, SNH, CCW, Joint Nature Conservation Committee (JNCC), BTO, RSPB, BirdLife International, NFU, Farming and Wildlife Advisory Group (FWAG), Defra, National Trust, & UK Wildlife Trusts. All searches were conducted during March/April 2005.

STUDY SELECTION CRITERIA

Studies were included if they fulfilled the following selection criteria:

Bird Population as Subject
Studied one (or more) of the following farmland bird species:
Bullfinch (*Phrrhula pyrrhula*), Cirl Bunting (*Emberiza cirius*), Corn Bunting (*Miliaria calandra*), Corncrake (*Crex crex*), Goldfinch (*Carduelis carduelis*), Greenfinch (*Carduelis chloris*), Grey Partridge (*Perdix perdix*), Jackdaw (*Corvus monedula*), Lapwing (*Vanellus vanellus*), Linnet (*Carduelis cannabina*), Reed Bunting (*Emberiza schoeniclus*), Red-backed Shrike (*Lanius collurio*), Rook (*Corvus frugilegus*), Skylark (*Alauda arvensis*), Song Thrush (*Turdus philomelos*), Spotted Flycatcher (*Muscicapa striata*), Starling (*Sturnus vulgaris*), Stone Curlew (*Burhinus oedicnemus*), Tree Sparrow (*Passer montanus*), Turtle Dove (*Streptopelia turtur*), Whitethroat (*Sylvia communis*), Woodpigeon (*Columba palumbus*), Yellowhammer (*Emberiza citronella*), Yellow Wagtail (*Motacilla flava*).

Interventions of Interest
Farms entered into land-based, agri-environmental schemes, or experimental plots/land/fields which simulated past, present or future land-based options/prescriptions.

Outcome Measures
Any of the following measures: 1) the number of birds, 2) density of bird species (territory, nest, etc.), 3) overall change in individual species' abundance over time.

Types of Study (Comparator)
A plot, field or site that is not included within a land-based scheme/prescription. The experimental design of the article was required to be a randomised control/block trial, control trial, site comparison, or time series experiment with a baseline. Articles were excluded if they were 1) only qualitative, 2) speculating on ideal land-based scheme designs without presenting evidence to support the authors recommendations, 3) based on the outputs of models.

DATA ANALYSIS

Meta-analysis was used to combine the effect sizes across all studies and test their level of significance. Sensitivity analyses were performed on the data to determine the effect of the inclusion/exclusion of different seasons (Summer and Winter densities), farmland bird species and individual prescriptions.

MAIN RESULTS

The searching of all electronic databases and the internet produced 5506 references. After duplicates were removed a total of 3070 unique references remained for assessment at title and abstract stage, of which 305 required full text assessment against the above inclusion criteria. Subsequent assessment yielded a total of 30 studies which were relevant for inclusion within the systematic review.

Data pertaining to four land-based schemes (Arable Stewardship Pilot Scheme, Countryside Stewardship, Organic Cropping and Set-aside) and two individual prescriptions, (Stubble and Wild-Bird Cover) were captured by the systematic review process. In addition data pertaining to 18 of the desired 24 species was captured with varying number of datasets covering either winter or summer densities.

Winter data
All four schemes and the two prescriptions contained significantly higher winter densities of total farmland birds (all species analysed together). The individual species analyses provided mixed results concerning their comparative utilisation of agri-environment scheme fields and conventional cropping systems. Data pertaining to 15 of the 18 species (83%) were captured (no data were available on Cirl Bunting (*Emberiza cirius*), Lesser Whitethroat (*Sylvia curruca*) and Yellow Wagtail (*Motacilla flava*)). Of the 15, eight species (Corn Buntings (*Miliaria calandra*), Greenfinch (*Carduelis chloris*), Grey Partridge (*Perdix perdix*), Lapwing (*Vanellus vanellus*), Linnet (*C. cannabina*), Rook (*Corvus frugilegus*), Skylark (*Alauda arvensis*) and Song Thrush (*Turdus philomelos*)) had significantly higher densities on agri-environment fields compared to conventional cropping. No species had higher densities on conventional agricultural fields compared to those fields entered under agri-environment scheme agreements.

Summer data
Mixed results were observed for the summer. Data were only available for Arable Stewardship Pilot Scheme, Organic Cropping and Set-aside. Both Organic Cropping and Set-aside contained significantly higher summer densities of total farmland birds, while the Arable Stewardship Pilot Scheme made no significant difference. No data were available on individual prescriptions for summer bird densities.

For the individual species analysis, data pertaining to 17 of the 18 species were captured (no data were available on Tree Sparrows (*Passer montanus*)). Six (Cirl Buntings, Grey Partridge, Lapwing, Rook, Skylark and Woodpigeon (*Columba palumbus*)) had significantly higher densities on agri-environment fields compared to conventional cropping. Ten species (Corn Bunting, Goldfinch, Greenfinch, Jackdaw (*C. monedula*), Lesser Whitethroat, Linnet, Reed Bunting (*E. schoeniclus*), Song Thrush, Starling (*Sturnus vulgaris*) and Yellowhammer (*E. citrinella*)) showed no statistically significant difference in density on either land-based schemes or conventional agricultural fields. Yellow Wagtail had significantly higher densities on conventional cropping fields compared to those entered into agri-environment schemes.

CONCLUSIONS

Available evidence, within the public domain, supports the effectiveness of land-based schemes for maintaining higher densities of farmland bird species, especially during winter periods, compared to conventionally cropped fields. Land-based scheme prescriptions provide additional food resources for wintering bird species at a vital time of the year, when resources had previously been depleted by the intensification of farmland within the U.K.

Although "total" farmland bird densities increase, it is important to appreciate which bird species respond positively to each scheme or, more importantly, to each individual management prescription/option. This is especially important if the targeted species have restricted ranges (e.g. Cirl Bunting) or are migratory (e.g. Lesser Whitethroat and Yellow Wagtail). It would be a waste of resources and possibly detrimental for target species (i.e. reducing densities and restricting ranges further) if inappropriate prescriptions were established in particular areas. Unfortunately, only a partial picture can be developed as there was insufficient high quality experimental evidence readily available within the public domain to analyse the effectiveness of each of the individual prescriptions available under umbrella land-based schemes. However, the evidence does highlight the effectiveness of wild bird (seed) cover and winter stubbles to provide suitable habitat and food resources for a range of farmland bird's wintering periods.

Further guidance is required in future agri-environment scheme documentation provided to farm/land managers. The objectives of each prescription within the scheme should be clearly described, providing managers with a greater understanding of why each prescription might benefit the biodiversity on their farm/land.

The evidence synthesised within this review, although allowing the assessment of the effectiveness of fields entered into land-based management schemes to contain significantly higher farmland bird densities, does not allow conclusions to be drawn on how bird species population trends respond to these additional resources. Whether species are simply redistributing between the available resources by aggregating in fields under agri-environment management and deserting conventional fields (no change in population trend), or experiencing increased breeding success or over-winter survival rate (positive population trend) giving evidence of species recovery, is unknown.

Currently, there appear to be two scales used to measure the success of land-based schemes. The first is an "overall scheme" scale which is used at political or policy level. Therefore if total farmland bird species abundance, or even individual species are increased due to introduction of land-based schemes then that scheme can be considered a success. The second measures success of land-based schemes at the individual "prescription" scale, and thus has greater biological meaning. It is therefore disappointing that datasets for only two prescriptions were captured. Even though the individual prescriptions were based on knowledge of bird resource needs, prior to being introduced as an option in land-based schemes, their effectiveness still needs to be ascertained to ensure that they are delivering the results that were initially predicted, in addition to the overall scheme's effectiveness.

Further investigation into farmland bird population trends is required via manipulative factorial or randomised controlled experiments, although these are both resource intensive in terms of time and finances. Careful consideration must be given to the level of replication, as the assessment of land-based interventions such as agri-environment schemes requires large units of replication. Alternatively, comparisons of outcome metrics such as over-winter survival, breeding productivity/fledgling survival, within the various landscape scales (fields/farms/regions) with and without land-based scheme options would allow the identification of farmland bird species population trends and provide suitable data to model national population trends.

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1. BACKGROUND

Population declines of farmland bird species have been highlighted as a conservation issue of concern in many western European countries (Berendse *et al*. 2004). Within the U.K., farmland bird populations have decreased by an average of 40% over the last 30 years (Siriwardena *et al.* 1998). The scale and causes of these declines did not become apparent until the mid 1990s. Agricultural intensification (especially after the U.K. joined the European Union (EU) and adopted the Common Agricultural Policy); weed control through the increased use of herbicides; the change from spring sown crops to autumn sown cropping systems, and increased stock densities are cited as primary causes of this dramatic decline (Donald *et al*. 2001; Vickery *et al*. 2001; Berendse *et al.* 2004).

In 1992 the EU provided member states with its Agri-environment Regulation 2078/92 to assist in the development of land-based and agri-environment schemes (collectively referred to as land based schemes from this point) to address the problem of intensification of farming systems, and halt the decline of biodiversity within the farming landscape (Kleijn and Sutherland, 2003; Berendse *et al.* 2004). These and subsequent EU regulations allowed each member state to control the design and implementation of national agri-environment schemes. Since 1994, approximately £24.3 billion has been spent on schemes within the EU (Bradbury *et al.* 2004).

In the U.K., a wild bird population index has been established as one of a number of headline indicators of the sustainability by the Department of Environment, Food and Rural Affairs (Defra) policies (Bradbury *et al.* 2004). The farmland bird trend (a subset of the wild bird index) declined by 46% between 1970s and 2000 (Gregory *et al.* 2002). Defra adopted a Public Service Agreement (PSA) target in 2000 'to care for our living heritage and preserve natural diversity by reversing the long term decline in the number of farmland birds in England by 2020.' Land-based schemes are seen as the primary policy mechanism for achieving these targets (Evans *et al.* 2002; Walker *et al.* 2004a). These schemes provide financial incentives for land managers (particularly farmers) to adopt environmentally beneficial management practices allowing, dependant upon the scheme, the farmer to choose individual management options (prescriptions) that can be undertaken upon their farm to provide additional resources to rural biodiversity. For example, within the Environmental Stewardship scheme, recently rolled out England wide, there are over 50 options that are available to the Entry Level tier of the scheme. Each option is designed for a specific purpose, (e.g. wild bird cover provides nesting cover and seed, while beetle banks provide increased invertebrates) and on a whole would produce wide heterogeneity of resources available to farmland biodiversity. However, it is not a requirement to undertake all options on each farm entered within the scheme. Therefore, although two adjacent farms may be entered into the same scheme, the individual options the farm manager chooses might differ considerably, and therefore the bird species (and other species) that are likely to benefit will also differ. It is therefore important to establish not only if each scheme is effective at contributing to the reversal of farmland bird species trends, but also which bird species benefit from each individual prescription so they can be properly targeted to give the greatest benefit. It is noted that land-based scheme options are designed to assist more than just bird species. However, this systematic review is solely focused on their impact on bird species.

There has already been considerable debate on whether land based schemes are effective in producing ecological benefits for the target species (Aebischer *et al.* 2000; Kleijn *et al.* 2001; Peach *et al.* 2001; Kleijn and Sutherland 2003; Berendse *et al.* 2004; Walker *et al.* 2004a; Kleijn *et al.* 2006). On the one hand, Aebischer *et al.* (2000) and Berendse *et al.* (2004) show that, since the introduction of schemes providing specialised management, increases in the abundance of Grey Partridge (*Perdix perdix*), Cirl Bunting (*Emberiza cirius*) and other farmland bird species have been recorded. On the other hand, large scale experiments across Western Europe by Klein *et al.,* (2006) have shown that bird abundance does not significantly differ on scheme fields compared to conventional agricultural systems. In fact in Germany, Red Data Book species were found to be more abundant on control fields than on those fields under agri-environment scheme management.

Despite the conflicting findings of recent research, no systematic review has been undertaken to assess the available evidence within the public domain on the effectiveness of land based schemes. We use an explicit systematic review methodology (Pullin & Stewart, 2006; Roberts *et al*. 2006) to provide a quantitative summary of the effectiveness of schemes and their options at increasing total farmland bird densities, and the densities of individual species.

2. OBJECTIVES

What effects do the different land-based schemes (especially agri-environment) and their prescriptions have on farmland bird densities within the U.K.?

To answer the above objective, the question was unpacked into the following two sub-questions:

(1) What are the effects of the different land-based schemes on total farmland bird densities?

(2) How have individual species densities responded to land-based schemes?

Please note: Not all prescriptions delivered by land-based schemes (or the schemes themselves, e.g. organic farming and set-aside) are targeted towards providing additional resources (e.g. nesting, food) for farmland bird species. However, some schemes and prescriptions, such as set-aside, have been reported within the literature to be beneficial to non-target species. We are assessing the available scientific evidence to establish each scheme's (and when possible prescription's) effectiveness at containing higher densities of farmland bird species compared to conventional cropping systems, irrespective of whether they were designed to target the particular species or not. This will highlight those scheme (and prescriptions), that are of benefit to farmland birds and provide an evidence base for future designs of schemes (and prescriptions).

3. METHODS

3.1. Question Formulation

The need for a systematic review on the effectiveness of land-based schemes and their individual prescriptions at increasing farmland bird species density was identified through consultation with English Nature (EN), The Royal Society for the Protection of Birds (RSPB) and Countryside Council for Wales (CCW), who also chose the target bird species reviewed in this document. An initial draft protocol was developed and circulated to UK stakeholders [EN, CCW, Scottish Natural Heritage (SNH), RSPB, Game Conservancy Trust (GCT), British Trust for Ornithology (BTO), National Farmers Union (NFU) and Defra (U.K. government - Department for the Environment, Food and Rural Affairs] for comment. After further consultation with all agencies, including follow-up phone calls, a finalised version of the protocol was developed (www.cebc.bham.ac.uk/protocols.htm), stating the objectives of the review (see above), the criteria for the inclusion and exclusion of studies within the review (see below) and the presentation and assessment of both data quality and data analysis.

3.2. Search Strategy for the Identification of Studies

The search strategy was designed to be inclusive, so that all references to land-based schemes, farmland birds and finally each of the target species were captured. The following online literature databases were searched to identify relevant articles and reports (dates refer to the database coverage of literature)

1. **ISI Web of Knowledge** (**WoK**) using CrossSearch Form involving the searching of the following products:
   ISI Web of Science (1981 to present).
   ISI Proceedings (1990 to present).
2. **Science Direct** – Agricultural and Biological Sciences (1823 to present).
3. **JSTOR**.
4. **Blackwell Synergy.**
5. **Index to Theses** (1970 to 2003).
6. **COPAC** – database of the 24 main British and Irish university libraries and the British Library and National Library of Scotland.
7. **Royal Agricultural College** – Online Library Catalogue.
8. **Wildlink** – English Nature's Library Catalogue (only available on-site).
9. **Countryside Council of Wales (CCW) WebCat** - Library Catalogue.
10. **Centre for Ecology & Hydrology (CEH) online web catalogue.**
11. **Directory of Open Access Journals.**

The following search terms were used on all the above databases to identify the initial library of all possibly relevant articles. For each of the bird species names two searches were undertaken when the electronic literature databases did not allow full use of boolean operators.

1. Set-aside
2. Agri-environment*
3. Farmland bird*
4. Farmland bird* AND set aside/agri-environment*
5. Stubble* AND bird*
6. Bullfinch/*Phrrhula pyrrhula* AND agri-environment*
7. Corn Bunting/*Miliaria calandra/ (*also known as *Emberiza calandra)* AND agri-environment*
8. Corncrake/*Crex crex* AND agri-environment*
9. Cirl bunting/*Emberiza cirius* AND agri-environment*
10. Goldfinch/*Carduelis carduelis* AND agri-environment*
11. Greenfinch/*Carduelis chloris* AND agri-environment*
12. Grey Partridge/*Perdix perdix* AND agri-environment*
13. Jackdaw/*Corvus monedula* AND agri-environment*
14. Lapwing/*Vanellus vanellus* AND agri-environment*
15. Lesser Whitethroat/*Sylvia curruca* AND agri-environment*
16. Linnet/*Carduelis cannabina (*also known as *Acanthis cannabina)*AND agri-environment*
17. Reed Bunting/*Emberiza schoeniclus* AND agri-environment*
18. Red-backed Shrike/*Lanius collurio* AND agri-environment*
19. Rook/*Corvus frugilegus* AND agri-environment*
20. Skylarks/*Alauda arvensis* AND agri-environment*
21. Song Thrush/*Turdus philomelos* AND agri-environment*
22. Spotted Flycatcher/*Muscicapa striata* AND agri-environment*
23. Starling/*Sturnus vulgaris* AND agri-environment*
24. Stone Curlew/*Burhinus oedicnemus* AND agri-environment*
25. Tree Sparrow/*Passer montanus* AND agri-environment*
26. Turtle Dove/*Streptopelia turtur* AND agri-environment*
27. Woodpigeon/*Columba palumbus* AND agri-environment*
28. Yellowhammer/*Emberiza citrinella* AND agri-environment*
29. Yellow wagtail/*Motacilla flava* AND agri-environment*

In addition, further internet searches using www.alltheweb.com, and http://scholar.google.com/ (Google Scholar Beta) were undertaken for the identification of further articles and unpublished (grey) literature e.g. in-house reports. In all cases only the website that was captured by the search engine was assessed, in the order which they appeared, (no links were followed from identified sites except to pdf or data files). Searches were completed for each of the keywords three times, with the first 50 "hits" being assessed for their relevance:

1. Standard search,
2. .pdf files only,
3. .doc OR .txt files only.

The following statutory and non-governmental organisations (NGOs) were inspected for further relevant material: EN, SNH, CCW, Joint Nature Conservation Committee (JNCC), BTO, RSPB, BirdLife International, NFU, Farming and Wildlife Advisory Group (FWAG), Defra, National Trust, & UK Wildlife Trusts were contacted and their publication lists searched for pertinent grey literature or unpublished data. All searches were conducted during March/April 2005.

The results of each search term on each database were imported into a separate EndNote™ library file. After all searches for a particular database were completed an overall database library was compiled, including all duplicates. All the database libraries were then incorporated into an overall online database library, recording the number of references captured. The same procedure was followed for reports and articles identified via internet searches. An overall library of all identified sources was finally compiled ready for filtering of duplicates and applicability for the review.

3.3. Study Inclusion Criteria

All references underwent a number of filtering processes for their inclusion within the final review and data analysis (see Fig 1, for the stages of the study selection process). First, all duplicates were removed using both the auto removal feature in EndNote™ and by hand searching. Second, a course title and abstract filter was undertaken to identify references that focused on the study of birds on, or using land-based scheme fields, or experimental plots which simulated past, present or future land-based options/prescriptions. Any reference which the reviewer was unsure of, due to lack of information, were included through to the full text stage. In addition, a subset of approximately 25% of the reference were assessed independently by a second reviewer; agreement on inclusion between the reviewers were considered to be "substantially good" Cohen's Kappa, $K = 0.729$ (Landis & Koch 1977), with any disagreements being discussed between the two reviewers.

Full text assessment was undertaken on articles fulfilling the previous filter. For an article to be included within the final review it was required to meet the following inclusion criteria:

Bird Population as Subject

Studied one (or more) of the following farmland bird species (Please note bird species were chosen by the initial stakeholder groups):
Bullfinch (*Phrrhula pyrrhula*), Cirl Bunting (*Emberiza cirius*), Corn Bunting (*Miliaria calandra* OR *Emberiza calandra*), Corncrake (*Crex crex*), Goldfinch (*Carduelis carduelis*), Greenfinch (*Carduelis chloris*), Grey Partridge (*Perdix perdix*), Jackdaw (*Corvus monedula*), Lapwing (*Vanellus vanellus*), Linnet (*Carduelis cannabina* OR *Acanthis cannabina*), Reed Bunting (*Emberiza schoeniclus*), Red-backed Shrike (*Lanius collurio*), Rook (*Corvus frugilegus*), Skylark (*Alauda arvensis*), Song Thrush (*Turdus philomelos*), Spotted Flycatcher (*Muscicapa striata*), Starling (*Sturnus vulgaris*), Stone Curlew (*Burhinus oedicnemus*), Tree Sparrow (*Passer montanus*), Turtle Dove (*Streptopelia turtur*), Whitethroat (*Sylvia communis*), Woodpigeon (*Columba palumbus*), Yellowhammer (*Emberiza citrinella*), Yellow Wagtail (*Motacilla flava*).

Interventions of Interest
Farms entered into land-based schemes, or experimental plots/land/fields which simulated past, present or future scheme options/prescriptions.

Outcome Measures
Any of the following measures: 1) the number of birds (with a measure of field area presented separately), 2) density of bird species (territory, nest, etc.), 3) overall change to individual species' abundance over time.

Types of Study (Comparator)
A plot, field or site that is not included within a land-based scheme/prescription. The experimental design of the article was required to be a randomised control/block trial, control trial, site comparison, or time series experiment with a baseline. Any data derived from models, inferred across areas or solely qualitative were rejected.

Attempts were made to contact first authors of all accepted articles, if any questions arose concerning the clarification of the reported results, missing data values or further explanation of their methodology or findings.

3.4. Data Extraction

We extracted the mean, sample size and standard deviation for both the experimental and control plots of each of the articles. In addition further information pertaining to the exact methods used in each study's experimental design was recorded to allow any reasons for heterogeneity to be investigated. This included methodological variables (e.g. plot sizes), population characteristics (e.g. species, age) and environmental factors (e.g. soil type, habitat/prescription type and area, time of year surveys were undertaken and location of sites). These potential reasons for heterogeneity had been identified and discussed with the question setters prior to undertaking any data extraction to allow information to be recorded for post hoc analysis if sufficient data were available.

3.5. Study Quality Assessment

All studies included within the systematic review had their methodological quality assessed against a hierarchy of evidence adapted from Stevens and Milne (1997) and Pullin and Knight (2001). This involved assessing the design, baseline comparisons, treatment variations, parameter of abundance, scale of experiment and the level of replication undertaken in each study against an a priori set of values (see Appendix 1). The greater the homogeneity between the treatment and control plots, the higher the quality assessment score achieved by the study. Any differences in the study quality scores were considered to be a possible reason for heterogeneity and were to be investigated further through the use of sensitivity meta-regression, when possible. Summary tables based on the results of each individual study quality assessment (see Appendix 2) and potential reasons for heterogeneity are presented below (Table 1).

3.6. Data Synthesis

Data from both intervention and control plots of each study were combined using meta-analysis. This approach allows individual studies to be combined to give the overall effect of an intervention (Gurevitch & Hedges 1999). Any missing variance values were extrapolated using the mean substitution method (Roth & Switzer 1995), with the mean value of the other variances from those data points involved in that particular meta-analysis replacing the missing values.

Each of the different schemes and bird species were separated into subgroups relating to the specifics of the intervention being assessed. A number of analyses were undertaken: First, a "scheme" or "individual prescription" analysis, involving all species with data on fields/farms involved in that particular land-based scheme (e.g. arable pilot stewardship scheme or wild bird cover crop). Second, separate meta-analyses were undertaken for each farmland bird species.

Cohen's D effect sizes (Egger *et al.* 2003; Sutton *et al.* 2000) were calculated for each independent data point where the mean, number of replicates and standard deviation was known. Standardized Mean Difference (SMD), DerSimonian-Laird (random effects) pooled effect $d+$ meta-analysis was used to combine the effect sizes across all studies (Egger *et al.* 2003). This method expresses the size of the treatment effect in each data point relative to the variability observed, allowing different abundance measures to be combined allowing them to effectively be analysed against the same scale (Deeks *et al.* 2001). However, in this case all data were converted from differing scales presented by each article to the density of bird per hectare (ha^{-1}) prior to undertaking data synthesis.

Prior to each of the meta-analyses, heterogeneity was assessed by the use of Forrest plots and formal tests of heterogeneity "Q" non-combinability for $d+$ and I^2 inconsistency of $d+$ (Thompson & Sharp 1998). Publication bias was also assessed using Funnel plots of asymmetry along with formal tests, to see the effect of the inclusion and exclusion of grey literature (Egger *et al.* 2003).

4. RESULTS

4.1. Review Summary Statistics & Quality Assessment

The searching of all electronic databases and the internet produced 5506 references (Fig 1). After duplicates were removed a total of 3070 unique references remained for assessment at title and abstract stage, of which 295 were, required for full text assessment against the above inclusion criteria. Subsequent assessment yielded a total of 30 studies which were relevant for inclusion within the systematic review.

A summary of each of the accepted articles: experimental design, geographical coverage, land-based scheme/prescription and species studied are also presented below, (Table 1), to allow side by side comparisons of each of the included articles within this systematic review.

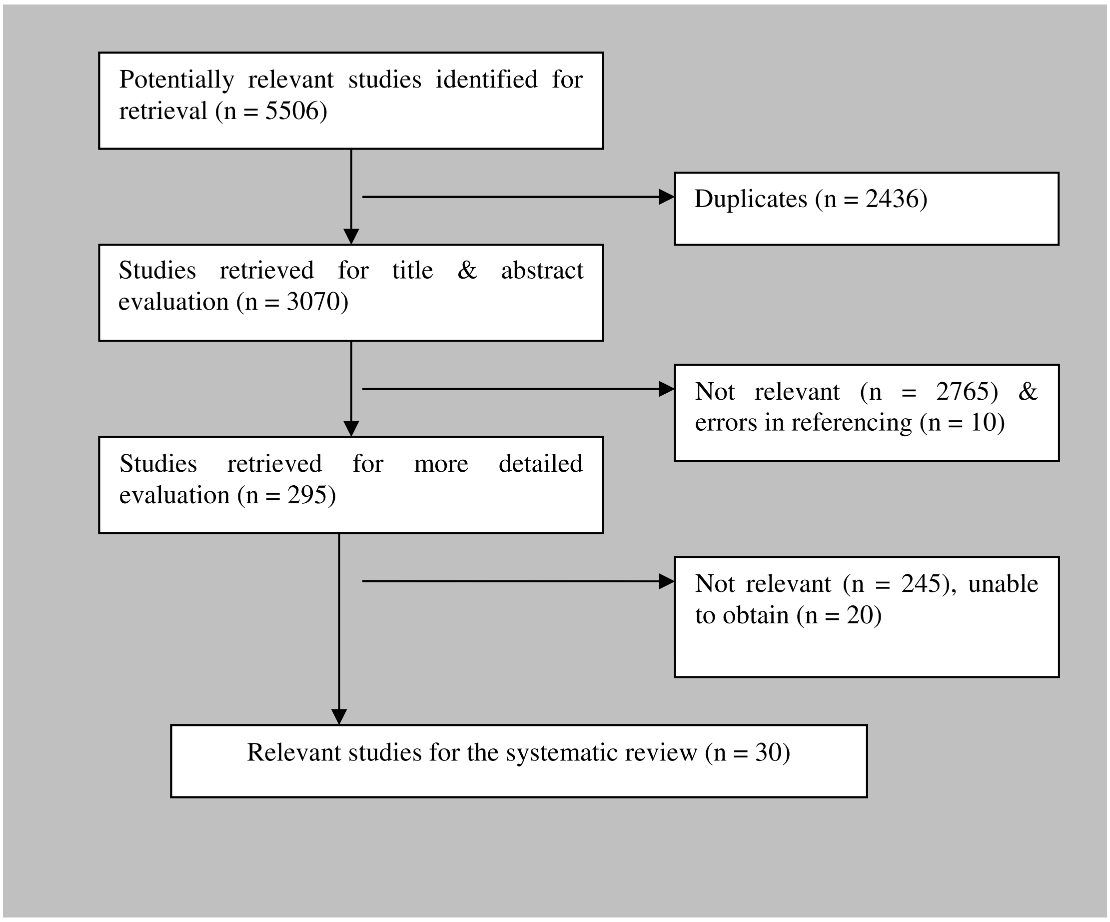

Fig. 1 Results of literature search and study selection process showing the final number of studies included in the systematic review. Values (n) are the number of studies at each stage (QUOROM statement flow diagram – see Moher *et al.* 1999).

Table 1: Summary of each of the accepted articles: experimental design, geographical coverage, land-based scheme/prescription and species studied.

Study	Location	Experimental Design	Years of exp.	Original Study Scale	Land-Based Scheme	Comparator Crops	Species of Studied
Aebischer, N. J. *et al* (2000)	Norfolk, U.K.	Site Comparisons	1992-98 (annual measures)	Farm (five farms/estates)	Estates undertaking Specialised Partridge Management	Local unmanaged estates	Grey Partridge Cirl Bunting
Berendse, F. *et al.* (2004)	South Devon, U.K.	Site Comparisons	1992-98	Farm	Countryside Stewardship Scheme providing grass margins & weedy winter stubbles	Adjacent unmanaged farms	Cirl Bunting
Boatman, N.D. & Stoate, C. (2002)	Norfolk, Hertfordshire & Leicestershire, U.K.	Randomised Block (RCT)	(98-99, 99-00 & 00-01) Winters	Field (three farms)	Winter seed bearing crops: (Borage, buckwheat, fat hen, forage rape, linseed, millet, mustard, oats, quinoa, sunflower, triticale, kale, teasel, chicory & evening primrose).	Conventional crop species: (Barley & wheat)	Goldfinch, Greenfinch, Reed bunting, Skylark, Yellowhammer
Boatman, N.D. *et al.* (2000)	East Leicestershire & Lincolnshire fens, U.K.	Time Series (*not entered in meta-analysis*)	1992-95 or 1992-98	Farm (two farms)	1) Use of Stubbles 2) Wild game management incl. late hedge cuts and grassy field margins, mid-field beetle banks and wild-bird cover seed mixtures	Comparator lacked details to extract data (*not entered in meta-analysis*)	Goldfinch, Greenfinch, Linnet, Song Thrush, Skylark, Yellowhammer, White Throat
Bradbury, R.B. (2001)a	West Midlands & East Anglia, U.K.	Randomised Control Trial	1998/99 1999/00	Regional (two regions) & Farm (26/28 agreement farms & 24 control farms)	Arable Stewardship Pilot Scheme Option 1 Overwintered Stubbles: (a) Preceded by limited herbicide use. (b) Not preceded by ltd herbicide use. (a+b) ltd herbicide use in cereal or linseed, followed by overwintered stubble and spring/summer fallow. (c) Overwintered stubble + spring crop (a+c) ltd herbicide use in cereal or linseed, followed by overwintered stubble spring crop. Option 2 Undersown Spring Cereals: (a) retention of stubble followed by	Conventionally managed farms	Results grouped Granivorous Passerines, Thrushes & Skylark

					spring crop. (b) Involves the retention of grass ley over winter. (a+b) overwintered stubble, followed by undersown spring cereal & grass ley. <u>Option 3</u> Crop Margins with NO Summer Insecticides: (a) conservation headland. (b) As (a) with no fertiliser applications. <u>Option 4</u> Field Margins & Strips: (a) Grass 4-12m wide. (b) Beetle banks (c) uncropped wildlife strip 4 - 12m wide. <u>Option 5</u> Wildlife Seed Mixtures		
Bradbury, R.B. (2001)b	West Midlands & East Anglia, U.K.	Randomised Control Trial	1998/99 1999/00	As above	<u>Arable Stewardship Pilot Scheme</u> (options as above)	Conventionally managed farms	Bullfinch, Corn Bunting, Goldfinch, Greenfinch, Jackdaw, Lapwing, Linnet, Reed Bunting, Skylark, Starling, Song Thrush, Tree Sparrow, Turtle Dove, Whitethroat, Woodpigeon, Yellowhammer, Yellow Wagtail
Bradbury, R.B. *et al.* (2004)	West Midlands & East Anglia, U.K.	Randomised Control Trial	1998 & 2002	As above	<u>Arable Stewardship Pilot Scheme</u> (options as above)	Conventionally managed farms	Grey Partridge (total birds & adults only)
Bradbury, R.B. *et al.* (2000)	Oxfordshire, Wiltshire & Warwickshire, U.K.	Site comparisons	1994-97 (annual measures)	Farm (97 farms across three counties)	Farms with set-aside (four were organic)	Farms without set-aside	Yellowhammer
Brickle, N.W. & Harper, D.G.C. (2000)	Worthing, West Sussex, U.K.	Control Trial	Winters of 1995-97	Region (10.5km^2)	Stubble provision	Grazing pasture (Cattle), Brassicas	Corn Buntings

Brickle, N.W. & Harper, D.G.C. (2002)	South Downs, West Sussex, U.K.	Control Trial	Summer of 1995-97	Region (10.5km^2)	Non-rotational set-aside & grassy margins	Winter wheat, spring barley, Brassicas, un-intensive grasslands	Corn Buntings
Browne, S. *et al.* (2000)	Across the whole of the U.K.	Site comparison	Summer 1997	National (608 Tetrad squares)	Set-aside	Brassicas, cattle pasture improved pasture, legumes, misc. natural grassland, misc. cereals, root crops, spring cereals, scrub, sheep pasture, unimproved grassland, winter cereal.	Skylarks
Chamberlain, D.E. *et al*. (1999)	Plots across England & Wales, U.K.	Control Trial	1992 & 93 (measured Autumn & Winter)	Farm (22 organic paired with local conventional)	Organic crops	Conventional crops	Goldfinch, Greenfinch, Grey partridge, Lapwing, Linnet, Skylark, Song thrush, Starling, Woodpigeon, Yellowhammer.
Donald, P.F. *et al.* (2002)	East Anglia, Oxfordshire & Dorset, U.K.	Site Comparison	1996-98 (Summer average)	Farm/Field (13 across three regions)	Set-aside	Cereals, grassland or other	Distribution of Skylark nests
Hancock, M.H. & Wilson, J.D. (2003)	Plots across Scotland, U.K.	Control Trial across multiple sites	Unknown year (Winter)	National (100 Tetrads)	<u>Stubbles</u> (Undersown cereal/barley/oat/wheat & oil-seed rape)	Rough ploughed fields, smooth bare fields, root crops, brassica fodder, grazed fodder, winter oilseed rape, winter cereal, re-seeded grass, rough grass, waste, marsh, field boundary	Corn Bunting, Goldfinch, Greenfinch, Linnet, Reed Bunting, Skylark, Tree Sparrow, Yellowhammer,

Henderson *et al.* (2003)	Plots across England, U.K.	Control Trial across multiple sites	1998 -01 (average of Winters	Field (192 plots from 161 farms)	<u>Winter seed bearing crops</u>: Buckweed, canary grass, 1st year kale, 2nd year kale, linseed, millet, mustard, maize, phacelia, quinoa, oilseed rape, sunflowers, teasel, turnips, cereal stubble, grassland, non-cereal stubble, sugar beet.	<u>Winter cereals</u> (agri crops bird densities relative to winter cereals – as no actual measure of winter cereals densities not used in meta-analysis).	Bullfinch, Chaffinch, Corn Bunting, Goldfinch, Grey partridge, Linnet, Reed Bunting, Rook, Skylark, Song Thrush, Tree Sparrow, Woodpigeon, Yellowhammer.
Henderson *et al.* (2000)	Norfolk, Suffolk, Dorset & Devon, U.K.	Control Trial across multiple sites	1996 or 1997	Regional/Farm (11 farms across two regions)	Set-aside	Winter wheat cropped	Farmland birds incl. of raptors & waders
Lock, L. (1999)	South Devon, U.K.	Site comparison	1992 & 98	Regional (43 Tetrads)	<u>Countryside Stewardship Scheme</u> (CSS) farms	Non-CSS farms	Cirl Bunting
Mason, C.F. & Macdonald, S.M. (2000)	Tendring district, NE Essex, U.K.	Control Trial	1994-96	Regional (10 tetrads within a 325km^2 area)	Set-aside & Conservation Grasslands	Autumn sown (wheat, barley, rape) Spring sown (cereal, potatoes, rape, peas, beans, salad crops, sugar beat, linseed, maize) & Pasture	Skylark, Yellow wagtail (territories) Linnet, Skylark, Turtle dove, Whitethroat, Yellow wagtail, Yellowhammer (Jacobs *D* preference index)
Morris, A.J. *et al* (2004)	Yorkshire, Norfolk, Suffolk, Cambridgeshire, Oxfordshire & Wiltshire, U.K.	Control Trial across multiple sites	2002	Field (45 plots, 3 treatments each grown on 15 farms)	Un-drilled field patches, Wide spaced crop lines	Winter wheat	Skylark (nest density)
O'Leary, E. (1995)	County Durham, U.K.	Control Trial	1995	Field (27 line transects)	Set-aside	Winter wheat, barley, Spring wheat, barley, veg. crops, oilseed rape, grassland	Jackdaw, Lapwing, Rook, Woodpigeon

Parish, D.M.B. & Sotherton, N.W. (2004)	Plots across Scotland, U.K.	Site comparison	2000-02 (combined Winters)	Farm (20 paired farms)	Game crop Set-aside & Stubbles	Conventional cropping	Goldfinch, Greenfinch, Skylark, Song Thrush, Yellowhammer
Peach, W.J. *et al.* (2001)	South Devon, U.K.	Control Trial	1992-99	Regional (tetrads)	Countryside Stewardship Scheme (CSS) farms	Non-CSS farms	Cirl Bunting
Perkins, A.J. *et al.* (2000)	Oxfordshire, Wiltshire, Warwickshire, U.K.	Control Trial across multiple sites	1997-98 (Winter)	Field (77 plots)	Grass or grass-clover ley	Pasture, rough grass	Corn Bunting, Goldfinch, Greenfinch, Grey partridge, Jackdaw, Lapwing, Linnet, Reed Bunting, Rook, Skylark, Song thrush, Tree Sparrow, Woodpigeon, Yellowhammer
Poulsen, J.G. *et al.* (1998)	Dorset, Hampshire, U.K.	Control Trial	1992 (Summer)	Field (68-88 fields across three farms)	Set-aside, ley grass	Permanent pasture, silage grass, herbage seed, spring cereal, winter cereal	Skylark
Robinson, R.A. (1997)	Norfolk coast, U.K.	Control Trial	1994/95, 95-96 (Winters)	Field (varies each study year)	Cereal stubble	Winter cereal	Corn bunting, Grey Partridge, Linnet, Skylark, Yellowhammer
Stoate, C. *et al.* (2003)	County Durham, U.K.	Control Trial using historical data as comparator	1999-01	Farm	Wild bird crop (WBC)	Data from prior to WBC	Goldfinch, Greenfinch, Linnet, Reed bunting, Song thrush, Yellowhammer
Tapper, S. & Aebischer, N.J. (2001)	East Anglia, West Midlands, U.K.	Randomised control trial	1998 & 2000	Farms (20 paired farms)	Arable Stewardship Pilot Scheme (options as above)	Conventionally managed farms	Grey partridge
Wakeham-Dawson, A. & Aebischer, N.J. (1998)	South Downs, U.K.	Control Trial	1995-96 & 96-97 (Winters)	Farm/Field (40 farms, 200 fields)	Environmentally Sensitive Areas (ESA) (permanent grassland or cereal stubble)	Winter wheat, downland turf, non-ESA grassland	Corn bunting, Rook, Skylark

Watson, A. & Rae, R. (1997)	NE Scotland U.K.	Control Trial across multiple sites	1988-92 (combined)	Field (10 paired)	Set-aside	Conventionally managed farms	Corn bunting, Lapwing, Skylark
Wilson, J.D. *et al.* (1997)	Oxfordshire, Suffolk, U.K.	Control Trial across multiple sites	1993-95 (Summers)	Farm (7 farms, 3 organic and 4 conventional)	Organic farms (All cereal, winter cereal, silage, grazed pasture, set-aside)	Intensive farms (All cereal, winter cereal, silage, grazed pasture, set-aside)	Skylark

Four articles reported on the Arable Stewardship Pilot Scheme, three articles on the Countryside Stewardship Scheme (CSS), three articles on Organic farming, five articles on Stubble provision, 11 on general set-aside provision (eight rotational and three non-rotational studies), five on Wild Bird Cover/mixes (WBC) and three on other provisions, including Environmentally Sensitive Areas (ESAs) and Game crops. Some articles assessed more than one scheme. The experimental methodologies used by the accepted studies included five randomised control trials, 20 control trials, seven site comparisons and one time series. All studies reported on experiments conducted between 1985 and 2005.

The bird species listed in Table 2 had data captured on their density of territories or nests, bird numbers or preference indices of field usage. Species with one or no datasets could not be utilised within the subsequent meta-analysis. Therefore the bird species analyses drop from 24 to 18 separate species.

Table 2: A breakdown of the data available for farmland bird species captured from articles accepted for inclusion in the systematic review. The total number of datasets which could be extracted is presented for each bird species.

Bird Species	Total N^{o}. of datasets extracted
Bullfinch	1
Cirl Bunting	3
Corn Bunting	23
Corncrake	0
Goldfinch	12
Greenfinch	11
Grey Partridge	24
Jackdaw	5
Lapwing	23
Linnet	10
Red-backed Shrike	0
Reed Bunting	6
Rook	24
Skylark	101
Song Thrush	15
Spotted Flycatcher	0
Starling	7
Stone Curlew	0
Tree Sparrow	3
Turtle Dove	0
Whitethroat (Lesser)	2
Woodpigeon	15
Yellow Wagtail	28
Yellowhammer	16

4.2. Outcome of the Review: Meta-analysis results

4.2.1. Land-Based Scheme & Prescription Results

Data were available on bird densities on a total of 12,653 fields, of which 5,381 fields were under land-based scheme management and 7,272 fields farmed under conventional intensive cropping systems. By performing an all-encompassing meta-analysis, irrespective of the type of land-based scheme the fields were managed under, we were able to show that fields within land-based schemes contain significantly higher densities of farmland birds compared to conventional intensively farmed systems (SMD = 0.8558; 95% CI = 0.74 to 0.97; P <0.0001) but significant heterogeneity between each of the data-points exists (Cochran Q_{390} = 2789.33; P <0.0001, I^2 (inconsistency) = 86% (95% CI = 85% to 87%)). Therefore further investigation and analyses of the data were undertaken to establish the ecological causes of the heterogeneity.

Data were captured relating to four land-based schemes (Arable Stewardship Pilot Scheme, Countryside Stewardship, Organic Cropping, Set-aside). In addition to the overall scheme, data related to two individual prescriptions, (Stubble and Wild-Bird Cover) were available for analysis. Only these individual prescriptions could be analysed due to the original studies reporting only overall scheme data, instead of breaking their results down to the individual scale. Seasonal data were also available for both winter and summer bird abundance on the fields under these schemes (and options) compared to adjacent (or local) conventional intensive farming systems. It seems logical to separate the data into the two seasons as land-based schemes (especially agri-environments) were designed to provide extra resources to bird species during winter months. Please note that although set-aside and organic farming schemes were never designed for the needs of biodiversity (e.g. farmland birds) they have within the literature been shown to be of benefit for numerous species therefore have been analysed inline with the other land-based schemes.

Winter data

Separate analyses of each of the four schemes and the two individual prescriptions were undertaken to estimate the effectiveness of fields of each scheme at containing higher densities of total farmland bird species densities (Table 3). In all cases fields under the different land-based schemes contained significantly higher densities of farmland birds, compared to those fields under conventional intensive cropping systems. Further investigation of the reasons for the heterogeneity between the data-points of each of the schemes and prescriptions was undertaken using meta-regression, (result tables presented in Appendix 3). These results are discussed when significant heterogeneity is present.

Twenty data-points were available for the Arable Stewardship Pilot Scheme (SMD = 0.2575; 95% CI 0.14 to 0.38; P <0.0001) without significant heterogeneity between each of the data-points (Cochran Q_{19} = 13.95; P = 0.7866, I^2 (inconsistency) = 0%)).

Twenty six data-points were available for Countryside Stewardship (SMD = 0.7189; 95% CI 0.01 to 1.43; P = 0.0475) but there is significant heterogeneity between each of the data-points (Cochran Q_{25} = 67.32; P <0.0001, I^2 (inconsistency) = 62.9%; 95% CI = 39.1% to 74.7%)). Further investigation of the reasons for heterogeneity suggest that granivorous passerine species show preference for Countryside Stewardship fields compared to conventional intensively farmed agriculture (*Coeff.* = 4.936; *Std. Err.* = 2.23; z = 2.21; P = 0.027), while other guilds (Corvids, Thrushes & Skylarks) do not show any specific preferences.

Forty data-points were available for Organic farming (SMD = 0.2445; 95% CI 0.07 to 0.41; P = 0.0048) but there is significant heterogeneity between each of the data-points (Cochran Q_{39} = 88.89; P <0.0001, I^2 (inconsistency) = 56.1% (95% CI = 33.8% to 68.6%)). Further investigation of the heterogeneity with six variables (four different guilds of bird and two time related variables) that could be extracted for all data-points was undertaken, but do not show any clear pattern to explain why differences between the data-points existed.

Thirty six data-points were available for Set-aside fields (SMD = 2.5936; 95% CI 1.97 to 3.22; P <0.0001) but again there is significant heterogeneity between each of the data-points (Cochran Q_{36} = 339.04; P <0.0001, I^2 (inconsistency) = 89.7% (95% CI = 87.1% to 91.5%)). As above, further investigation of the heterogeneity with six variables (three different guilds of bird and three different comparator crops) that could be extracted for all data-points was undertaken, but do not show any clear pattern to explain why differences between the data-points existed.

The two individual prescriptions both contained significantly higher densities of total farmland bird species compared to the adjacent conventional farming fields.

For Stubble fields 52 data-points were available for meta-analysis (SMD = 0.9626; 95% CI 0.70 to 1.23; P <0.0001) but again there is significant heterogeneity between each of the data-points (Cochran Q_{52} = 354.85; P <0.0001, I^2 (inconsistency) = 85.6% (95% CI = 82.2% to 88.1%). As with the scheme results, further investigations of the heterogeneity were undertaken. Two guilds of farmland birds showed significantly higher densities in Stubble fields (Granivorous Passerines: *Coeff.* = 1.496; *Std. Err.* = 0.26; z = 5.85; P <0.001 and Corvids: *Coeff.* = 1.755; *Std. Err.* = 0.23; z = 7.72; P = <0.001).

For Wild Bird Cover fields 11 data-points were available for meta-analysis (SMD = 0.9626; 95% CI 0.70 to 1.23; P <0.0001) without significant heterogeneity between each of the data-points (Cochran Q_{11} = 7.90; P = 0.63, I^2 (inconsistency) = 0%).

Summer data

Mixed results were observed for the same schemes and prescriptions for summer densities of farmland bird species (Table 3). Firstly, data were only available for three of the land-based schemes (Arable Stewardship Pilot Scheme, Organic Cropping and Set-aside). Secondly, no data were captured during the search for literature on bird densities on fields of any individual prescriptions of land-based schemes during summer.

Thirty-one data-points were available for the Arable Stewardship Pilot Scheme, analysis which shows no difference between those fields under agri-environment management and those under conventional systems (SMD = 0.0013; 95% CI -0.47 to 0.47; P = 0.9956). There is only a slight degree of heterogeneity between each of the data-points (Cochran Q_{30} = 42.67; P = 0.0627; I^2 (inconsistency) = 29.7% (95% CI = 0% to 54.2%)).

For Organic cropping, only five data-points were available. However analysis showed that significantly higher densities of farmland bird species were present on fields under organic management (SMD = 2.2887; 95% CI 1.00 to 3.58; P = 0.0005) without significant heterogeneity between each of the data-points (Cochran Q_4 = 6.88; P = 0.1422; I^2 (inconsistency) = 41.9% (95% CI = 0% to 77.4%).

Finally, a total of 82 data-points were available for meta-analysis, showing that significantly higher densities of farmland bird species were present on fields removed from production and under Set-aside designation (SMD = 0.9512; 95% CI 0.73 to 1.17; P < 0.0001). Unfortunately, although there is significant heterogeneity between the data-points within this analysis (Cochran Q_{81} = 883.477061; P < 0.0001; I^2 (inconsistency) = 90.8% (95% CI = 89.5% to 91.9%)) the potential reasons (variables) that might explain this result were not consistently recorded for all data-points, therefore further meta-analysis and regression could not be performed.

4.2.2. Individual Species Results

As previously mentioned, data pertaining to 18 of the 24 farmland bird species originally sought were obtained for analysis within this systematic review. As with the land-based scheme analyses, the data were split into winter and summer monitoring and analysed separately for each species.

Winter data

Individual species analyses was possible for 15 farmland bird species (Table 4). Investigation of reasons of heterogeneity could not be investigated further due to the absence of any ecological or temporal variables being uniformly recorded throughout each species data-set.

Eight species (53% of the 15) had significantly higher densities on land-based scheme fields compared to those fields under conventional intensive agricultural systems. These include Corn Bunting (SMD = 0.8714; P < 0.0001), Greenfinch (SMD = 0.4552; P = 0.0196), Grey Partridge (SMD = 0.2491; P = 0.0040), Lapwing (SMD = 1.0491; P = 0.0036), Linnet (SMD = 0.3920; P = 0.0150), Rook (SMD = 0.2093; P = 0.0073), Skylark (SMD = 1.8152; P <0.0001) and Song Thrush (SMD = 0.3261; P = 0.0141).

Seven species (47% of the 15) showed no significant differences in density on land-based scheme and comparator fields. These species include Goldfinch (SMD = 0.2623; 95% CI -0.07 to 0.59; P = 0.1161), Jackdaw (SMD = 0.1201; 95% CI -1.15 to 1.39; P = 0.8526), Reed Bunting (SMD = 0.1016; 95% CI -1.22 to 1.43; P = 0.8805), Tree Sparrow (SMD = -0.3015; 95% CI -1.20 to 0.60; P = 0.5104), Woodpigeon (SMD = 0.3262; 95% CI -0.01 to 0.66; P = 0.0577) and Yellowhammer (SMD = 0.3232; 95% CI -0.03 to 0.67; P = 0.07).

Overall, none of the individual species analyses resulted in higher densities being present on conventional intensive agricultural fields compared to fields under land-based scheme management.

Summer data

Individual species analyses were possible for 17 farmland bird species (Table 5). As before, investigation of reasons heterogeneity could not be investigated further due to ecological or temporal variables not being uniformly recorded throughout each species data-set.

Six species (35% of the 17) had significantly higher densities on land-based scheme fields compared to those fields under conventional intensive agricultural systems. These included Cirl Buntings (SMD = 5.039; P <0.0001), Grey Partridge (SMD = 0.5027; P = 0.028), Lapwing (SMD = 0.7214; P = 0.0056), Rook (SMD = 0.9962; P = 0.0075), Skylark (SMD = 1.7738; P <0.0001) and Woodpigeon (SMD = 1.4946; P <0.0001).

Ten species (59% of the 17) showed no significant differences in density on land-based scheme and comparator fields. These species include Corn Bunting (SMD = -0.068; 95% CI -0.64 to 0.50; P = 0.8155), Goldfinch (SMD = 0.938; 95% CI = -0.56 to 2.43; P = 0.2196), Greenfinch (SMD = -1.451; 95% CI -5.22 to 2.31; P = 0.450), Jackdaw (SMD = 0.8325; 95% CI -1.85 to 3.52), Lesser Whitethroat (SMD = -0.5355; 95% CI -2.65 to 1.58; P = 0.6193), Linnet (SMD = -0.0582; 95% CI -1.47 to 1.36; P = 0.9357), Reed Bunting (SMD = 0.2633; 95% CI -1.31 to 1.84; P = 0.7435), Song Thrush (SMD = 0.2613; 95% CI -1.14 to 1.66; P = 0.7141) Starling (SMD = -5.0978; 95% CI – 15.70 to 5.50; P = 0.3459), and Yellowhammer (SMD = 0.607; 95% CI -0.27 to 1.47; P = 0.1758). The majority of the individual species analyses in this section were performed on small sized datasets, as the analyses were performed on data collected over solely the summer period. Again, as with the winter analyses, further data is required for a robust analysis of their abundance.

One species (6% of the 17), Yellow Wagtail (SMD = -1.117; 95% CI -1.82 to -0.42; P = 0.0017) had significantly lower densities on land-based scheme fields compared to conventional intensive agriculture.

Table 3: Results of the meta-analyses for each of the land-based schemes and prescriptions. Those schemes that show a significant increase in the density of farmland bird species in comparison to conventional cropping are highlighted in **bold**. n = the number of data points within each analysis.

Land-based scheme[1] or prescription[2]	*Season*	*n*	*Pooled effect size (d+)*	*95% confidence intervals*	*Significance*	*Heterogeneity significance*
Arable Stewardship Pilot Scheme (ASPS)[1]	Summer	31	0.0013	-0.47 to 0.47	p = 0.9956	p = 0.0627
	Winter	**20**	**0.2575**	**0.14 to 0.38**	**p <0.0001**	p = 0.7866
Countryside Stewardship[1]	Summer	No data available				
	Winter	**26**	**0.7189**	**0.01 to 1.43**	**p = 0.0475**	**p < 0.0001**
Organic[1]	**Summer**	**5**	**2.2887**	**1.00 to 3.58**	**p = 0.0005**	p = 0.1422
	Winter	**40**	**0.2445**	**0.07 to 0.41**	**p = 0.0048**	**p < 0.0001**
Set-aside[1]	**Summer**	**82**	**0.9512**	**0.73 to 1.17**	**p <0.0001**	**p < 0.0001**
	Winter	**36**	**2.5936**	**1.97 to 3.22**	**p <0.0001**	**p < 0.0001**
Stubble[2]	Summer	No data available				
	Winter	**52**	**0.9626**	**0.70 to 1.23**	**p <0.0001**	**p < 0.0001**
Wild Bird Cover[2]	Summer	No data available				
	Winter	**11**	**0.9197**	**0.63 to 1.21**	**p < 0.0001**	p < 0.727

Table 4: The meta-analysis results for each of the farmland bird species winter densities. Those bird species highlighted in **bold** show a significant increase in their densities on land-based schemes.

Farmland Bird Species	*Season*	*n*	*Pooled effect size (d+)*	*95% confidence intervals*	*Significance*	*Heterogeneity significance*
Cirl Bunting	Winter	No data available				
Corn Bunting	**Winter**	**14**	**0.8714**	**0.44 to 1.31**	**p < 0.0001**	p < 0.0001
Goldfinch	Winter	10	0.2628	-0.07 to 0.59	p = 0.1161	p = 0.1652
Greenfinch	**Winter**	**9**	**0.4552**	**0.07 to 0.84**	**p = 0.0196**	p = 0.0586
Grey Partridge	**Winter**	**14**	**0.2491**	**0.08 to 0.42**	**p = 0.004**	p = 0.6900
Jackdaw	Winter	2	0.1201	-1.15 to 1.39	p = 0.8526	p = 0.9483
Lapwing	**Winter**	**14**	**1.0491**	**0.34 to 1.76**	**p = 0.0036**	p < 0.0001
Lesser Whitethroat	Winter	No data available				
Linnet	**Winter**	**8**	**0.3920**	**0.08 to 0.71**	**p = 0.015**	p = 0.9159
Reed Bunting	Winter	4	0.1016	-1.22 to 1.43	p = 0.8805	p = 0.0613
Rook	**Winter**	**17**	**0.2093**	**0.06 to 0.36**	**p = 0.0073**	p = 0.7346
Skylark	**Winter**	**41**	**1.8152**	**1.38 to 2.25**	**p <0.0001**	p <0.0001
Song Thrush	**Winter**	**13**	**0.3261**	**0.07 to 0.59**	**p = 0.0141**	p = 0.0708
Starling	Winter	5	0.2308	-0.38 to 0.85	p = 0.462	p = 0.1007
Tree Sparrow	Winter	2	-0.3015	-1.20 to 0.60	p = 0.5104	p = 0.9601
Woodpigeon	Winter	6	0.3262	-0.01 to 0.66	p = 0.0577	p = 0.9802
Yellow wagtail	Winter	No data available				
Yellowhammer	Winter	10	0.3232	-0.03 to 0.67	p = 0.07	p = 0.1053

Table 5: The meta-analysis results for each of the farmland bird species summer densities. Those bird species highlighted in **bold** show a significant increase in their densities on land-based schemes Bird species that showed a significant increase in density on conventional cropping types are *underlined and italicised*.

Farmland Bird Species	*Season*	*n*	*Pooled effect size (d+)*	*95% confidence intervals*	*Significance*	*Heterogeneity significance*
Cirl Bunting	**Summer**	**3**	**5.039**	**4.15 to 5.39**	**p <0.0001**	p <0.0001
Corn Bunting	Summer	9	-0.068	-0.64 to 0.50	p = 0.8155	p = 0.801
Goldfinch	Summer	2	0.938	-0.56 to 2.43	p = 0.2196	p = 0.3771
Greenfinch	Summer	2	-1.451	-5.22 to 2.31	p = 0.450	p = 0.0423
Grey Partridge	**Summer**	**10**	**0.5027**	**0.05 to 0.95**	**p = 0.028**	p = 0.9897
Jackdaw	Summer	3	0.8325	-1.85 to 3.52	p = 0.5435	p = 0.013
Lapwing	**Summer**	**9**	**0.7214**	**0.21 to 1.23**	**p = 0.0056**	p = 0.9891
Lesser Whitethroat	Summer	2	-0.5355	-2.65 to 1.58	p = 0.6193	p = 0.1617
Linnet	Summer	2	-0.0582	-1.47 to 1.36	p = 0.9357	p = 0.4247
Reed Bunting	Summer	2	0.2633	-1.31 to 1.84	p = 0.7435	p = 0.2757
Rook	**Summer**	**7**	**0.9962**	**0.27 to 1.73**	**p = 0.0075**	p <0.0001
Skylark	**Summer**	**60**	**1.7738**	**1.46 to 2.09**	**p <0.0001**	p <0.0001
Song Thrush	Summer	2	0.2613	-1.14 to 1.66	p = 0.7141	p = 0.7093
Starling	Summer	2	-5.0978	-15.70 to 5.50	p = 0.3459	p = 0.0099
Tree Sparrow	Summer	No data available				
Woodpigeon	**Summer**	**9**	**1.4946**	**1.10 to 1.89**	**p <0.0001**	p = 0.0074
Yellow wagtail	***Summer***	***28***	***-1.117***	***-1.82 to -0.42***	***p = 0.0017***	*p <0.0001*
Yellowhammer	Summer	6	0.6007	-0.27 to 1.47	p = 0.1758	p = 0.0199

5. DISCUSSION

5.1. Principle Findings

The systematic review findings are presented below in response to the two unpacked questions to allow the original objectives of the review to be answered (section 2).

5.1.1. What are the effects of the different land-based schemes on total farmland bird densities?

During winter, fields managed under each of the four land-based schemes (Arable Stewardship Pilot Scheme, Countryside Stewardship, Organic Farming and Set-aside) and the two prescriptions (Stubbles and Wild Bird Cover) contained significantly higher densities (per ha^{-1}) of total farmland bird species compared to land managed under conventional cropping regimes.

However, there were mixed outcomes from the analysis of the summer period data. Datasets were available for three of the land-based schemes (Arable Stewardship Pilot Scheme, Organic Farming and Set-aside). Both Organic farming and Set-aside fields contained significantly higher densities (per ha^{-1}) of total farmland bird species compared to land managed under conventional cropping regimes. However, only marginally higher densities of farmland birds were achieved on fields managed under the Arable Stewardship Pilot Scheme. The summer results for this scheme suffered due to the inclusion of migrant species, such as Yellow Wagtails which totally ignored scheme fields in preference of conventionally managed salad and root crops. Finally, data were not available for the Countryside Stewardship land-based scheme and for both of the prescriptions (Stubble and Wild Bird Cover).

Both winter and summer periods are important, as each demands differing resource requirement for each species. These have been reviewed in detail (see Aebischer *et al.* 2000; Anderson *et al.* 2001; Aebischer *et al.* 2003) and fall into three overlapping categories: (1) breeding season food, (2) nesting sites & material and (3) winter food. Although the resource needs of the 18 farmland bird species reviewed here differ considerably, there are a number of resources that if widely provided would benefit for the majority of species. For example, increasing the amount of uncropped habitat, especially field margins, rank grasses, conservation headlands and set-aside would increase the amount of foraging areas available to the majority of farmland bird species during both winter and summer periods (Aebischer *et al.* 2003; Vickery *et al.* 2004). Some species, such as Skylarks, avoid field boundaries and would therefore require additional management, such as providing Skylark scrapes, ley grasslands, stubbles and harvesting later in the breeding season (Browne *et al.*, 2000; Donald *et al.,* 2002).

Loss of habitat diversity, at a range of different scales, especially at local (farm) and regional scales, is a major factor that has caused the decline and loss of farmland biodiversity (Benton *et al.* 2003). All the land-based schemes within this systematic review allow both local (farm) and within field heterogeneity to increase, due to the amount of prescriptions that are available to the farm/land manager. The increase in habitat heterogeneity however might be limited to these smaller scales as land-based schemes agreements are undertaken at the individual farm level and not on a regional scale, unlike schemes such as Environmental Sensitive Areas (ESA) where land-owners within the designated area are encouraged to join the available biodiversity enhancement schemes (Vickery *et al*. 2004).

Each of the land-based schemes has provided a different range of prescriptions/options for the farm/land manager. Countryside Stewardship was launched in 1991, with farm/land managers voluntarily signing 10 year agreements to place the land under good farming practice management to enhance the biodiversity vale of the land. The scheme also provided grants to the managers for tree planting and hedge laying. Countryside Stewardship agreements were concentrated around the central and western pastoral areas of England, with priority habitat including calcareous grasslands, acidic grasslands, upland hay and lowland meadows, coastal/floodplain grazing marsh, heathland and cereal field margins (Carey *et al.* 2001; Defra, 2001). From 2002, Countryside Stewardship agreements included a new range of prescriptions (including Winter Stubbles and Wild Bird Cover) designed especially for arable fields and have been used to target range-restricted and declining bird species (Evans *et al.* 2002). The potential of these prescriptions at providing additional resources for farmland bird species have been reviewed in detail elsewhere (e.g. Vickery *et al*. 2004).

Organic farming involves the restriction on the use of artificial fertilisers and pesticides, with mandatory management practices for both crops and livestock given by both the Soil Association and the Organic Farmers and Growers membership. In addition there are recommendations for the management of non-farming habitats, such as hedgerows, farm woods and ponds (Chamberlain *et al.* 1999). Organic farms generally also make wider usage of traditional farming management techniques, such as crop rotation, manure and mechanical or hand weed control (Lampkin, 1990). Organic farming was not established to assist in providing additional resources for farmland bird species, but the management recommendations and requirements established under organic farm regulations have benefited bird species. Chamberlain *et al.* (1999) found that the enhancement of the hedgerow structure on organic farms, compared to those on conventional farms, allowed greater nesting resources for farmland bird species, and possibly accounts for the higher densities of bird species on organic fields. In addition, the traditional approach to weed control allows for a greater number and diversity of weed species. It has been suggested (e.g. Moreby *et al.* 1994; Brooks *et al.* 1995) that this increases both weed seed and invertebrate abundance, again providing important resources for both breeding and wintering periods. However, mechanical weed control might have the potential to damage nests of those species, such as lapwing and skylark that nest within the crop away from hedgerows (Vickery *et al*. 2004). As discussed above the loss of farmland heterogeneity is potentially a major cause in the decline of many farmland bird species (Benton *et al.* 2003). Organic farming systems use a mixture of arable crop and pasture rotations for soil fertility reasons, this increase in the heterogeneity of field types on a farm scale benefits the farmland bird species, providing both nesting and foraging resources within close proximity.

Set-aside was first introduced to the U.K. as a production control measure in 1988. Arable cropping area was taken out of production to halt the growing European grain mountains. Fields were left to naturally regenerate or by sowing a grass or seed mixture (Henderson *et al.* 2000). Options under set-aside management included the provision of seed crops for birds and under either rotational or non-rotational management different amounts of fallow and stubbles were provided. Under rotational set-aside a vegetation cover was required after harvest providing food resources for farmland bird species (Henderson *et al.* 2000). However, this benefit is reduced under non-rotational set-aside as only in the first year after harvest are the resources available, although the field/land is under a five/six year fallow period (Wilson 1992; Draycott *et al.* 1997). During winter, additional seed and split grains from stubble provision are available and sown seed crops provide additional winter food resources (Evans *et al.* 1997; Boatman *et al.* 2002). In summer additional breeding sites are available, especially for species which are field nesting, such as Lapwing (Wilson *et al.* 2001) and Skylark (Wilson *et al.* 1997). Both of these species were found to have significant preference towards set-aside fields compared to other land-based scheme fields and conventional agricultural crop types. However, the use of herbicides, such as glyphosate is permitted during spring on set-aside land. These herbicides would reduce nesting cover; plant seed provision; invertebrate numbers and potentially destroy nests (Moreby *et al.* 1994; Potts 1997).

The Environmental Stewardship Scheme is currently available for farm/land managers within England and was born out of parts of the Arable Stewardship Pilot Scheme, Countryside Stewardship and Organic farming practices. Environmental Stewardship has three elements; (1) Entry Level Stewardship, is a whole farm scheme open to all those farming in England. (2) Organic Entry Level Stewardship, is also a whole farm scheme available to those wishing to farm organically, and (3) Higher Level Stewardship, providing greater resources in exchange for more significant environmental benefits in high priority situations and areas. At the Entry Level Stewardship there is choice of over 50 management options/prescriptions, mostly for the benefit of biodiversity, although some provide additional resources for non-crop features such as ponds (RDS 2005). Monitoring of this scheme over time will show whether this scheme continues to benefit farmland bird species (as well as other species). It is important that monitoring programmes include details of each management option/prescription so that its individual effectiveness can be determined, informing whether its inclusion within the Environmental Stewardship scheme or future land-based (agri-environment) scheme should be continued.

5.1.2. How have individual species densities responded to land-based schemes?

As with the scheme analyses, the individual farmland bird species when data was available had separate analyses for winter and summer (including breeding periods) performed. Both these periods are important as the resource requirement for each species differs between the demand for food and foraging sites and nesting sites & material. During winter, land-based schemes appear to be effective at containing higher densities of the majority of farmland bird species. Of the 15 species where data were available, 14 species had higher densities (eight of which were statistically significant) on land-based scheme fields. Only one species showed a slight negative trend, having higher densities on conventional cropped fields. In summer, mixed results were derived for the 17 species for which data were available. Eleven species had higher densities (six of which were statistically significant) on land-based scheme fields. Five species (one statistically significant) had higher densities on the conventional cropped fields compared to land-based scheme.

The range of resources required differs for each of the farmland bird species, but common to all is the need for food and nesting resources. During winter, weed seeds and grains are an integral part of 14 species' diets and invertebrates complement the diet of species such as Jackdaw and Rook (Aebischer *et al.* 2003). These resources, especially the seeds and grains declined rapidly after the intensification of farming and shifting timing of crops from spring to autumn sown. Winter foraging habitats that are associated with the majority of species are broad leaved crops, set-aside and stubbles. With a few species, especially those associated with a diet of soil invertebrates (e.g. Rook and Starling), also requiring grassland areas.

In the summer, especially the breeding period, foraging sites and food resources are also vital for chick survival. In addition, nesting sites and material is required. Both of these resources are normally located within close proximity (Aebischer *et al.* 2003). For summer, 14 farmland bird species' diets are associated with a mixture of invertebrates and seeds/grain. Foraging habitat and nesting site requirements are more diverse than those required for winter foraging. These are reviewed in detail in Aebischer *et al.* (2003), but a mix of set-aside/fallow, grassland, cereal crops/seed mixture crops and crop margins are required for foraging sites. Nesting sites are normally focused around field boundaries in non-crop areas such as hedgerows (e.g. Linnet), woods (e.g. Starling). However, some species require nesting sites in cropped areas (e.g. Corn Bunting, Skylark and Lapwing), requiring additional management consideration to avoid destroying nests (Poulson *et al.* 1998; Boatman *et al.* 2000; Brickle & Harper 2002).

Land-based schemes (especially agri-environment schemes) provide prescriptions/options that are designed to deliver vital resources so the chance over-winter survival of farmland bird species is enhanced. Within recent agri- environment schemes and the current Environmental Stewardship scheme individual prescriptions/options have been designed to provide valuable resources for farmland bird species. The wild bird seed (cover) is one such prescription. The meta-analyses for the wild bird seed prescriptions contained the highest densities of Goldfinch, Greenfinch, Linnet, Reed Bunting, Song Thrush and Yellowhammer, compared to any other schemes or prescription. Corn-Buntings were also found in considerably higher densities in wild bird seed prescription fields, but stubble fields contained the highest densities for this species. Through extensive field surveys on an experimental farming system, Stoate *et al.* (2003) found that passerine species utilised wild bird seed crops as a major winter foraging habitat. They concluded that this prescription formed a significant food source for a wide range of passerine species, with bird densities 14 times higher than on adjacent conventionally cropped commercial farms. A variety of seed bearing plant species are required for a high diversity of granivorous passerine species. Two mixtures of wild bird cover are available to landowners: one Kale-based (*Brassica oleracea*), providing food and cover during winter, the other a cereal-based mixture, providing a foraging area during the breeding season which is relatively rich in invertebrate species and a source of seeds for winter (Stoate *et al.* 2003). The plant species contained within the mixture are important if targeting particular bird species. Kale, especially when seeding in its second year, is utilised by most passerines, with the exception of Goldfinch. Quinoa (*Chenopodium quinoa*) is also used by a diverse range of farmland bird species, including Redpoll (*Carduelis flammeus*), Reed Bunting and Tree Sparrow (*Passer montanus*), while mixtures based on crop species, such as Barley (*Hordeum vulgare*) and Linseed (*Linum usitatissimum*) are preferred by Yellowhammers and Goldfinches (Wilson *et al.* 1999; Stoate *et al.* 2003). In addition, wild bird seed crops provide increased invertebrate food resources during the summer and provide nesting sites and material for numerous farmland bird species.

Over-wintering stubbles (winter stubbles) contain the highest densities of Jackdaws, Rooks and Corn Buntings within the meta-analyses. These species make use of the spilt grain and weed seeds that remain after harvest to naturally regenerate. The amount of bare ground exposed within a stubble field is also important when targeting particular species. Corn Buntings prefer high percentages of bare ground, while the opposite is true for Woodpigeons (Moorcroft *et al.* 2002). During the summer, if subsequent spring cereals are available with relatively sparse ground vegetation, ground nesting species (e.g. Skylark) are likely to benefit from additional nesting sites (Wilson *et al.* 1997; Donald & Vickery 2001). In addition, winter and spring fallow prescriptions will enhance the amount of sites for ground nesting species and provide further weed species and invertebrates during summer (Vickery *et al.* 2004).

Other management prescriptions that are predicted to be of benefit to farmland birds are highlighted by Vickery *et al.* (2004). Those prescriptions of note include: buffer strips of between 2m – 6m wide for cropped or intensive grasslands. These buffer strips at the field margins provide additional food resources, such as seeds, grasses and invertebrates through the summer, while also providing nesting sites and additional resources for the winter period (Defra 2005). Also of note, is provision for funding boundary features, such as ditch and hedgerow management, the latter being an important nesting resource for numerous farmland bird species. This habitat is an important foraging resource for both Tree Sparrows and Reed Bunting (Aebischer *et al.* 2003; Vickery *et al.* 2004).

In addition to the provision of resources for farmland bird species, both habitat heterogeneity at a number of scales and the structure of the habitat are important for enhancing farmland biodiversity (Benton *et al.* 2003; Wilson *et al.* 2005). As previously highlighted the land-based schemes, such as Environmental Stewardship, increase the habitat heterogeneity at both, the between-field (farm scale) and the within-field scale, dependant upon which management prescriptions are chosen by the land manager. However, as yet this is not an explicitly stated aim of land-based schemes. Further guidance for managers is also required in relation to the management of the structure of each of the prescriptions (Wilson *et al.* 2005). Simple notes given to managers on how to best manipulate each of the management prescriptions to yield maximum conservation benefits for biodiversity could be provided.

5.2. Review limitations

Although allowing the assessment of the effectiveness of fields entered into land-based management schemes to contain significantly higher farmland bird densities compared to conventional cropping systems, this review does not allow conclusions to be drawn on how bird species population trends (or breeding population) respond to these additional resources. Are the species simply redistributing among the available resources (no change in population trend), or is there an improvement in terms of increased breeding success or over-winter survival rate (giving a positive change to population trend) which allows evidence of recovery to be captured?

Although the results of this review are significant in themselves, there was a lack of reporting of important site and methodological characteristics. Firstly, there was limited reported information pertaining to individual management prescriptions undertaken on each of the study farms to allow a full investigation of each separately. The effectiveness of only two individual prescriptions/options (Wild Bird Cover and Stubbles) of these schemes could be explored. In fact reporting of the number of fields under each of the individual options was lacking from the majority of the original articles. Secondly, investigation of potential reasons for heterogeneity was only possible for the winter data on total farmland bird species. With more journals allowing additional online (electronic) supplementary material, details such as the individual management prescription undertaken on each farm can be reported easily for further analysis at a later date. In addition, data tables could be provided on potential reasons for heterogeneity, such as soil types, hedgerow condition and lengths, which might affect farmland bird species distributions.

This systematic review assessed the higher levels of evidence (Stevens & Milne 1997) that used experimental methodology (i.e. control trials, site comparisons and before and after time-series) to investigate the effectiveness of land-based schemes. This review does not look, or compare the results against individual studies or reviews of other levels of evidence, or modelling data predictions. This is not a strict limitation of the review as this was not in the original protocol and these other levels have the potential for greater bias (Stevens & Milne 1997; Roberts *et al.* 2006). However, comparison with these lower levels of evidence could possibly allow further investigation of the potential reasons for heterogeneity.

6. Reviewers' Conclusions

6.1. Implications for farm/land management & policy makers

Available evidence, within the public domain, supports the effectiveness of land-based schemes for maintaining higher densities of farmland bird species, especially during winter periods, compared to fields conventional cropped. Land-based scheme prescriptions provide additional food resources for wintering bird species at a vital time of the year, when resources had previously been depleted by the intensification of farmland within the U.K. The analyses show that greater numbers of some bird species utilise scheme fields during summer periods due to the management prescriptions providing additional breeding food and nesting resources.

Although "total" farmland bird densities are increased along with the majority of farmland bird species, especially during winter periods, it is important to appreciate which bird species respond positively to each scheme or, more importantly, to each individual management prescription/option. This is especially important if the targeted species have restricted ranges (e.g. Cirl Bunting) or are migratory (e.g. Lesser Whitethroat and Yellow Wagtail). It would be a waste of resources and possibly detrimental for target species (i.e. reducing densities and restricting ranges further) if inappropriate prescriptions were instituted in a particular area. Unfortunately, only a partial picture can be developed as there was insufficient high quality experimental evidence readily available within the public domain to analyse the effectiveness of each of the individual prescriptions available under umbrella land-based schemes. However, the evidence does highlight the effectiveness of wild bird (seed) cover (which contained the highest densities of: Goldfinch, Greenfinch, Linnet, Reed Bunting, Song Thrush and Yellowhammer, compared to any other schemes, prescription or comparator crops) and winter stubbles (for: Corn Buntings, Jackdaw and Rooks) to provide suitable habitat and food resources for a range of farmland birds wintering periods. Both of these management options are included within the new agri-environment scheme Environmental Stewardship recently rolled out to all English farmers and the existing Tir Gofal available to Welsh farmers.

Currently, there appears to be two scales being used to measure the success of land-based schemes (Siriwardena, 2006 *per comms*). The first is an "overall scheme" scale which is used at a political or policy level. Therefore if total farmland bird species abundance, or even individual species are increased due to the introduction of land-based schemes then the land-based scheme can be considered a success. However, the best approach for measuring the success of land-based schemes is on the individual "prescription" scale, as this has greater biological meaning. It is therefore disappointing that datasets for only two prescriptions were captured. Even though the individual prescriptions were based on knowledge of bird resource needs, prior to being introduced as an option in land-based schemes. Their effectiveness still needs to be ascertained, to ensure that they are delivering the results that were initially predicted of them, in addition to the overall scheme's effectiveness.

Further guidance is required in future agri-environment scheme documentation which is provided to land managers. The objectives of each available prescription within the scheme should be clearly described, providing farm/land mangers with a greater understanding of why each prescription might be required on their farm. Although good quality information has been developed for the Higher Level of the new Environmental Stewardship scheme, this should be filtered down to documentation related to the Entry Level. Further to this, policy makers could improve the targeting of prescriptions to farms within areas where particular bird species have either suffered from recent declines or provide new resources on the edges of species' ranges to allow further expansions.

6.2. Implications for further research

A number of studies initially thought to be eligible for inclusion within this review were excluded as they reported incomplete datasets and/or failed to satisfy all the inclusion criteria. The majority of studies lacked baseline data of the bird species, as they used control trial design/site comparisons of pre-existing land-based schemes against fields cropped under a general title of conventional cropping systems. In addition, small levels of independent replication (>20) were commonplace among the accepted studies (most likely due to funding limitations) but, in some cases pseudoreplication was present, due to either the choice of experimental design or inappropriate use of statistical analysis. First, simple pseudoreplication (Hurlbert, 1984), this is when samples from the same sample universe were used as a substitute for general replication (e.g. taking multiple measures from the same field rather than from different fields under the same treatment). Second within times series experiments, temporal pseudoreplication (Hurlbert, 1984), whereby multiple samples from each experimental unit are not taken simultaneously but sequentially over each of several dates. It is when the successive dates are used as if they were independent replicates of a treatment that this becomes invalid. These features highlight a requirement for authors to report full site details and the experimental and statistical methodology used to obtain the results presented.

Further studies are required to address the issue of whether the species are simply redistributing between the available resources by aggregating among the resources provided by the fields under agri-environment management and deserting conventional fields (no change in population trend), or are showing increased breeding success or over-winter survival rate (positive population trend) giving evidence of species recovery. Investigating population trends, requires manipulative factorial or randomised control experiments to be undertaken (Green 1994; Kleijn & Sutherland 2003). Careful consideration must be given to the level of replication (Cooper *et al.* 1999), as the assessment of land-based schemes such as agri-environment schemes requires large units of replication. Dependent upon the spatial scale of the study, increasing the level of replication (and therefore statistical power) is resource intensive in terms of both time in undertaking surveys and cost of the study. To detect long-term effects additional surveys after an interval of 3+ years might be required, to establish differences within population trends (Johnstone 2004). Alternatively, comparisons of outcome metrics such as over-winter survival, breeding productivity/fledgling survival, within the various landscape scales (fields/farms/regions) with and without land-based scheme options would allow the identification of population trends and provide suitable data to model national population trends. Overall the financial requirements of a large-scale experiment involving landscape manipulation at the scale required to measure population trends or demographic parameters of farmland birds' response to agri-environment schemes and prescription make it impractical. Instead prior to initiating any agri-environment scheme baselines monitoring should be undertaken, with follow-up sampling taken at regular intervals. This process has already been initiated for the latest land-based scheme – Environmental Stewardship, with baseline monitoring complete and follow-up due in approximately 2010 (Siriwardena, 2006 *per comms*), and could be performed at local (farm) scales at each subsequent farm that enters into a stewardship agreement.

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8. POTENTIAL CONFLICTS OF INTEREST AND SOURCES OF SUPPORT

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APPENDIX 1. The quality assessment instrument, to provide an estimate of bias surrounding extracted data from the original studies. The higher the quality score, the less the likelihood that bias has affected the evidence resulting from the study.

Generic data quality features	Specific data quality features	Quality element	Quality score
Study Design	NA	Randomized Controlled Trial	**80**
		Quasi-RCT (a trail applying a pseudo random allocation mechanism, e.g. date of planting)	**70**
		Controlled Trial	**60**
		Historical CT (data for the control arm comes from archives not from current experimental observation	**50**
		Site comparison	**40**
		Time Series	**30**
		Interrupted time series	**20**
		Questionnaire	**10**
		Expert Opinion	**10**
Baseline comparison (heterogeneity between treatment and control arms with respect to defined confounding factors before treatment)	Size of experimental area	Treatment and control arms homogenous	**1**
		Treatment and control arms not comparable with respect to confounding factors OR insufficient information	**0**
	Geographical area/region	Treatment and control arms homogenous	**1**
		Treatment and control arms not comparable with respect to confounding factors OR insufficient information	**0**
	Crop Age	Treatment and control arms homogenous	**1**
		Treatment and control arms not comparable with respect to confounding factors OR insufficient information	**0**
	Soil Type	Treatment and control arms homogenous	**1**
		Treatment and control arms not comparable with respect to confounding factors OR insufficient information	**0**
Intra treatment variation	Size of experimental area	No heterogeneity within treatment and control arms	**1**
		Replicates within treatment and control arms not comparable	**0**
	Crop type	No heterogeneity within treatment and control arms	**1**
		Replicates within treatment and control arms not comparable	**0**
	Location	No heterogeneity within treatment and control arms	**1**
		Replicates within treatment and control arms not comparable	**0**
Measurement of co-interventions	Other management techniques used on the crop e.g. pesticides/herbicides applied.	Factor equal in treatment and control	**1**
		Factor not equal or unreported	**0**
Measurement of outcome	Replication, measurement parameter (accuracy)	Well replicated objective measurement parameter used (>5 replications)	**10**
		Replicated objective measurement parameter used (2 - 4 replications)	**5**
		Un-replicated observations or subjective measurement parameter used	**0**

APPENDIX 2: Individual study characteristics tables for each study accepted at full text. Note that the data in these tables are in the form extracted from each study. Outcomes were re-calculated for each species for density ha^{-1} prior to analysis.

Study 1	**Aebischer, N. J. *et al* (2000)**	
Full Reference	Aebischer, N. J., R. E. Green, and A. D. Evans. (2000). From science to recovery: four case studies of how research has been translated into conservation action in the U.K. Pages 43-54. Ecology and Conservation of Lowland Farmland Birds.	
Population and co-intervention details	Size of experimental area:	Unknown
	Species of farmland bird with data:	**Grey Partridge (*Perdix perdix*)** **Cirl Bunting (*Emberiza cirius*)**
	Crop types:	Unknown
	Location:	Differs with each species (see below)
	Site management:	Differs with each species (see below)
Intervention & Comparator	**Grey Partridge (*Perdix perdix*)** The **average annual spring density (pairs/km^2)** of Grey Partridges on five estates in Norfolk where partridge management began in 1992, and on five unmanaged estates from the same area. In addition, two of the formerly unmanaged estates started management in 1996. In the 1998 numbers fell due to a wet June and disastrous 1997 breeding season. Data was taken from reading off graph (fig 1) from paper.	

Outcomes

	Managed - pairs/km^2		**Unmanaged - pairs/km^2**
1992 – Baseline	3	-	3.2
1993	4.2	-	3
1994	5.5	-	3.7
1995	6.6	-	2.1
1996	11	2	2
1997	12	5	1.2
1998	8	6.2	1

Intervention & Comparator	**Cirl Bunting (*Emberiza cirius*)** Data from RSPB unpublished records was compiled for **number of pairs** on land managed under Countryside Stewardship and number of pairs on adjacent land during 1992-1998. Management agreements could include the provision of overwinter stubble fields, grass margins, hedgerow and pasture management – however no details were given for any of the sites.

Outcomes

	Countryside Stewardship	**Adjacent – unmanaged**
1992	60	124
1998	102	126
% change	+70%	+2%

Study design	Site comparisons: 40
Baseline comparison	No data on size of areas, crop types or soil, but geographical region, the same: 1
Intra treatment variation	Again similar to above: 1
Measurement of co-interventions	No information on management details of sites: 0
Replication & measurement parameter	Replication was undertaken at each site, five + sites recorded for both species. The recording parameter was consistent with both treatment and control arms: 10
Sum of data quality	**52**
Other notes	Details of the type of management available for **Grey Partridge (*Perdix perdix*), Cirl Bunting (*Emberiza cirius*), Corncrake (*Crex crex*) and Stone Curlew (*Burhinus oedicnemus*)** are discussed within each of the case-studies.

Study 2	**Berendse, F. *et al* (2004)**	
Full Reference	Berendse, F., Chamberlain, D., Kleijn, D., & Schekkerman, H. (2004) Declining biodiversity in agricultural landscapes and the effectiveness of agri-environment schemes. *Ambio*, **33**, 499-502.	
Population and co-intervention details	Size of experimental area:	Unknown
	Species of farmland bird with data:	**Cirl Bunting (*Emberiza cirius*)**
	Crop types:	Unknown
	Location:	Differs with each species (see below)
	Site management:	Differs with each species (see below)

Intervention & Comparator	**Cirl Bunting (*Emberiza cirius*)** The effects of Countryside Stewardship Schemes (CSS) on cirl bunting populations in south Devon reported that agreements to provide grass margins around arable fields and weedy winter stubbles resulted in a rapid increase of the species. Between 1992 – 1998 cirl bunting numbers were recorded on farms with CSS agreements against those on adjacent land. Although data below looks compelling for the case of CSS, methodological concerns are raised in the original paper due to: Most farms entered into the CSS in 1992, but in that year there were already high numbers of cirl buntings on land with management agreements than on the adjacent land not managed under CSS. Part of this differences is possibly is explained by the prior management between 1989-1992 on the farms that entered the CSS as these farmers would have most likely had undertaken management under set-aside or direct payment management from RSPB for leaving stubble in fields during the winter.		
Outcomes		**Countryside Stewardship**	**Adjacent – unmanaged**
	% change	+83%	+2%
Study design	Site Comparison: 40		
Baseline comparison	No details into specifics of the sites at there baseline: 0		
Intra treatment variation	No information provided: 0		
Measurement of co-interventions	No information provided: 0		
Replication & measurement parameter	No information provided to whether any replication had been undertaken: 0		
Sum of data quality	**40**		

Study 3	**Boatman, N. D. *et al.* (2002)**			
Full Reference	Boatman, N.D. & Stoate, C. (2002) Growing crops to provide food for seed-eating birds in winter. *Aspects of Applied Biology*, **67**, 229-236.			
Population and co-intervention details	Size of experimental area:	Plot sizes for the randomised blocks were 50m x 12m (Norfolk), 20m x 12m (Herts.) & 20m x 16m (Leicestershire)		
	Species of farmland bird:	**Greenfinch (*Carduelis chloris*), Goldfinch (*Fringilla coelebs*), Reed bunting (Emberiza schoeniculus), Yellowhammer (Emberiza critrinella), Skylark (Alauda arvensis)**		
	Crop types / species:	**Annual crops grown**: Barley (*Hordeum sativum*), borage (*Borago officinalis*), buckwheat (*Fagopyrum esculentum*), fat hen (*Chenopodium album*), forage rape (*Brassica napus*), linseed (*Linum usitatissimum*), millet (*Panicum effusum*), mustard (*Sinapis alba*), oats (*Aventa sativa*), quinoa (*Chenopodium quinoa*), sunflower (*Helianthus annuus*), triticale (*xTriticale*) and wheat (*Triticum aestivum*). **Biennial crops sown**: Kale (*Brassica oleracea*), teasel (*Dipsacus fullonum*), chicory (*Cichorium intybus*) and evening primrose (*Oenothera biennis*).		
	Location:	1) Flitcham, Norfolk, 2) Royston, Hertfordshire and 3) Loddington, Leicestershire.		
	Site management:	See below		
Intervention & Comparator	Experiments were undertaken over a three winter period (1998/99-2000/01) at the three study sites: 1) Flitcham, Norfolk, (sandy soil) 2) Royston, Hertfordshire (chalky soil) and 3) Loddington, Leicestershire (clay soil). At each site, nine or 10 annual crops or other seed bearing plant species were sown in spring each year in a randomised block design with three replicates. Four biennial crops were also sown at each site in the winters of 89/99 and 99/00. Annual crops species which are underlined were sown at all sites in all years; others were grown for one or two years. Borage was replaced by fat hen at Norfolk (farmers' choice). At each site, birds were monitored at weekly intervals from October to March. Wherever possible counts were carried out before 11am and rain or strong winds were avoided. Each time the observer walked along a series of plots, recording numbers of each bird species seen feeding in, or flushed from each plot. Please note that all the results presented below have been calculated by reading values from graphs presented in the original paper.			
Outcomes	**Goldfinch data** – **annual crop** usage data based on bird numbers (replication is 6 months of data x 3 sites = 18) $^{+}/_{-}$ 1 s.e.			
		1998	**1999**	**2000**
	Oats	1000 $^{+}/_{-}$ 40000	1000 $^{+}/_{-}$ 60000	20000 $^{+}/_{-}$ 40000

	Wheat	30000 +/- 40000	1000 +/- 60000	1000 +/- 30000
	Triticale	20000 +/- 40000	1000 +/- 60000	1000 +/- 15000
	Millet	120000 +/- 50000	1000 +/- 55000	1000 +/- 15000
	Linseed	100000 +/- 40000	330000 +/- 50000	10000 +/- 30000
	Fat Hen	180000 +/- 50000	85000 +/- 70000	20000 +/- 40000
	Quinoa	20000 +/- 40000	1000 +/- 60000	10000 +/- 30000
	Mustard	20000 +/- 50000	60000 +/- 65000	5000 +/- 20000
	Sunflower	30000 +/- 50000	60000 +/- 60000	20000 +/- 40000
	Buckweed	110000 +/- 50000	1000 +/- 60000	20000 +/- 40000
	Borage	30000 +/- 50000	60000 +/- 65000	85000 +/- 25000
Outcomes	**Yellowhammer data** – **annual crop** usage data based on bird numbers (replication is 6 months of data x 3 sites = 18) +/- 1 s.e.			
		1998	**1999**	**2000**
	Oats	44000 +/- 36000	6000 +/- 12000	2000 +/- 40000
	Wheat	7000 +/- 36000	28000 +/- 12000	60000 +/- 16000
	Triticale	72000 +/- 40000	18000 +/- 12000	12000 +/- 14000
	Millet	48000 +/- 22000	4000 +/- 12000	14000 +/- 16000
	Linseed	44000 +/- 36000	12000 +/- 10000	4000 +/- 22000
	Fat Hen	100000 +/- 36000	10000 +/- 20000	4000 +/- 24000
	Quinoa	110000 +/- 34000	44000 +/- 10000	68000 +/- 24000
	Mustard	1000 +/- 38000	4000 +/- 16000	4000 +/- 22000
	Sunflower	1000 +/- 38000	1000 +/- 12000	2000 +/- 38000
	Buckweed	10000 +/- 34000	4000 +/- 12000	2000 +/- 42000
	Borage	1000 +/- 36000	48000 +/- 16000	78000 +/- 26000
Outcomes	Use of **annual crops**, based on 3 years of data combined, as originally presented +/- 1 s.e.:			
		Reed bunting	**Yellowhammer**	
	Oats	16000 +/- 16000	80 +/- 28	
	Wheat	12000 +/- 16000	160 +/- 24	
	Triticale	44000 +/- 40000	154 +/- 21	
	Millet	106000 +/- 12000	141 +/- 26	
	Linseed	56000 +/- 12000	7 +/- 26	
	Fat Hen	102000 +/- 32000	12 +/- 35	
	Quinoa	32000 +/- 14000	40 +/- 24	
	Mustard	48000 +/- 14000	10 +/- 35	
	Sunflower	2000 +/- 16000	10 +/- 30	
	Buckweed	8000 +/- 16000	18 +/- 35	
	Borage	2000 +/- 20000	35 +/- 35	
Outcomes	Use of biennial crops, based on 2 years of data combined, as originally presented +/- 1 s.e.:			
		Greenfinch	**Goldfinch**	**Song Thrush**
	Kale	360000 +/- 40000	6000 +/- 37500	40000 +/- 5000
	Evening Primrose	12500 +/- 37500	90000 +/- 25000	25000 +/- 12500
	Teasel	100000 +/- 50000	340000 +/- 37500	1000 +/- 12500
	Chicory	100000 +/- 50000	25000 +/- 85000	12500 +/- 25000
Study design	Randomised block design: 80			
Baseline comparison	Experimental plot sizes, soil types, geographical regions and crops all recorded: 4			
Intra treatment variation	All the sizes of plots, soil types, altitudes and locations, are different, but the results have been combined: 0			
Measurement of co-interventions	No other factors of management recorded as different between sites: 1			
Replication & measurement parameter	Well replicated experiment at three different sites over three winters, with each winter covering six months: 10			
Sum of data quality	**95**			
Other notes	**Greenfinches** largely confined feeding to four crops, borage, sunflower, mustard and linseed, but both the number of birds and relative use of the crops changed as the winter progressed (see papers fig1). In Sept, greenfinches fed on borage and sunflower, but as borage seed soon exhausted, feeding became more concentrated on sunflower during Oct and Nov. By Dec, sunflower seeds became depleted so feeding transferred to mustard for Dec and Jan. Small numbers of birds were also observed on linseed throughout the winter. Only **greenfinches** used sunflower and borage, preferring these crops to those such as quinoa and fat hen which were favoured by other species. **Yellowhammer** had a distinct preference for cereals, making very little use of other crop types. Few birds used buckwheat. Most **skylarks** in the experimental plots were recorded in late winter when seed depletion had			

<table>
<tr><td></td><td>occurred, especially borage. It might be the open crop structure at this time was also an important factor in attracting the skylarks.
Fat hen (farmer class as weed) and quinoa (close relative – non native, not frost tolerant, therefore possible alternative) attracted high numbers of most species but not greenfinch.
Based on the results, the authors provide the following suggestions for Wild Bird Cover and Wildlife Seed Mixtures on set-aside:
Only a few species can cover the majority of birds.
Kale and quinoa can be sown together in late spring, with quinoa providing seed in the 1st year and kale in the 2nd. The widest range of bird species would be provided for by adjacent strips being sown in alternative years.
The addition of teasel to the above would benefit goldfinches.
For larger buntings, cereals need to be provided. Sown autumn or early spring. To broaden range of bird species attracted, linseed can be grown in mixture with cereals, and varieties are available for sowing at similar times in spring or autumn.</td></tr>
</table>

<table>
<tr><th>Study 4</th><th colspan="3">Boatman, N.D. et al. (2000)</th></tr>
<tr><td>Full Reference</td><td colspan="3">Boatman, N.D., Stoate, C., & Watts, P.N. (2000). Practical management solutions for birds on lowland arable farmland. In Ecology and Conservation of Lowland Farmland Birds, pp. 105-114.</td></tr>
<tr><td rowspan="5">Population and co-intervention details</td><td>Size of experimental area:</td><td colspan="2">1) Loddington Estate is 333-ha mixed farmland.
2) Vine House Farm is 118-ha arable farm</td></tr>
<tr><td>Species of farmland bird:</td><td colspan="2">Greenfinch (Carduelis chloris), Goldfinch (Fringilla coelebs), Yellowhammer (Emberiza critrinella), Skylark (Alauda arvensis), Linnet (Carduelis cannabina), White Throat (Sylvia communis), Song Thrush (Turdus philomelos)</td></tr>
<tr><td>Crop types:</td><td colspan="2">1) A mixture of permanent sheep grazed pasture (43-ha), woodland (28-ha) arable land with hedgerow boundaries (approx 200-ha).
2) A variety of arable crops, including: potatoes, sugar beet, winter wheat, oilseed rape, linseed, peas and grass for seed. Also a two spinneys of 0.6-ha (wood). Only one established hedgerow on the farm.</td></tr>
<tr><td>Location:</td><td colspan="2">1) Loddington Estate, East Leicestershire,
2) Vine House Farm, Lincolnshire fens.</td></tr>
<tr><td>Site management:</td><td colspan="2">1) Loddington = conservation management for wild game birds is undertaken (see below for more detail). 2) Vine House = variety of management practices that are "perceived" to cater for the needs of resident species are undertaken – backed by observation.</td></tr>
<tr><td>Intervention & Comparator</td><td colspan="3"><u>Skylarks & Set-aside</u>
At Vine House, set-aside stubbles were left to regenerate naturally until July 1992-1995.
In Loddington, numbers of skylarks on set-aside were also recorded.</td></tr>
<tr><td rowspan="3">Outcome</td><td colspan="3"><u>Skylark numbers</u> at Vine House associated with set-aside stubbles</td></tr>
<tr><td>1992</td><td>Baseline (pre stubble)</td><td>4</td></tr>
<tr><td>1995</td><td>After 3 years of stubbles</td><td>16</td></tr>
<tr><td>Intervention & Comparator</td><td colspan="3"><u>Conservation management across Loddington for farmland birds</u>
A number of management techniques have been undertaken over a six year period (1992-1998) to promote birds (mainly wild game management) at Loddington. Hedges are cut in late winter to avoid nest disturbance and allow berries to establish for additional food sources. Field boundaries are managed to contain at least 1m of uncut tussocky vegetation each side of hedge. Insecticides were only used in summer where pest insects exceeded damage thresholds – careful monitoring was undertaken on crop pests. Buffer zones are established, no insecticide was sprayed within 6m of the crop edge or 12m for cereal in summer. Beetle banks form part of mid-field set-aside strips, 20m wide, managed to provide a range of habitats so that birds have ready access to good feeding habitat. Brood-rearing cover mimicking a conservation headland is established on long-term set-aside, by sowing a cereal-based crop mixture, including 5% legumes to attract insects as well as naturally occurring annual weeds. Some winter stubble is present; however previous observations have deemed this to be of minimal assistance to farmland birds at this site. "Wild Bird Cover" mixtures were used including cereals or kale or kale/teasel or kale/evening primrose or kale/parsnip.</td></tr>
<tr><td rowspan="8">Outcomes</td><td colspan="3">Numbers of breeding territories at Loddington between 1992-1998</td></tr>
<tr><td></td><td>1992 – baseline</td><td>1998 – after 6 years management</td></tr>
<tr><td>Skylark</td><td>36</td><td>36</td></tr>
<tr><td>Song Thrush</td><td>15</td><td>45</td></tr>
<tr><td>Whitethroat</td><td>25</td><td>42</td></tr>
<tr><td>Greenfinch</td><td>18</td><td>58</td></tr>
<tr><td>Linnet</td><td>10</td><td>20</td></tr>
<tr><td>Yellowhammer</td><td>55</td><td>53</td></tr>
</table>

Outcomes	Habitat Use by feeding farmland birds at Loddington in winter 1997/98				
		Greenfinch	Linnet	Goldfinch	Yellowhammer
	1st year Kale	15%	-	1%	5%
	2nd year Kale	52.5%	77%	4%	2.5%
	Kale/Evening Primrose	5%	7.5%	40%	-
	Kale/Teasel	15%	5%	50%	1.5%
	Kale/Parsnip	5%	3%	2%	-
	Cereal	-	2.5%	-	25%
	Feed site	-	-	-	59%
	Hedge	7.5%	5%	3%	7.5%
	Farm crop	-	-	-	17.5%
Study design	Time Series: 30				
Baseline comparison	Baseline conditions have been recorded – size, location, crop age, soil type are present: 4				
Intra treatment variation	Again all are recorded and compatible: 3				
Measurement of co-interventions	Other management on the site is listed and all equal for the areas studied: 1				
Replication & measurement parameter	No measure of variance is available and no details of replication are recorded: 0				
Sum of data quality	**38**				
Other notes	At Loddington, field boundaries are managed to contain the minimum of 1m uncut tussocky vegetation each side of the hedge. Field boundaries with such extensive vegetation contained more **Yellowhammer** and **Whitethroat** territories per km of field boundary than without such vegetation. Mean nest heights were 0.28m for **Yellowhammer** and 0.48m for **Whitethroat**, compared to 1.26m for **Chaffinch**. **Yellowhammers** often built on the ground in rank grass and herbs, whilst **Whitethroats** nested low down in herbs and brambles.				

Study 5	Bradbury, R.B. (2001)a		
Full Reference	Bradbury, R.B. (2001a). Ecological evaluation of the Arable Stewardship Pilot Scheme: Technical Annex VI/1. Edward Grey Institute of Field Ornithology, University of Oxford, Oxford.		
Population and co-intervention details	Size of experimental area:	See below for more detail	
	Species of farmland bird:	Bird species were combined in the following groups as reported in the original paper:	
		Granivorous Passerines	**Bullfinch, Brambling, Corn Bunting, Chaffinch, Goldfinch, Greenfinch, House Sparrow, Linnet, Lesser Redpoll, Reed Bunting, Snow Bunting, Tree Sparrow, Yellowhammer**
		Thrushes	**Blackbird, Fieldfare, Song Thrush, Redwing, Mistle Thrush**
		Skylark	**Skylark**
	Crop types:	Option 1 – Overwintered Stubbles (a) – preceded by limited herbicide use (b) – not preceded by ltd herbicide use. Option 2 – Undersown Spring Cereals (a) – retention of stubble followed by a spring crop (b) – involves the retention of a grass ley over winter Option 3 – Crop Margins with NO Summer Insecticides Option 4 – Field Margins and Strips Option 5 – Wildlife Seed Mixtures	
	Location:	West Midlands (WM) and East Anglia (EA)	
	Site management:	No other site management reported.	
Intervention & Comparator	Assessments of the effect of the Arable Stewardship Pilot Scheme on winter birds was undertaken at the farm scale, with sites as replicates (where a site is either a whole farm or, where farms are divided into two or more blocks at least 1km apart, each block is considered a separate site). In East Anglia, 26 agreement sites and 24 control sites were censured in both winters (1998/99 and 99/00), while in the West Midlands, 28 agreement and 24 control sites were censured in both winters. Each site was censured twice per winter, once between 1st Oct and 31st Dec and once between 1st Jan and 31st March. Counts of birds were made of all birds feeding in each field using		

	binoculars. The observer walked a number of pre-determined transects across each field. Some species tend to use only field edge, so the two outer transects were within 10m of field boundaries. Census commenced at least one hour after sunrise and were completed by at least one hour before sunset, avoiding heavy rain, strong wind or poor visibility. Results are presented as mean relative densities (number of birds per unit area)
Outcomes	Mean relative densities of bird classes across the two regions and two site types

		Year 1		Year 2	
		AS sites	Control	AS sites	Control
Granivorous Passerines	EA	0.693	0.784	0.999	0.864
	WM	2.752	1.728	1.953	1.152
Skylark	EA	1.235	0.795	0.656	0.738
	WM	0.792	0.745	0.599	0.430
Thrushes	EA	0.159	0.360	0.674	0.466
	WM	1.399	0.766	1.082	0.736

Study design	Randomised Control Trial across multiple sites: 80
Baseline comparison	Baseline elements recorded and similar: 3
Intra treatment variation	All recorded and similar: 3
Measurement of co-interventions	No records of management difference between sites: 1
Replication & measurement parameter	Replicated within each region as listed above and mean density was calculated by taking the mean of 4 observations at each site then calculating the regions mean density: 10
Sum of data quality	**97**
Other notes	Three classes (**granivorous passerines, thrushes** and **wagtails/pipits**) showed positive effects of the scheme. **Granivorous passerines** in WM and **wagtails/pipits** in both Pilot Areas both showed higher numbers on agreement sites than control sites in both winters. **Thrushes** in EA showed a grater increase between winters on agreement than control sites, while in WM they showed higher densities on agreement than control farms in both winters. **Skylarks** showed a negative effect due to the scheme.

Study 6	**Bradbury, R.B. (2001)b**	
Full Reference	Bradbury, R.B. (2001b). Ecological evaluation of the Arable Stewardship Pilot Scheme: Technical Annex VI/2. Edward Grey Institute of Field Ornithology, University of Oxford, Oxford.	
Population and co-intervention details	Size of experimental area:	See below for more detail
	Species of farmland bird:	**Bullfinch, Corn Bunting, Goldfinch, Greenfinch, Jackdaw, Lapwing, Linnet, Reed Bunting, Skylark, Starling, Song Thrush, Turtle Dove, Tree Sparrow, Whitethroat, Woodpigeon, Yellowhammer, Yellow Wagtail**
	Crop types:	Option 1 – Overwintered Stubbles (a) – preceded by limited herbicide use (b) – not preceded by ltd herbicide use. Option 2 – Undersown Spring Cereals (a) – retention of stubble followed by a spring crop (b) – involves the retention of a grass ley over winter Option 3 – Crop Margins with NO Summer Insecticides Option 4 – Field Margins and Strips Option 5 – Wildlife Seed Mixtures
	Location:	West Midlands (WM) and East Anglia (EA)
	Site management:	No other site management reported.
Intervention & Comparator	Assessments of the effect of the Arable Stewardship Pilot Scheme on winter birds was undertaken at the farm scale, with sites as replicates (where a site is either a whole farm or, where farms are divided into two or more blocks at least 1km apart, each block is considered a separate site). In East Anglia, 26 agreement sites and 24 control sites were censured in both winters (1998/99 and 99/00), while in the West Midlands, 28 agreement and 24 control sites were censured in both winters. Each site was censured twice per winter, once between 1st Oct and 31st Dec and once between 1st Jan and 31st March. Counts of birds were made of all birds feeding in each field using binoculars. The observer walked a number of pre-determined transects across each field. Some species tend to use only field edge, so the two outer transects were within 10m of field boundaries. Census commenced at least one hour after sunrise and were completed by at least one hour before sunset, avoiding heavy rain, strong wind or poor visibility. Results are presented as mean relative densities (number of birds per unit area)	

Outcomes	Relative densities of observations during two consecutive years in both regions on both AS and control sites

		1999		2000	
		AS sites	Control	AS Sites	Control
Bullfinch	EA	0.2	0.2	0.3	0.3
Corn Bunting	EA	1.4	1.5	0.9	1.0
	WM	0.6	0.9	0.3	0.4
Goldfinch	EA	0.4	0.2	0.5	0.5
	WM	1.3	0.8	1.1	0.5
Greenfinch	EA	0.7	1.6	0.6	0.6
	WM	0.9	1.1	0.5	0.1
Jackdaw	EA	0.7	0.1	0.6	0.0
	WM	2.3	1.6	0.9	0.3
Lapwing	EA	0.7	2.0	0.3	0.2
	WM	1.2	0.7	1.1	1.4
Linnet	EA	2.0	3.0	1.1	1.8
	WM	2.9	2.0	1.5	0.6
Reed Bunting	EA	0.1	0.4	0.5	0.6
	WM	0.4	0.2	0.9	0.1
Skylark	EA	15.6	13.7	10.1	9.5
	WM	2.3	1.3	8.7	7.3
Starling	EA	1.0	5.0	0.9	0.1
	WM	0.9	1.1	0.9	1.1
Song Thrush	EA	0.2	0.2	0.5	0.5
	WM	0.5	0.3	0.8	0.6
Turtle Dove	EA	0.1	0.4	0.2	0.4
Tree Sparrow	WM	1.5	0.8	1.1	0.9
Whitethroat	EA	2.3	3.4	2.7	3.1
	WM	2.6	1.6	1.2	0.9
Woodpigeon	EA	34.5	22.4	18.9	21.4
	WM	8.6	6.3	8.6	8.3
Yellowhammer	EA	3.5	4.9	3.1	4.9
	WM	7.6	6.1	7.9	6.3
Yellow Wagtail	EA	0.2	0.2	0.2	0.3
	WM	0.4	0.8	0.4	0.4

Study design	Randomised Control Trial across multiple sites: 80
Baseline comparison	Baseline elements recorded and similar: 3
Intra treatment variation	All recorded and similar: 3
Measurement of co-interventions	No records of management difference between sites: 1
Replication & measurement parameter	Replicated within each region as listed above and mean density was calculated by taking the mean of 4 observations at each site then calculating the regions mean density: 10
Sum of data quality	**97**
Other notes	There is a distinct lack of statistical power to detect real differences due to low sample sizes. Option 1b was popular with farmers with 41% of sites being under this option. Spring cropping was also popular, on 70% of sites.

Study 7	**Bradbury, R. B. *et al.* (2004)**	
Full Reference	Bradbury, R.B., Browne, S.J., Stevens, D.K., & Aebischer, N.J. (2004) Five-year evaluation of the impact of the Arable Stewardship Pilot Scheme on birds. *Ibis*, **146**, 171-180.	
Population and co-intervention details	Size of experimental area:	See below
	Species of farmland bird:	**Grey Partridge**
	Crop types:	**Option 1 – Overwintered Stubbles** (a) – preceded by limited herbicide use (b) – not preceded by ltd herbicide use (a) + (b) – limited herbicide use in cereal or linseed, followed by overwintered stubble and spring/summer fallow (c) – overwintered stubble followed by spring crop (a) + (c) – limited herbicide use in cereal or linseed, followed by

		overwintered set-aside stubble and a spring crop **Option 2 – Undersown Spring Cereals** (a) – retention of stubble followed by a spring crop (b) – involves the retention of a grass ley over winter (a) + (b) – overwintered stubble, followed by undersown spring cereal and grass ley **Option 3 – Crop Margins with NO Summer Insecticides** (a) conservation headlands (b) conservation headlands with no fertiliser applications **Option 4 – Field Margins and Strips** (a) grass field margins by natural regeneration / sown grass (4-12m wide) (b) beetle banks (c) uncropped wildlife strips (4-12m wide) **Option 5 – Wildlife Seed Mixtures**
	Location:	East Anglia (EA) and West Midlands (WM)
	Site management:	No other activities other than AS Scheme work is recorded as being undertaken
Intervention & Comparator	Assessments of the effect of the Arable Stewardship Pilot Scheme on winter birds was undertaken at the farm scale, with sites as replicates (where a site is either a whole farm or, where farms are divided into two or more blocks at least 1km apart, each block is considered a separate site). In East Anglia, 26 agreement sites and 24 control sites were censured in both winters (1998/99 and 99/00), while in the West Midlands, 28 agreement and 24 control sites were censured in both winters. Each site was censured twice per winter, once between 1st Oct and 31st Dec and once between 1st Jan and 31st March. Outcomes below are read from graphs.	

Outcomes

Densities of **grey partridges -** mean and (se) **- *Total birds***

	1998		2002	
	AS	**Control**	**AS**	**Control**
East Anglia	9.5 (3.0)	5.5 (2.0)	7.5 (2.5)	1.9 (0.5)
West Midlands	3.0 (1.0)	1.4 (0.6)	0.8 (0.5)	0.8 (0.7)

Densities of **grey partridges -** mean and (se) **- *Adults only***

	1998		2002	
	AS	**Control**	**AS**	**Control**
East Anglia	4.75 (1.5)	2.25 (1.0)	2.5 (0.75)	1.2 (0.3)
West Midlands	0.75 (0.25)	0.6 (0.3)	0.4 (0.2)	0.3 (0.2)

Study design	Randomised control trials across multiple sites and multiple years: 80
Baseline comparison	Baseline elements recorded and similar: 3
Intra treatment variation	All recorded and similar: 3
Measurement of co-interventions	No records of management difference between sites: 1
Replication & measurement parameter	Replicated within each region as listed above and mean density was calculated by taking the mean of 4 observations at each site then calculating the regions mean density: 10
Sum of data quality	**97**
Other notes	In East Anglia (EA), 73% of AS farms had stubble options, 69% had wildlife seed mixture options and 50% had both. In the West Midlands (WM), 100% of AS farms had stubble options, 82% had both stubble and wildlife seed mixtures.

	Total area (ha)	**% area of farm = stubble**	**% with wildlife seed mixture**	**% with game feeder**
AS farms	3258	12.03	5.78	14.88
Control farms	3342	15.93	7.84	13.33
Wider countryside	c. 1.7 million	19	?	?
AS farms	1831	25.39	10.84	17.83
Control farms	2086	19.53	2.12	3.39
Wider countryside	c. 0.9 million	10	?	?

Study 8	Bradbury, R.B. *et al* (2000)		
Full Reference	Bradbury, R.B., Kyrkos, A., Morris, A.J., Clark, S.C., Perkins, A.J., & Wilson, J.D. (2000) Habitat associations and breeding success of yellowhammers on lowland farmland. *Journal of Applied Ecology*, **37**, 789-805.		
Population and co-intervention details	Size of experimental area:	See below	
	Species of farmland bird:	**Yellowhammer**	
	Crop types:	See below – different types of set-aside options on mixed farms.	
	Location:	Nine farms, in four areas in (Oxfordshire, Wiltshire and Warwickshire) – four of which were organic.	
	Site management:	See below	
Intervention & Comparator	**Densities of Yellowhammer Territories** The study was undertaken between April – July 1994-97, on mixed farmland, with fields bounded by ditches, hedges or tree lines. Land-use consisted of a combination of arable crops (autumn and spring sown cereals, legumes, maize, oilseed rape, kale and linseed), hay and silage for winter forage, pasture grazed by cattle, sheep and horses. Rotational set-aside land was present either as a 'green cover' of weeds and crop regeneration, or as a sown mixture of grass and clover. The organic farms rotated crops and included nitrogen fixing legumes for soil-nutrient replenishment and weed control as an integral part of the system. Infestations of weeds and grasses in the crops were controlled by raking and cutting. The other 'intensive' farms were all managed using agrochemical fertilisers and pesticides. Boundaries of all farms were largely unaltered during the course of the study, apart from the removal of a few dead trees and periodic winter hedge trimming, resulting in small height variations. The number of **Yellowhammers** was recorded twice a month, between 07:00 and 13:00 GMT missing wet or windy days. The transect route was reversed for the second census. Territory location was recorded using CBC methods – those on the edge of the farm scored 0.5 those within the farm boundaries scored 1. Outcomes below are read from graphs.		
Outcomes	The number of **Yellowhammer** territories (pairs) per 100m with the presence of absence of set-aide – mean and (+/- 95% confidence intervals)		
		Set-aside	**No set-aside**
	1994	0.5 (0.150)	0.325 (0.125)
	1995	0.55 (0.125)	0.4 (0.100)
	1996	0.35 (0.075)	0.25 (0.065)
	1997	0.25 (0.100)	0.225 (0.075)
Study design	Site comparison: 40		
Baseline comparison	Data is provided on % land use composition of fields and of size of the farms: 3		
Intra treatment variation	Again all data provided, except soil types: 4		
Measurement of co-interventions	All data provided: 3		
Replication & measurement parameter	Good level of replication, nine sites: 10		
Sum of data quality	**60**		
Other notes	Across all years – the larger the grass ley adjacent to the field boundary the greater the number of territories per 100m are recorded.		

Study 9	Brickle, N.W. *et al.* (2000)	
Full Reference	Brickle, N.W. & Harper, D.G.C. (2000). Habitat use by Corn Buntings *Miliaria calandra* in winter and summer. In *Ecology and Conservation of Lowland Farmland Birds*, pp. 156-164.	
Population and co-intervention details	Size of experimental area:	10.5km^2 of farmland.
	Species of farmland bird:	**Corn Bunting**
	Crop types:	Winter wheat, improved grass, spring barley, non-rotational set-aside, brassicas, woodland & scrub, grassy margin and ungrazed grass.
	Location:	Worthing, West Sussex (between TQ 0306 and TQ 2013).
	Site management:	No site management details given other than crop types that have been planted.
Intervention & Comparator	A set route was walked at 2 to 3 week intervals between October and March during the winters of 1995-96 and 1996-97, passing within 20m of every point in the study area. The direction of the route was alternated between visits. All surveys were done between 10:00 and 16:00 GMT,	

	avoiding heavy rain or strong winds. Data taken from table 3 of paper.
Outcomes	Summary of different habitat use by **Corn Buntings** during three periods of winter

Period	Crop Type	Mean % Observations (Individuals)
Period 1 (1 October – 10 December)	Stubble	67 (63)
	Cattle	6 (4)
	Brassicas	19 (29)
	Other	8 (5)
Period 2 (11 December – 10 February)	Stubble	22 (12)
	Cattle	49 (62)
	Brassicas	23 (25)
	Other	5 (2)
Period 3 (11 February – 31 March)	Stubble	9 (9)
	Cattle	27 (25)
	Brassicas	10 (13)
	Spring barley	45 (52)
	Other	8 (2)

Study design	Control Trial: 50
Baseline comparison	All factors provided, apart from soil types: 3
Intra treatment variation	All factors provided: 3
Measurement of co-interventions	No information provided to other management on site: 1
Replication & measurement parameter	Observations is the average of two years: 5
Sum of data quality	**62**
Other notes	Stubbles were used heavily only until grain became more available elsewhere, from late December at cattle troughs and between mid-February and late March on freshly drilled fields. Although direct-drilling machinery is designed to plant grain at some depth, densities on the surface can be as high as stubble. Support by agri-environment schemes for the spring sowing of cereals would probably benefit **Corn Buntings**, especially if some of these fields were undersown with a grass/legume mix (according to faeces analysis undertaken).

Study 10	**Brickle, N.W. *et al.* (2002)**
Full Reference	Brickle, N.W. & Harper, D.G.C. (2002) Agricultural intensification and the timing of breeding of Corn Buntings *Miliaria calandra*. *Bird Study*, **49**, 219-228.
Population and co-intervention details	

Size of experimental area:	10.5km^2 of farmland
Species of farmland bird:	**Corn Buntings**
Crop types:	See outcomes below
Location:	South Downs, north of Worthing, West Sussex.
Site management:	No site management details given other than crop types that have been planted.

Intervention & Comparator	Between 1995 and 1997, breeding **Corn Buntings** were studied. The position of singing males were mapped and their territories systematically watched for at least one hour at intervals of no more than three days from mid-April to mid- August.
Outcomes	Mean habitat composition of the study site and total number of nests in each habitat and (first attempt)

Habitat	Mean %	Number of nests
Winter-sown wheat	34	40 (35)
Intensive grass (rotational and non-rotational)	32	0
Spring-sown barley	12	43 (39)
Non-rotational set-aside	9	18 (17)
Other	7	0
Brassicas	3	0
Grassy margins	2	9 (8)
Un-intensive grass	1	10 (10)

Study design	Control Trial: 50

Baseline comparison	All factors provided, apart from soil types: 3
Intra treatment variation	All factors provided: 3
Measurement of co-interventions	No information provided to other management on site: 1
Replication & measurement parameter	Observations is the average of two years: 5
Sum of data quality	**62**
Other notes	It is hard for **Corn Buntings** to rear two broods in some modern agricultural landscapes. Since second broods have been shown to boost a female's annual reproductive success by 50%, differences in the frequency of double-brooding could be important.

Study 11	**Browne, S. *et al.* (2000)**	
Full Reference	Browne, S., Vickery, J., & Chamberlain, D. (2000) Densities and population estimates of breeding Skylarks *Alauda arvensis* in Britain in 1997. *Bird Study*, **47**, 52-65.	
Population and co-intervention details	Size of experimental area:	Britain – results of the first national survey.
	Species of farmland bird:	**Skylark (Alauda arvensis)**
	Crop types:	See below for details
	Location:	Across the whole of Britain
	Site management:	No site management details recorded due to scale of the survey.
Intervention & Comparator	Fieldwork was undertaken during the summer 1997, by 600 volunteers across Britain, sampling a total of 608, 1km grid squares (see fig 2 of paper for distribution of squares). Detailed habitat information was collected for each square, usually prior to the **Skylark** survey. Squares were divided into distinct habitat patches, defined as areas greater than 20m x 20m within which the habitat or land-use was relatively uniform. Habitats were divided into nine major habitat types and then increased in detail to account for the various farmland habitats. Observers were asked to visit each square four times, with visits evenly spread between mid-April and mid-June. The locations of all singing **Skylarks** were mapped, during morning surveys, within two hours of sunrise, avoiding poor weather. Population estimates were calculated assuming that a singing **Skylark** represents a **Skylark** territory. Preference index close to 1, indicates that this habitat is neither avoided or preferred. Above 1 = preferred, below 1 = avoided.	
Outcomes	Habitat preferences and densities (pairs per km^2) of Skylarks based on the total number of counts per square and the proportion of the square occupied by a given habitat. Sample sizes are in brackets. All data from table 4 of paper.	

Habitat	Density +/- sd	Preference index
Bog	3.43 +/- 6.92 (21)	0.54 (16)
Brassicas (incl. oilseed rape)	8.97 +/- 13.80 (87)	0.94 (77)
Cattle pasture, light grazed	4.71 +/- 11.52 (98)	0.74 (69)
Cattle pasture, heavily grazed	4.64 +/- 10.48 (142)	0.88 (107)
Coastal (e.g. sand dunes, saltmarsh)	14.05 +/- 24.63 (12)	0.80 (9)
Chalk downland & other dry semi-natural grassland	16.33 +/- 36.21 (36)	1.55 (29)
Dry heathland	7.86 +/- 19.90 (93)	1.17 (54)
Improved ungrazed pasture	8.42 +/- 21.08 (244)	1.24 (170)
Improved grazed pasture	2.99 +/- 7.56 (93)	0.59 (76)
Legumes	12.51 +/- 19.00 (56)	1.35 (51)
Mixed heathland	6.99 +/- 17.68 (62)	0.96 (32)
Moorland	12.95 +/- 23.08 (64)	1.53 (46)
Misc. natural grassland	6.22 +/- 22.83 (19)	0.67 (15)
Misc. cereals (e.g. tritical, rye etc.)	9.87 +/- 15.68 (106)	1.14 (89)
Other/unspecified habitats	5.16 +/- 13.10 (69)	0.97 (57)
Root crops	10.82 +/- 24.37 (66)	1.09 (57)
Spring cereals	12.22 +/- 17.91 (99)	1.30 (93)
Scrub	4.75 +/- 16.20 (134)	0.86 (99)
Set-aside	30.61 +/- 35.68 (55)	2.15 (52)
Sheep pasture (lightly grazed)	5.00 +/- 10.72 (79)	0.94 (44)
Sheep pasture (heavily grazed)	3.75 +/- 10.00 (157)	0.52 (92)

	Suburban	1.48 $^{+}/_{-}$ 7.24 (233)	0.36 (153)
	Unimproved ungrazed grassland	7.02 $^{+}/_{-}$ 21.11 (95)	1.41 (78)
	Unimproved grazed grassland	0.62 $^{+}/_{-}$ 2.93 (44)	0.98 (95)
	Winter cereals	10.73 $^{+}/_{-}$ 13.37 (209)	1.05 (182)
	Wet heathland	3.94 $^{+}/_{-}$ 7.81 (43)	0.86 (20)
	Woodland	1.99 $^{+}/_{-}$ 20.85 (309)	0.29 (215)
Outcomes	**Crop-specific mean density (birds/ha) and crop area**		
	Crop Type	Crop area (%)	Mean density
	England & Wales		
	Set-aside	263 906 (3)	0.296
	Improved grassland	4622 877 (47)	0.054
	Rough grazing	983 503 (10)	0.059
	Legumes	194 644 (2)	0.129
	Root crops	336 975 (3)	0.119
	Brassicas	396 626 (4)	0.095
	Spring cereals	223 965 (2)	0.129
	Winter cereals	2670 167 (27)	0.103
	Other cereals	93 209 (1)	0.196
	Scotland		
	Set-aside	40 175 (2)	0.360
	Grazed pasture	781 660 (45)	0.084
	Grass for mowing	323 000 (19)	0.076
	Brassicas	67 078 (4)	0.051
	Spring Cereals	278 801 (16)	0.096
	Winter Cereals	195 143 (11)	0.141
	Other Cereals	8 806 (1)	0.142
Study design	Site comparison: 40		
Baseline comparison	All factors provided, apart from soil types: 3		
Intra treatment variation	All factors provided: 3		
Measurement of co-interventions	No information provided to other management on site: 1		
Replication & measurement parameter	Densities of pairs based over 608, 1km squares, sample sizes provided: 10		
Sum of data quality	**57**		

Study 12	**Chamberlain, D.E. *et al.* (1999)**	
Full Reference	Chamberlain, D.E., Wilson, J.D., & Fuller, R.J. (1999) A comparison of bird populations on organic and conventional farm systems in southern Britain. *Biological Conservation*, **88**, 307-320.	
Population and co-intervention details	Size of experimental area:	Varied with farm – all sites had to be larger than 30ha.
	Species of farmland bird:	**Grey partridge, Lapwing, Woodpigeon, Skylark, Song thrush, Starling, Greenfinch, Goldfinch, Linnet** and **Yellowhammer**.
	Crop types:	Organic and conventional crop types – no details of actual crop types/species.
	Location:	Across England and Wales.
	Site management:	No other details except either organic or conventionally cropped systems.
Intervention & Comparator	**Organic V Conventional crops** Organic farms were defined according to Soil Association and UK Register of Organic Food standards and were identified from the official Soil Association and Organic Farmers and Growers membership list. Farms were eligible for inclusion in the survey if they were arable, mixed or pastoral enterprises with at least 30 ha of cropped area. In total, 22 fully organic farms across England and Wales which met the above criteria agreed to allow survey work to be carried out, although the numbers varied between seven and 18 farms per season. There were only four farms which had continuous surveys from 1992 to 1994. Each of the organic farms was paired with a conventional farm (within 5km) for a comparison which controlled for geographical variation in bird populations. Each site received a minimum of four census visits in the breeding season (April – July) and three visits each in both autumn (September – November) and winter (December – February). During each visit, the perimeter of every field per site was walked and every bird seen in all field boundaries and field was recorded.	

Outcomes	Autumn 1992 – No. of farm pairs 16		
	Data below is taken from table 5 of the original paper showing mean density ± SD of birds **using fields** outside the breeding season. (individuals/10 ha)		
		Organic	**Conventional**
	Grey partridge	0.09 ± 0.31	0.15 ± 0.31
	Lapwing	0.05 ± 0.06	0.06 ± 0.23
	Woodpigeon	4.45 ± 6.35	2.29 ± 6.15
	Skylark	1.20 ± 1.90	1.02 ± 1.98
	Song thrush	0.02 ± 0.11	0.02 ± 0.05
	Starling	5.88 ± 9.72	4.40 ± 6.49
	Greenfinch	1.84 ± 6.66	0.01 ± 0.05
	Goldfinch	0.47 ± 1.16	0.17 ± 0.58
	Linnet	2.39 ± 9.60	0.31 ± 0.92
	Yellowhammer	3.17 ± 11.02	0.11 ± 0.26
	Winter 1992 – No. of farm pairs 18		
	Data below is taken from table 5 of the original paper showing mean density ± SD of birds **using fields** outside the breeding season. (individuals/10 ha)		
		Organic	**Conventional**
	Grey partridge	0.11 ± 0.26	0.10 ± 0.21
	Lapwing	0.34 ± 1.29	0.28 ± 0.76
	Woodpigeon	7.48 ± 9.53	4.78 ± 10.97
	Skylark	2.50 ± 4.17	1.72 ± 2.99
	Song thrush	0.09 ± 0.20	0.16 ± 0.41
	Starling	8.93 ± 15.49	3.93 ± 6.04
	Greenfinch	0.93 ± 3.95	0.04 ± 0.18
	Goldfinch	0.20 ± 0.50	0.19 ± 0.65
	Linnet	0.34 ± 1.32	0
	Yellowhammer	0.37 ± 1.19	0.38 ± 0.10
	Autumn 1993 – No. of farm pairs 16		
	Data below is taken from table 5 of the original paper showing mean density ± SD of birds **using fields** outside the breeding season. (individuals/10 ha)		
		Organic	**Conventional**
	Grey partridge	0.05 ± 0.19	0
	Lapwing	0.34 ± 1.29	0.28 ± 0.76
	Woodpigeon	4.88 ± 5.97	3.67 ± 6.66
	Skylark	1.93 ± 4.53	0.77 ± 1.52
	Song thrush	0.05 ± 0.11	0.04 ± 0.07
	Starling	4.26 ± 5.76	9.90 ± 12.94
	Greenfinch	1.48 ± 4.65	1.71 ± 5.36
	Goldfinch	1.68 ± 3.82	1.20 ± 2.31
	Linnet	4.43 ± 12.57	0.34 ± 1.21
	Yellowhammer	0.12 ± 0.21	0.28 ± 0.57
	Winter 1993 – No. of farm pairs 14		
	Data below is taken from table 5 of the original paper showing mean density ± SD of birds **using fields** outside the breeding season. (individuals/10 ha)		
		Organic	**Conventional**
	Grey partridge	0.02 ± 0.01	0
	Lapwing	0	0.55 ± 1.95
	Woodpigeon	10.39 ± 10.32	5.52 ± 11.65
	Skylark	1.34 ± 2.58	1.05 ± 2.76
	Song thrush	0.23 ± 0.69	0.12 ± 0.20
	Starling	15.66 ± 29.76	4.72 ± 5.04
	Greenfinch	0.29 ± 1.03	0.02 ± 0.08
	Goldfinch	0.05 ± 0.18	0.04 ± 0.09
	Linnet	0.54 ± 1.63	0.25 ± 0.94
	Yellowhammer	0.10 ± 0.39	0.09 ± 0.28
Study design	Match pair site comparison/control trial: 60		
Baseline comparison	All factors provided, apart from soil types: 3		
Intra treatment variation	All factors provided: 3		
Measurement of co-interventions	No information provided to other management on site: 1		
Replication &	14-18 paired sites, three replications at each site: 10		

measurement parameter	
Sum of data quality	**77**
Other notes	Organic farms have consistently higher densities of both individual and total species than conventional farms. Organic farms differed from conventional farms not only in management of crops but also in field boundary structure. Organic farms tended to have higher, wider hedges and in one year more trees than conventional farms.

Study 13	**Donald, P.F. *et al.* (2002)**	
Full Reference	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.	
Population and co-intervention details	Size of experimental area:	Unknown
	Species of farmland bird:	**Skylarks (Alauda arvensis)**
	Crop types:	Cereals, Set-aside, Grass and Other.
	Location:	East Anglia (Norfolk, Suffolk, Cambridgeshire) Oxfordshire (incl. N Berkshire) and South West (Dorset)
	Site management:	See below for further details
Intervention & Comparator	Farms were chosen to cover as wide a range of lowland farming types as possible and varied from intensive arable (with and without set-aside) through mixed arable and grass to intensive pastoral systems. Farms were chosen after questionnaire returns from farms. Nearly all farms were conventionally managed, with the exception of one organic hay system (E), one set-aside and grazing marsh (Q). Surveys for Skylark nests were undertaken during the breeding seasons of 1996-1998 (April – August). Most were found by direct observation of nest building, incubating or food-carrying adults, often from a car or hide. At each nest, the following was recorded: crop type, height and vegetation. The vertical density of the vegetation, distance of nest to nearest boundary, distance of nest to nearest hedge/tree-line and in cereals, distance to the nearest tramline (bare, unplanted tractor tracks).	
Outcomes	Distribution of **Skylark** nests geographically and by field type, with brief descriptions of farms and years of coverage.	

			Skylark nests found in:				
Farm	Region	Years	Cereal	Set-aside	Grass	Other	Description
A	EA	96-98	35	383		4	Arable with set-aside
B	EA	96-98	5		26	1	Mixed arable/grass, no set-aside
C	EA	96-98	3				Arable, no set-aside
D	EA	96-98	7	1		4	Arable, little set-aside
E	OX	96-98			47		Organic grass
F	OX	96-98	19	2	37	1	Mixed arable, grass
G	OX	96-98	5	1	4		Mostly winter cereals
H	OX	96-98	21		2		Spring and winter cereals
J	SW	96-98	12	12	9	8	Mixed arable, grass
K	SW	96-98		2			Grass and fodder crops
L	SW	96-98	31	6		20	Arable with set-aside
M	SW	96-98	5	53	20		Mixed grass, some arable
N	OX	96-98	19	27	35	5	Mixed arable, grass, set-aside
P	EA	98	4	12	4	1	Arable, set-aside
Q	EA	98		30	12	3	Set-aside, grazing marsh
R	EA	98	13	2		12	Arable with set-aside
S	EA	98	8	4		1	Arable with set-aside
T	SW	98	1	8			Mixed arable-grass, set-aside
total			189	543	196	60	

Study design	Site comparison: 40
Baseline comparison	All factors provided, apart from soil types: 3
Intra treatment variation	All factors provided: 3

Measurement of co-interventions	No information provided on management of sites: 1
Replication & measurement parameter	Site walking at each site, 18 farms: 10
Sum of data quality	**57**
Other notes	Height of vegetation at nest sites in six field types: Winter cereals 55cm, Spring cereals 42cm, Set-aside 22cm, Cropped grass 19cm, Non-cropped grass 19cm, Other 26cm. Nest survival rates in farmland grassland are low due to the high rates of nest loss to agricultural operations and to trampling by livestock.

Study 14	**Hancock, M.H. *et al.* (2003)**	
Full Reference	Hancock, M.H. & Wilson, J.D. (2003) Winter habitat associations of seed-eating passerines on Scottish farmland. *Bird Study*, **50**, 116-130.	
Population and co-intervention details	Size of experimental area:	A farm 1km^2 within each of the 100, 10km squares which had been selected (see fig.1 of the paper).
	Species of farmland bird:	Skylark, Tree Sparrow, Greenfinch, Goldfinch, Linnet, Yellowhammer, Reed Bunting, Corn Bunting.
	Crop types:	See outcomes for full list of crop types.
	Location:	Scotland (see fig.1 of the paper)
	Site management:	No details are reported, apart from the crop type.
Intervention & Comparator	Selection of the study area was based on the 1981-84 winter distributions and counts of six passerine species from the winter atlas Survey undertaken during winters 1997/99. Each 1km square was visited three times, once in each of three eight-week periods: early winter, mid-winter and late winter. Certain habitats (woods, urban, scrub, gardens, inter-tidal) were not surveyed. Surveyors walked included compartments to within 40, 20 and 10m of every point when the vegetation height was 0-3, 3-15 and >15cm respectively. Boundaries adjoining compartments were surveyed. All birds of the surveyed species that were seen in, or flushed from, a field, perched on wires over it or singing above it were treated as using the field, Basic habitat surveys, incl. height of vegetation were carried out for the included compartments.	
Outcomes	Sample sizes and bird densities by habitat type – missing values show were no birds of the species were seen in this crop type.	

	Skylark	**Tree Sparrow**	**Green-finch**	**Gold-finch**	**Linnet**	**Yellow-hammer**	**Reed Bunting**	**Corn Bunting**
Sample size								
Total count	6082	297	1102	513	3020	1669	493	72
No. of compartments species in	610	24	59	55	106	144	108	12
No. of squares species in (max 100)	93	19	54	53	50	62	50	10
Mean birds/ha per visit								
Undersown cereal stubble	1.35	0.14	0.00	0.01	0.07	0.12	0.08	
Barley stubble	1.20	0.01	0.02	0.02	0.18	0.28	0.03	0.01
Oat stubble	3.18				0.10	0.09	0.08	0.04
Wheat stubble	0.81				0.79	0.50	0.06	
Rape stubble	2.51		2.33	1.18	11.54	0.10	0.02	
Rough ploughed fields	0.10	0.00	0.01	0.00	0.07	0.04	0.00	
Smooth bare field	0.08	0.07	0.19			0.04		
Potatos/veg.	0.03	0.01	0.02		0.08	0.01	0.07	
Ungrazzed fodder brassica	0.57	0.09	1.91	0.40	4.02	0.10	0.05	
Fodder crop, post grazing	0.80		0.45	0.07	1.96	0.07	0.01	
Winter oilseed rape	0.16			0.00	0.00	0.00	0.00	
Winter cereal	0.07		0.00		0.00	0.00	0.00	

	Established re-seeded grass	0.12	0.00	0.01	0.01	0.05	0.01	0.01	0.00
	Young re-seeded grass	0.47							
	Rough grass	0.10		0.00	0.03	0.01	0.00	0.02	0.00
	Semi-natural maritime grass	0.06							
	Farmyard		0.12	0.45	0.03	0.07	0.40	0.15	0.03
	Fallow / waste land	0.70	0.02	0.01	0.11	0.32	0.01	0.02	
	Freshwater marsh and reeds	0.03		0.00			0.01	0.24	
	Field boundary	0.02	0.15	0.31	0.17	0.25	0.87	0.15	0.01

Study design	Controlled trial across multiple sites: 60
Baseline comparison	All factors provided, apart from soil types: 3
Intra treatment variation	All factors provided: 3
Measurement of co-interventions	No information provided on other management of sites: 0
Replication & measurement parameter	100 sites, all walked 3 times, however no measure of variance is given in the paper: 5
Sum of data quality	**71**
Other notes	The habitats of surveyed squares are provided in table 1 of the paper, for all regions and each separately.

Study 15	**Henderson, I.G. *et al.* (2003)**	
Full Reference	Henderson, I.G., Vickery, J.A., & Carter, N. (2003). The relative abundance of birds on farmland in relation to game-cover and winter bird crops. British Trust for Ornithology, Thetford. UK.	
Population and co-intervention details	Size of experimental area:	Size of the experimental plots differed at each site.
	Species of farmland bird:	**Grey partridge (P), Woodpigeon (WP), Skylark (S), Song Thrush (ST), Rook (RO), Tree Sparrow (TS), Bullfinch (BF), Goldfinch (GO), Linnet (LI), Chaffinch (CH), Reed Bunting (RB), Yellowhammer (Y), Corn Bunting (CB).**
	Crop types:	See below for further details
	Location:	Plots located across England
	Site management:	
Intervention & Comparator	Field surveys were undertaken over three winters 1998/99, 1999/00 and 2000/01, from farms selected arbitrarily from mixed and arable farming regions across England. On each farm an observer was allotted a plot comprising one pre-selected winter bird crop and up to four nearby conventional fields. Surveys were undertaken from October to March and involved the observer walking the perimeter of each of the fields and then once through the crop. The location of all birds seen or heard on fields or boundaries was recorded. All data is taken from table 4.1 of the report.	
Outcomes	Densities of birds on winter crops relative to winter cereals, per ha^{-1}	

	P	WP	S	ST	RO	TS	BF	GO	GR	LI	CH	RB	Y	CB
BK	0.0	0.7	0.0	1.6	0.0	0.0	0.0	1.2	3.2	0.2	1.6	1.0	0.6	0.0
CG	0.0	0.1	0.0	4.1	0.0	0.0	1.5	6.7	6.2	1.1	1.9	0.0	11.8	0.0
CL	0.8	0.9	0.5	1.3	0.1	1.4	0.8	3.0	2.9	0.5	2.9	1.8	2.9	3.0
K1	0.3	0.5	2.1	2.5	4.5	2.8	1.3	0.8	2.7	0.9	3.2	2.3	1.0	3.4
K2	2.7	2.0	1.1	2.5	0.7	4.5	2.4	1.3	4.5	1.8	6.0	2.7	1.9	0.1
LI	0.5	0.4	1.6	0.9	0.8	2.0	0.8	2.1	4.2	1.8	2.7	1.1	1.9	2.9
ML	0.7	1.5	1.3	1.3	0.7	2.4	1.3	1.0	2.7	0.4	1.7	1.8	1.0	0.2
MU	0.6	1.3	0.5	0.6	0.7	2.1	1.6	0.4	2.9	1.9	1.1	1.8	0.8	3.4
MZ	0.7	5.1	0.9	1.3	0.7	2.1	2.4	0.8	3.1	0.8	2.1	2.1	1.0	0.6
PH	0.0	0.6	0.0	0.9	0.0	0.0	0.0	0.5	3.9	0.2	0.3	3.1	0.2	0.0
QU	0.7	1.2	0.5	2.2	0.5	2.5	2.9	0.9	8.0	0.9	2.6	2.7	1.2	3.4
RA	1.6	3.1	0.8	1.9	0.6	3.4	0.0	0.6	3.0	1.2	1.7	3.2	1.9	0.0
SU	0.3	1.6	0.5	0.8	0.4	1.2	0.0	0.6	5.3	0.6	1.5	2.1	0.6	0.0

TE	0.8	1.7	0.0	2.0	0.0	0.8	0.0	0.8	2.5	0.2	1.6	2.2	1.7	0.0
TU	1.0	1.8	1.3	2.3	0.1	0.0	0.8	0.5	4.5	1.3	3.8	10.1	1.8	2.1
BA	1.5	1.8	1.1	1.0	0.8	0.1	0.9	1.1	0.9	0.2	1.0	0.9	0.8	0.3
CS	1.1	1.1	2.5	0.9	1.6	1.0	0.7	1.3	4.1	1.9	1.7	2.5	1.6	3.4
GR	2.1	1.5	1.3	0.9	0.6	1.9	2.1	2.1	1.3	1.0	1.4	2.1	0.9	0.0
NS	0.0	1.6	0.7	1.3	0.3	0.0	1.0	3.3	4.4	2.8	2.7	4.1	0.6	0.0
SB	0.1	2.5	1.5	1.5	0.6	0.7	0.0	0.3	3.3	0.3	0.9	0.0	0.5	3.3

Key: Crop types are as follows, first are the winter bird crops followed by the conventional field types in italics and underlined: buckweed (BK), canary grass (CG), cereals (CL), 1st year kale (K1), 2nd year kale (K2), linseed (LI), millet (ML), mustard (MU), maize (MZ), phacelia (PH), quinoa (QU), rape (RA), sunflowers (SU), teasel (TE), turnips (TU), bare earth (*BA*), cereal stubble (*CS*), grassland (*GR*), non-cereal stubble (*NS*), sugar beet (*SB*).
Bird species are as follows: Grey partridge (P), Woodpigeon (WP), Skylark (S), Song Thrush (ST), Rook (RO), Tree Sparrow (TS), Bullfinch (BF), Goldfinch (GO), Linnet (LI), Chaffinch (CH), Reed Bunting (RB), Yellowhammer (Y), Corn Bunting (CB).

Study design	Control trial across multiple sites: 60
Baseline comparison	All factors provided, apart from soil types of the different sites: 3
Intra treatment variation	All factors provided: 3
Measurement of co-interventions	No information provided on management of sites: 0
Replication & measurement parameter	Well replicated experiment across multiple sites, 122, 130 and 82 farm plots each year respectively: 10
Sum of data quality	**73**
Other notes	Weed content of the crops was also measured. It was positively related to the occurrence of Grey Partridge, Tree Sparrow and Reed Bunting. The high average rank across species of kale, particularly in its second year, is a key result. This crop was used not only by granivorous species but also by three declining insectivorous passerines, Dunnock, **Song Thrush** and Blackbird. Kale was among the top three preferred crops for **Grey Partridge, Skylark, Song Thrush, Tree Sparrow, Bullfinch and Corn Bunting.**

Study 16	**Henderson, I.G. *et al.* (2000)**	
Full Reference	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.	
Population and co-intervention details	Size of experimental area:	Varies at each of the 11 sites – reported in table 1 of the paper.
	Species of farmland bird:	All farmland birds incl. raptors and waders.
	Crop types:	Set-aside (rotational and non-rotational) versus conventional crops.
	Location:	South eastern and western England (Worcestershire, Norfolk, Suffolk, Dorset and Devon).
	Site management:	Other than crop types no management was recorded.
Intervention & Comparator	A set of 11 farms, in eastern and western England were selected for surveying. At each site, two fields were selected, a set-aside field and an adjacent arable field. Both fields had similar proportions of boundary length given over to hedgerows or open edges. The cropped fields comprised mainly of winter cereals (but one was a potato and one was a brassica crop). Winter cereals were chosen as a comparison crop as they are the dominant crop on farmland in the UK, comprising around 64% of arable land. Sites 1-6 were surveyed during 1996, sites 7-11 were surveyed during 1997 each field was surveyed 4 time. Data for all the bird species was combined therefore the mean density on set-aside and adjacent crops, includes species which are not analysed elsewhere in this systematic review.	

Outcomes

Site	**Crop type**	**Mean density ha^{-1} (se)**	**Species richness**	**Total No. sp. per site**
1	Set-aside	4.90 (1.60)	21	22
	Crop	0.81 (0.33)	5	
2	Set-aside	1.71 (0.27)	15	16
	Crop	0.31 (0.12)	3	
3	Set-aside	2.26 (0.27)	13	15
	Crop	0.31 (0.04)	4	
4	Set-aside	7.07 (3.47)	16	16

		Crop	0.20 (0.08)	2	
	5	Set-aside	1.93 (1.16)	8	9
		Crop	0.29 (0.04)	2	
	6	Set-aside	2.55 (1.09)	17	17
		Crop	0.20 (0.10)	3	
	7	Set-aside	2.01 (0.30)	10	10
		Crop	0.51 (0.01)	4	
	8	Set-aside	2.85 (1.04)	9	11
		Crop	0.19 (0.08)	2	
	9	Set-aside	1.67 (0.24)	7	7
		Crop	0.34 (0.14)	3	
	10	Set-aside	2.67 (0.95)	7	9
		Crop	0.30 (0.12)	3	
	11	Set-aside	1.42 (0.34)	8	8
		Crop	0.58 (0.05)	3	
Study design	Control trial at each farm and between areas: 60				
Baseline comparison	All factors provided, apart from soil types of the different sites: 3				
Intra treatment variation	All factors provided: 3				
Measurement of co-interventions	No information provided on management of sites: 0				
Replication & measurement parameter	Each of the 11 sites was surveyed four times: 10				
Sum of data quality	**76**				

Study 17	**Lock, L. (1999)**			
Full Reference	Lock, L. (1999) Saving the Cirl Bunting ... and lots more. *British Wildlife*, **11**, 17-21.			
Population and co-intervention details	Size of experimental area:	Tetrads (2 x 2km squares)		
	Species of farmland bird:	**Cirl Bunting**		
	Crop types:	Countryside Stewardship (CS) versus non-CS areas		
	Location:	South Devon		
	Site management:	No other information is available on site managements or actual crop types		
Intervention & Comparator	The RSPB estimated the effectiveness of Countryside Stewardship by comparing bird numbers in tetrads (2 x 2km squares) with and without CS agreements. Provisional analysis of the data is presented below (table 1 from paper). No details of surveying methods or site details are given within the paper.			
Outcomes	Comparison between Cirl Bunting populations in 1992 and 1998, inside and outside CS agreement sites – based on N = 43			
		1992	1998	% increase
	Territories in CS	60	102	70%
	Territories outside CS	124	126	2%
Study design	Site comparison: 40			
Baseline comparison	Apart from tetrad size, none of the specific data quality features are reported: 1			
Intra treatment variation	As above: 1			
Measurement of co-interventions	No information on other management of the tetrads is available: 0			
Replication & measurement parameter	Data is based on 43 tetrads, but don't know the exact breakdown of the number with CS agreements and number without: 5			
Sum of data quality	**47**			

Study 18	Mason, C.F. *et al.* (2000)	
Full Reference	Mason, C.F. & Macdonald, S.M. (2000) Influence of landscape and land-use on the distribution of breeding birds in farmland in eastern England. *Journal of Zoology*, **251**, 339-348.	
Population and co-intervention details	Size of experimental area:	Ten tetrads (2x2km^2) total area = 40km^2
	Species of farmland bird:	**Skylark, Yellow wagtail, Turtle Dove, Linnet, Common Whitethroat, Lesser Whitethroat, Yellowhammer, Reed Bunting.**
	Crop types:	See below (outputs) for further details
	Location:	Tendring district of north-east Essex, U.K. (51°50'N, 1°10'E).
	Site management:	No management details reported other than crop types
Intervention & Comparator	Ten tetrads (2x2km^2) total area = 40km^2 were selected randomly. All landscape features were fixed on 1:25000 maps, and field boundaries were recorded by field survey and classified as with/without hedges. All tetrads were visited on 4 occasions between mid-April and mid-July 1994, 1995 and 1996. Surveys started at first light and completed before 10:00 GMT. The position of all birds considered to be holding territories was plotted on maps. Birds were considered to be holding territories if they were singing, carrying nesting material or food, or behaving in an agitated manner without flying away on the approach of the observer. Skylarks were plotted when they rose or returned to ground following a song-flight or, when in the air, they could be clearly related to a crop (i.e. in very large fields). Surveys were not conducted in wet or windy weather. Preferences for particular habitats or crops were measured for each year of the study using Jacobs preference index: $D = (r-p) / (r+p-2rp)$ Where r = the proportion of territories in a habitat (or crop) and p is the proportion of habitat (or crop) in the study area as a whole. The index ranges from -1 (complete avoidance) to +1 (exclusive use). A score of 0 indicates that the habitat or crop was used in proportion with its availability.	

Outcomes

Territory density (km^2 ± se) – taken from table 4 of the paper.

	Skylark	Yellow wagtail
Autumn-sown crops		
Wheat	9.5 ± 0.95	0.5 ± 0.19
Barley	7.8 ± 1.15	0.2 ± 0.11
Oil-seed rape	7.9 ± 2.24	0
Spring-sown crops		
Cereals	8.4 ± 2.92	0.7 ± 0.71
Potatoes	10.0 ± 1.78	4.4 ± 1.00
Oil-seed rape	15.3 ± 3.10	1.1 ± 1.00
Peas	18.8 ± 4.39	4.6 ± 1.77
Beans	4.2 ± 2.11	3.9 ± 2.69
Salad crops	13.7 ± 4.84	4.0 ± 1.78
Sugar beat	6.8 ± 2.27	1.1 ± 0.42
Linseed	40.1 ± 15.0	2.1 ± 1.30
Maize	3.3 ± 2.18	4.5 ± 3.10
Pasture	3.6 ± 1.14	0.2 ± 0.14
Conservation grasslands	62.4 ± 4.00	0
Set-aside	24.1 ± 5.9	1.2 ± 0.66

Outcomes

Mean preference (Jacobs D ± se) shown by seven species of farmland birds across the three years of surveying.

<table>
<tr><th></th><th>Skylark</th><th>Yellow wagtail</th><th>Turtle dove</th><th>Linnet</th><th>Common whitethroat</th><th>Lesser whitethroat</th><th>Yellowhammer</th></tr>
<tr><td colspan="8">Autumn-sown crops</td></tr>
<tr><td>Wheat</td><td>-0.077 ± 0.012</td><td>-0.488 ± 0.059</td><td rowspan="2">-0.33± 0.032</td><td rowspan="2">-0.31 ± 0.133</td><td rowspan="2">-0.14 ± 0.056</td><td rowspan="2">-0.10 ± 0.048</td><td rowspan="2">-0.07± 0.048</td></tr>
<tr><td>Barley</td><td>-0.132 ± 0.002</td><td>-0.808 ± 0.192</td></tr>
<tr><td>Oil-seed rape</td><td>-0.038 ± 0.133</td><td>-1.000 ± 0.000</td><td>-0.04± 0.210</td><td>+0.46 ± 0.184</td><td>+0.27 ± 0.080</td><td>-0.68 ± 0.311</td><td>-0.16± 0.107</td></tr>
<tr><td colspan="8">Spring-sown crops</td></tr>
<tr><td>Cereals</td><td>+0.041 ± 0.187</td><td>-0.316 ± 0.343</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Potatoes</td><td>+0.071 ± 0.039</td><td>+0.702 ± 0.086</td><td>-0.27± 0.218</td><td>-0.19 ± 0.165</td><td>+0.13± 0.043</td><td>-0.15 ± 0.100</td><td>+0.07 ± 0.021</td></tr>
<tr><td>Oil-seed rape</td><td>0.375 ± 0.215</td><td>-0.534 ± 0.466</td><td>-0.38± 0.328</td><td>-0.75 ± 0.253</td><td>-0.33± 0.330</td><td>-0.58 ± 0.419</td><td>-0.07 ± 0.028</td></tr>
<tr><td>Peas</td><td>0.238 ± 0.118</td><td>+0.357 ± 0.254</td><td>+0.07± 0.092</td><td>-0.38 ± 0.092</td><td>+0.12± 0.074</td><td>+0.26± 0.162</td><td>+0.26± 0.043</td></tr>
<tr><td>Beans</td><td>-0.340 ± 0.250</td><td>+0.693 ± 0.081</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Salad crops</td><td>+0.251 ± 0.095</td><td>+0.752 ± 0.039</td><td>-0.62± 0.377</td><td>+0.67 ± 0.31</td><td>+0.14± 0.255</td><td>+0.01 ± 0.255</td><td>-0.35± 0.370</td></tr>
</table>

	Sugar beat	+0.075 ± 0.065	-0.026 ± 0.228	-0.01± 0.335	-0.58± 0.242	+0.12± 0.130	+0.19± 0.043	0.00± 0.049
	Linseed	+0.315 ± 0.265	-0.007 ± 0.448					
	Maize	-0.185 ± 0.095	+0.114 ± 0.585					
	Pasture	-0.390 ± 0.040	-0.356 ± 0.124	+0.68± 0.093	-0.38± 0.130	+0.30± 0.090	+0.42 ± 0.063	+0.23± 0.043
	Conservation grasslands	+0.700 ± 0.000	-1.000 ± 0.000					
	Set-aside	+0.338 ± 0.032	-0.054 ± 0.479	+0.11± 0.166	+0.53± 0.285	-0.05± 0.080	-0.32 ± 0.414	+0.27 ± 0.130
Study design	Control trail: 60							
Baseline comparison	Only geographical area and size of plots provided: 2							
Intra treatment variation	All information provided: 3							
Measurement of co-interventions	No information provided on individual farm management: 0							
Replication & measurement parameter	10 tetrad replicates undertaken: 10							
Sum of data quality	**75**							

Study 19	**Morris, A.J. *et al* (2004)**		
Full Reference	Morris, A.J., Holland, J.M., Smith, B., & Jones, N.E. (2004) Sustainable Arable Farming For an Improved Environment (SAFFIE): managing winter wheat sward structure for Skylarks (*Alauda arvensis*). *Ibis*, **146**, 155-162.		
Population and co-intervention details	Size of experimental area:	Each treatment was a minimum of 5ha, either a whole field or subdivided.	
	Species of farmland bird:	**Skylarks**	
	Crop types:	See below for further details	
	Location:	England (north and east Yorkshire, Norfolk, Suffolk, Cambridgeshire, Bedfordshire, Oxfordshire and Wiltshire).	
	Site management:	No other details of site management reported	
Intervention & Comparator	In 2002, experimental manipulation was undertaken at 15 sites. On each site, three treatments were compared: (1) conventional winter wheat (control), (2) winter wheat sown in wide spaced rows at double normal width WSR (3) undrilled patches (UP), also known as Skylark scrapes. These are small patches 4m x 4m in size, created at a density of two per hectare. Between the start of April and mid August, fieldworkers collected data on the number of nests located in each of the treatments.		
Outcomes	Number of nests in each treatment		
	Treatment	Total No. of nests	Nests per ha
	Control (winter wheat)	33	0.18
	UP	52	0.31
	WSR	14	0.16
Study design	Control trial: 60		
Baseline comparison	All factors, apart from soil type are provided: 3		
Intra treatment variation	All factors are provided: 3		
Measurement of co-interventions	No information to other management is available: 0		
Replication & measurement parameter	Experiment is replicated at each site and across each of the 10 sites: 10		
Sum of data quality	**76**		

Study 20	O'Leary, E. (1995)	
Full Reference	O'Leary, E. (1995) *Habitat utilisation and distribution of several common farmland bird species.* MSc. thesis. University of Durham, U.K.	
Population and co-intervention details	Size of experimental area:	27 transects along 28km stretch
	Species of farmland bird:	**Rook, Jackdaw, Woodpigeon, Lapwing**
	Crop types:	See below for further details
	Location:	County Durham, North-East England (se of Sedgefield NZ 32 N.E. 435500 529500)
	Site management:	
Intervention & Comparator	In 1995 a study area at Sedgefield, County Durham, comprising of 2868 ha was surveyed for nine different common farmland bird species (four of which are extracted for this SR) and their preference for crops. Line transects were used to survey the bird species. Each of the 27 transects took approximately six hours. During each of the transects, observations were made with binoculars and telescope if required. Surveys was undertaken during 18th May – 7th August.	
Outcomes	Number of observations made per transect in each of the habitats (95% confidence intervals, based on N=27)	

	Total Area of study sites (in ha)	Rook	Jackdaw	Wood pigeon	Lapwing
Total	2867.8	201.5 (180-267)	19 (14-30)	62 (40-83)	22.5 (5-40)
Winter Wheat	1337.5	0 (0-1)	0 (0-0)	0 (0-0)	0 (0-0)
Spring Wheat	13.8	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Winter Barley	165.8	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Spring Barley	12.9	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Veg Crops	34.7	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Oil Seed Rape	294.8	0 (0-0)	0 (0-0)	8.5 (2-28)	0 (0-0)
Set-aside	183.7	19.5 (4-39)	0 (0-0)	9.5 (4-14)	9.5 (4-21)
Grassland	488.7	149.5 (96-192)	13 (4-18)	6.5 (2-15)	0 (0-0)
Woodland Edge	142.3	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Rural Settlement	100.7	0 (0-0)	0 (0-0)	1 (0-3)	0 (0-0)
Roads	92.7	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)

Outcoms: Relative density of all birds combined per habitat type (data taken from graph 3.5.1. of the thesis)

Habitat/Crop type	Relative density (birds per ha)
Winter Wheat	0.0375
Spring Wheat	0.0375
Winter Barley	0.1250
Spring Barley	0.0125
Veg Crops	0.1000
Oil Seed Rape	0.2375
Set-aside	0.6250
Grassland	0.6750
Woodland Edge	0.0063
Rural Settlement	0.1500
Roads	0.2500

Study design	Site comparison: 40
Baseline comparison	All factors provided apart from crop ages and soil types: 2
Intra treatment variation	All factors provided: 3
Measurement of co-interventions	No information to site management provided: 0
Replication & measurement parameter	Replicated over 27 transects across the area: 10
Sum of data quality	**55**

Study 21	Parish, D.M.B. *et al.* (2004)			
Full Reference	Parish, D.M.B. & Sotherton, N.W. (2004) Game crops and threatened farmland songbirds in Scotland: a step towards halting population declines? *Bird Study*, **51**, 107-112.			
Population and co-intervention details	Size of experimental area:	20 sites each with three crop types of varying size (table 1 for details).		
	Species of farmland bird:	**Greenfinch, Yellowhammer, Goldfinch, Song Thrush, Skylark**		
	Crop types:	Game crop (Kale, Triticale, Mustard, Wheat, Oilseed Rape and Quinoa), set-aside + stubble (were cereal stubbles left to naturally regenerate and at least 2 winters old) and conventional crops		
	Location:	8 in Aberdeenshire, 4 in Agus, 3 in Perthshire, 4 in The Borders and 1 in East Lothian, Eastern Scotland, U.K.		
	Site management:	On all sites, game cover crops were planted in small strips or blocks close to field boundaries. Game crops may receive some fertiliser around sowing, but afterwards no additional inputs are applied.		
Intervention & Comparator	Counts were conducted monthly throughout the winter period (Nov-Feb) 2000/01 (Oct-Feb) 2001/02. Although not every field was visited every month. One to three blocks of game crop were chosen randomly at each site and the birds using them were counted by walking through and/or around plots when necessary.			
Outcomes	Mean ± se bird densities (per ha^{-1}) on the three different crop types			
		Game crop	Set aside & stubble	Conventional crop
	Greenfinch	7.28 ± 1.7	0.05 ± 0.01	0.01 ± 0.01
	Yellowhammer	1 ± 0.34	0.05 ± 0.01	0.01 ± 0.01
	Goldfinch	0.8 ± 0.32	0.03 ± 0.01	0.01 ± 0.01
	Song Thrush	0.5 ± 0.12	0.01 ± 0.01	0.00 ± 0.01
	Skylark	0.1 ± 0.06	0.3 ± 0.09	0.02 ± 0.01
Study design	Site comparison: 40			
Baseline comparison	All factors present, apart from soil type: 3			
Intra treatment variation	All factor reported: 3			
Measurement of co-interventions	Management of each crop type was briefly described: 1			
Replication & measurement parameter	Well-replicated experiment with an objective parameter of measurement: 10			
Sum of data quality	**57**			

Study 22	Peach, W.J. *et al.* (2001)	
Full Reference	Peach, W.J., Lovett, L.J., Wotton, S.R., & Jeffs, C. (2001) Countryside stewardship delivers cirl buntings (*Emberiza cirlus*) in Devon, UK. *Biological Conservation*, **101**, 361-373.	
Population and co-intervention details	Size of experimental area:	Tetrads (2 x 2km)
	Species of farmland bird:	**Cirl Bunting**
	Crop types:	Details provided in the original paper.
	Location:	South Devon, U.K. (from Newton-Ferrers to Topsham)
	Site management:	Other than the info below and crop types listed in the original paper no other information is provided.
Intervention & Comparator	Data from tetrad (2 x 2km squares) surveys carried out in 1992, 1998 and 1999. The data from 1992 and 1998 was collected as part of a national survey, while 1999 data was collected where it was known that land was under Countryside Stewardship Schemes (CSS) and was within 5km of known **Cirl Bunting** breeding range. The 1992 survey provided a baseline from which CSS effects can be measured. The survey method involved at least two visits to each tetrad, the first during mid-April to late May and the second between early June and the end of August. **Cirl Bunting** positions were mapped on 1:25,000 maps. Surveyors attempted to walk within 500m of every part of the tetrad. Field workers typically spent 4-5 hr surveying each tetrad. Changes in the abundance of **Cirl Buntings** between 1992 and 1999 were analysed for all 47 tetrads within 5km of the known range of the **Cirl Bunting** in 1998 that contained some land under CSS management by 1998. Unsuitable habitat such as urban areas and sea were excluded from the analysis. Thus, the analysis compared the changes in the abundance of breeding **Cirl Buntings** in two categories of land (CSS agreement land and non-CSS countryside) within the same 47 tetrads.	
Outcomes	Changes in the relative density of breeding **Cirl Buntings** between 1992 and 1999 on land entering CSS agreements between 1992 and 1998 and adjacent countryside (within the same	

	tetrad) not entering stewardship agreements. Mean (± s.e.)		
		CSS land	non-CSS land
	1992	2.09 ± 0.36	1.0 ± 0.0
	1998	3.91 ± 0.72	1.09 ± 0.15
	1999	3.73 ± 0.72	0.82 ± 0.10
Study design	Control Trial: 60		
Baseline comparison	Size of area & the geographical region was provided, other factors not reported: 2		
Intra treatment variation	Details of crop type could not be linked with bird densities, other factors present: 2		
Measurement of co-interventions	Other management of the sites is not provided: 0		
Replication & measurement parameter	Measurement parameter is relative densities and the level of replication is 2 per tetrad: 5		
Sum of data quality	**69**		
Other notes	"This study provides the first conclusive evidence of a UK agri-environment scheme delivering regional increases in target fauna." Given the limited current dispersal capacity of the UK **Cirl Bunting** population, extending clusters of closely-spaced agreements from known breeding sites might be the most effective means of facilitating future increase in **Cirl Bunting** abundance and range in south-west England. In the current study of **Cirl Bunting**s, smaller agreements performed just as well as larger agreements, although this is unlikely to be true for other taxonomic groups.		

Study 23	**Perkins, A.J. *et al.* (2000)**	
Full Reference	Perkins, A.J., Whittingham, M.J., Bradbury, R.B., Wilson, J.D., Morris, A.J., & Barnett, P.R. (2000) Habitat characteristics affecting use of lowland agricultural grassland by birds in winter. *Biological Conservation*, **95**, 279-294.	
Population and co-intervention details	Size of experimental area:	77 grass fields covering 432ha (ranging in area from 0.4 to 22.2ha, with a mean of 5.61ha) across 8 study sites in mixed lowland farms.
	Species of farmland bird:	**Grey partridge, Lapwing, Woodpigeon, Skylark, Song thrush, Jackdaw, Rook, Starling, Tree sparrow, Greenfinch, Goldfinch, Linnet, Yellowhammer, Reed bunting, Corn bunting.**
	Crop types:	Grass ley, Grass-clover ley, Pasture, Rough grass.
	Location:	Oxfordshire, Wiltshire and Warwickshire, U.K.
	Site management:	Information on other site management was requested by the authors of the paper but is not reported in detail.
Intervention & Comparator	Fieldwork took place between October 1997 and March 1998. Two visits per month were made to each field. All bird species using the field were counted. Birds resting on or in boundary features were ignored. Counts were made with binoculars, with the observer walking a number of predetermined transects across each of the fields. Surveys were carried out at least 1 hr after sunrise and completed by at least 1 hr before sunset, to avoid missing birds travelling to or from roost sites. During October and November 'autumn' and again in March 'spring', quadrate surveys were carried out on each of the 77 fields to obtain data on sward structure. Data form most fields were collected from 15 1x1 m quadrats, subdivided into 100, 10cm squares. Sward height was measured using a ruler placed vertically in each corner square and the centre of the quadrat. Sward density was measured by taking the number of squares with <50% of the surface area is visible as bare soil. Herb richness and grass in seed was also calculated for each quadrat. The presence and species of grazing stock, number of stock.	
Outcomes	Total counts of farmland bird species on the four field management categories across all sites.	

Species	Grass ley	Grass-clover ley	Pasture	Rough grass	Total birds
Grey partridge	4	16	2	0	22
Lapwing	0	6	0	0	6
Woodpigeon	384	2498	518	16	3416
Skylark	207	205	6	30	448
Song thrush	0	0	4	9	13
Jackdaw	747	231	403	66	1447
Rook	1181	993	1587	209	3970
Starling	1293	1137	555	0	2986
Tree sparrow	0	0	5	0	5
Greenfinch	0	0	35	0	35
Goldfinch	0	1	18	2	21
Linnet	0	1	5	0	6

	Yellowhammer	3	78	61	6	148
	Reed bunting	3	0	0	9	12
	Corn bunting	0	0	0	0	0
	Total	7841	9792	5726	612	23597
	Area (ha)	107.0	179.2	127.7	18.1	432
Study design	Control Trial: 60					
Baseline comparison	Size of area & the geographical region was provided, other factors not reported: 2					
Intra treatment variation	Details of crop type could not be linked with bird densities, other factors present: 2					
Measurement of co-interventions	Other management of the sites is not provided to the authors of the paper and briefly discussed: 1					
Replication & measurement parameter	Measurement parameter is total counts of each bird species, which can be transformed into relative densities as have each crop types area. There are more than 5 replicates per crop type: 10					
Sum of data quality	**70**					
Other notes	Grazed fields were occupied significantly more frequently than ungrazed fields by five species: fieldfare**, jackdaw**, **rook**, carrion crow and **starling**.					

Study 24	**Poulsen, J.G. *et al.* (1998)**
Full Reference	Poulsen, J.G., Sotherton, N.W., & 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.
Population and co-intervention details	Size of experimental area: Just over 1400ha of farmland on three sites.
	Species of farmland bird: **Skylarks**
	Crop types: Winter sown cereals (mainly winter wheat), spring sown cereals (spring barley), grass (herbage seed, silage grass, grazed leys, permanent pasture), and set-aside. Mean field sizes (ha) of the four crop types presented below, number of fields are presented in brackets – 1991/2 growing season

	Winter cereals	Spring Cereals	Grass	Set-aside
South Allenford Farm (589ha)	20.6 (12)	32.1 (4)	26.7 (8)	0 (0)
Down Farm (234ha)	21.8 (3)	22.2 (2)	13.5 (2)	13.9 (7)
West Woodyates Farm (599ha)	13.3 (19)	18.1 (13)	13.9 (8)	0 (0)

Location:	Three farms in southern England on the borders of Dorset and Hampshire (51°10'N, 1°40'W). The three farms were within 3km of each other. Soil type was classified as chalky clay morain for all three sites.
Site management	Very detailed section on management of the three farms – summarised in table 2.
Intervention & Comparator	The study was carried out over 1992 from mid-April to early August. All fields of set-aside were permanent fallow and in their 4th year of the Set-aside Scheme which was established in 1988. On each field, skylark territories were counted and mapped every two weeks for 12 weeks from 20th April till 16th July. The timing of repeat visits was randomised with respect to time of day to avoid bias caused by any variation in detectability with time of day. If a territory overlapped several fields (x), it contributed to 1/x to the number of territories in each of these fields. Attempts were made to locate all nests with young through intensive fieldwork by two observers.
Outcomes	Mean number of Skylark territories per ha ± se during three time periods of the breeding season. (Data read from fig.1 & 2 of the original paper).

Crop type	20th April – 23rd May	24th May – 20th June	21st June – 16th July
Set-aside	0.184 ± 0.08	0.416 ± 0.05	0.3 ± 0.05
Permanent pasture	0.075 ± 0.015	0.019 ± 0.035	0.14 ± 0.035
Silage grass	0.1 ± 0.025	0.085 ± 0.025	0.975 ± 0.025
Ley grass	0.04 ± 0.02	0.035 ± 0.01	0.025 ± 0.01
Herbage seed	0.035 ± 0.02	0.005 ± 0.01	0.005 ± 0.0075
Spring cereal	0.04 ± 0.032	0.15 ± 0.032	0.092 ± 0.024
Winter cereal	0.04 ± 0.004	0.04 ± 0.024	0.016 ± 0.032

Outcomes	Mean number of successful nests ha ± se April – July 1992.

		Permanent pasture	Set-aside	Spring barley	Silage grass
	Late April	0.058 ± 0.008	0.02 ± 0.008		
	Early May	0.06 ± 0.006	0.024 ± 0.008		
	Late May	0.08 ± 0.016	0.036 ± 0.014	0.024 ± 0.02	
	Early June	0.058 ± 0.01	0.024 ± 0.012	0.02 ± 0.01	0.004 ± 0.002
	Late June	0.0496 ± 0.018	0.049 ± 0.014	0.012 ± 0.008	0.025 ± 0.001
	Early July	0.036 ± 0.014	0.022 ± 0.014	0.004 ± 0.008	0.023 ± 0.01
Study design	Control trial: 60				
Baseline comparison	Size of area, geographical region and soil type and crop age provided: 4				
Intra treatment variation	All factors present: 3				
Measurement of co-interventions	Other management of the sites is not provided in detail: 1				
Replication & measurement parameter	Measurement parameter is number of territories and nests of skylarks. There are multiple replicates: 10				
Sum of data quality	**78**				

Study 25	**Robinson, R.A. (1997)**	
Full Reference	Robinson, R.A. (1997) *The ecology and conservation of seed-eating birds on farmland.* PhD Thesis. University of East Anglia, U.K.	
Population and co-intervention details	Size of experimental area:	Field sizes ranged from 3-40 ha (mean 16ha).
	Species of farmland bird:	**Skylark, Yellowhammer, Corn Bunting, Linnet, Grey Partridge.**
	Crop types:	Undersown stubble, sprayed stubble, set-aside, winter cereal, grass ley, cereal stubble, linseed stubble
	Location:	Choseley (TF7541), North Norfolk coast, U.K.
	Site management:	Field layout and cropping is reported and detailed figures of the farm are provided in fig. 3.1 of the thesis. The presence of hares (*Lepus europaeus*) was noted during observations – another declining farmland species.
Intervention & Comparator	Fieldwork was undertaken between November and March during the winters of 1994/95 and 1995/96. Surveys of the farms fields were undertaken by walking up and down the fields at 60m intervals, counting the number of birds that were flushed into the air. Fields were counted at approximately monthly intervals, between one hour after dawn and midday. The order that the fields were visited was varied on each occasion. Counts were not undertaken on days with high winds or rainfall. Seed and vegetation sampling was also completed for each field. Habitat preference of the bird species was calculated using Jacobs D (as described above). The relative densities of certain species were also calculated.	
Outcomes	Skylark densities in three different fields under both treatments. (Data read off graph) per ha^{-1}	

	Field G		Field M		Field W	
	Cereal stubble	Winter cereal	Cereal stubble	Winter cereal	Cereal stubble	Winter cereal
Skylark	2.45	0.15	1.50	0.15	2.55	0.25

Outcomes

Habitat preference (Jacobs D) for farmland bird species over two winters. No standard errors are given for when birds were never (or only) recorded on that crop type. Values of <0 birds using the habitat less than expected (dislike habitat), >0 more than expected (prefer habitat)

	Yellowhammer	Corn Bunting	Linnet	Skylark	Grey Partridge
Winter cereal (95)	-1	-1	-1	-0.89 ± 0.02	-0.90 ± 0.10
Grass ley (95)	-1	-1	-1	-0.58 ± 0.11	-1
Cereal stubble (95)	1	1	1	0.77 ± 0.04	0.93 ± 0.05
Linseed stubble (95)	-1	-1	-1	0.72 ± 0.07	-1
Sprayed stubble(95)	-1	-1	-1	-0.61 ± 0.22	-1
1yr. set-aside (95)	-1	-1	-1	0.03 ± 0.09	-0.68 ± 0.32
Winter cereal (96)	-1	-1	-1	-0.72 ± 0.10	-0.65 ± 0.20
Grass ley (96)	-1	-1	-1	-0.60 ± 0.17	-0.88 ± 0.12
Cereal stubble (96)	1	1	1	0.74 ± 0.10	0.71 ± 0.16

Study design	Replicated Time Series: 50
Baseline comparison	All factors apart from soil type provided: 3
Intra treatment variation	All factors (size of experimental area, crop type and locations) provided: 3

Measurement of co-interventions	Management of the crops is provided including the fields sprayed: 1
Replication & measurement parameter	Parameter of abundance is provided and suitable, replication is not undertaken for the skylark density measurement, however is present for the habitat preference: 5
Sum of data quality	**62**

Study 26	**Stoate, C. *et al.* (2003)**		
Full Reference	Stoate, C., Szczur, J., & Aebischer, N.J. (2003) Winter use of wild bird cover crops by passerines on farmland in northeast England. *Bird Study*, **50**, 15-21.		
Population and co-intervention details	Size of experimental area:	Exact experimental areas are presented on table 1 in original paper – range from 91.4 – 0.3 ha for Piercebridge.	
	Species of farmland bird:	**Song Thrush, Linnet, Greenfinch, Goldfinch, Reed Bunting, Yellowhammer**	
	Crop types:	Commercial crops (Arable, pasture), Wild Bird Cover (1st year Kale & Quinoa, 2nd year Kale, Mixed cereal linseed and rape, mixed cereal linseed, triticale/rape mixture, barley, rape. (Exact areas (ha) of the crops are presented in the original paper in table 1).	
	Location:	Piercebridge, County Durham, England	
	Site management:	Other than crop type no management details were reported.	
Intervention & Comparator	The study was conducted over three winters (1997/98, 1998/99 and 2000/01). Crops were mainly autumn sown. As it was a commercial farm, cropping practices reflected the wider countryside. Outside the cropped area, some habitats are managed using wild bird cover (WBC). WBC crops were planted in strips, approximately 20m wide, along the edges of arable fields, with the exception of three small fields dedicated to WBC. Bird counts were conducted twice a month (over three consecutive days) from October 1997 to March 1998. In 1998/99 and 2000/01 counts took place three times a month in October, November and December, and twice in January, February and March (except 2001 due to F&M disease). Each count was conducted over a two day period, and counts were separated by at least a week. All birds within each habitat and dense vegetation were surveyed to within a few metres while open pasture was surveyed to within 50m. Flying birds were not counted.		
Outcomes	Bird densities (**mean number/km^2 ± se**) at Piercebridge.		
		With WBC 2000/01	Without WBC 1999/2000
	Song Thrush	26.68 ± 6	6.68 ± 1.67
	Linnet	36.66 ± 13.36	5 ± 3.34
	Greenfinch	16.7 ± 13.36	3.34 ± 1.67
	Goldfinch	16 ± 6	3.34 ± 1.67
	Reed Bunting	26.68 ± 10	3.34 ± 1
	Yellowhammer	20 ± 6	4 ± 3.5
Study design	Historical control trial (data from two different years): 50		
Baseline comparison	Only soil type data is not presented: 3		
Intra treatment variation	All factors reported within the original paper: 3		
Measurement of co-interventions	No extra information, other than crop types is provided: 0		
Replication & measurement parameter	Level of replication is good >5 and the measurement parameter is objective: 10		
Sum of data quality	**66**		

Study 27	**Tapper *et al.* (2001)**	
Full Reference	Tapper, S. & Aebischer, N.J. (2001). Ecological evaluation of the Arable Stewardship Pilot Scheme: Technical Annex VI/3. Game Conservancy Trust, Oxford.	
Population and co-intervention details	Size of experimental area:	See below
	Species of farmland bird:	**Grey Partridge**
	Crop types:	Option 1 – Overwintered Stubbles (a) – preceded by limited herbicide use (b) – not preceded by ltd herbicide use. Option 2 – Undersown Spring Cereals (a) – retention of stubble followed by a spring crop (b) – involves the retention of a grass ley over winter

		Option 3 – Crop Margins with NO Summer Insecticides (a) conservation headlands (b) conservation headlands with no fertiliser applications Option 4 – Field Margins and Strips (a) grass field margins by natural regeneration / sown grass (b) beetle banks (c) uncropped wildlife strips Option 5 – Wildlife Seed Mixtures
	Location:	East Anglia (EA) and West Midlands (WM)
	Site management:	No other management was reported
Intervention & Comparator	Counts of grey partridge were taken on 21 Arable Stewardship (AS) farms and 20 control in EA and 18 AS and 22 control farms in WM. Each farm was counted during a single morning or evening visit. The counts took place 2-3 hours after daybreak in the mornings and 2-3 hours before sunset in the evening. For farms of less than 200ha, every cereal field stubble, on each farm was counted. For farms with more than 200ha, as much as possible was counted within the time available.	
Outcomes	Total number of grey partridges by year and area	

	1998		**2000**	
	AS	**Control**	**AS**	**Control**
East Anglia	361	154	369	111
West Midlands	80	28	25	50

Outcomes: Mean brood sizes of young partridges in conveys by area, year and treatment. Number of broods in each category presented in brackets.

	1998		**2000**	
	AS	**Control**	**AS**	**Control**
East Anglia	5.36 (33)	6.77 (13)	4.84 (43)	5.78 (9)
West Midlands	6.56 (9)	8.00 (2)	3.75 (4)	6.56 (9)

Study design	Randomised Control Trial: 80
Baseline comparison	Baseline elements recorded and similar: 3
Intra treatment variation	All recorded and similar: 3
Measurement of co-interventions	No records of management difference between sites: 1
Replication & measurement parameter	Replicated within each region as listed above and mean density was calculated by taking the mean of 4 observations at each site then calculating the regions mean density: 10
Sum of data quality	**97**

Study 28	**Wakeham-Dawson, A. *et al* (1998)**	
Full Reference	Wakeham-Dawson, A. & Aebischer, N.J. (1998) Factors determining winter densities of birds on Environmentally Sensitive Area arable reversion grassland in southern England, with special reference to skylarks (*Alauda arvensis*). *Agriculture, Ecosystems & Environment*, **70**, 189-201.	
Population and co-intervention details	Size of experimental area:	217 fields (total area approx. 40km^2) over 40 downland farms.
	Species of farmland bird:	**Skylark, Rook, Corn Bunting**
	Crop types:	See below for further details.
	Location:	About 85% of the fields were situated in the South Downs ESA and the remainder in the South Wessex Downs ESA
	Site management:	
Intervention & Comparator	Experiment took place of the winter of 1995/96 (after a summer of severe drought) and again in winter 1996/97. Each field was surveyed once during December and January in each of the study years, by walking across the field in a way that ensured that the whole field was visible; surveys were conducted between 0900 and 1400hr.	
Outcomes	The effects of crop type on the density of winter farmland birds (**birds km^2 ± se**)	

Crop Type	N	Skylarks	Rooks	Corn Buntings
		Winter 1994/95		
Permanent grassland	71	7±3	77±33	
Chalk downland	37	230±89	167±118	
Downland turf	45	0±0	37±24	
Non-ESA grassland	17	4±3	54±41	
Winter wheat	32	2±1	0±0	
Cereal stubbles	15	223±42	123±79	
		Winter 1995/96		
Permanent grassland	77	11±4	22±9	0.1±0.1

	Chalk downland	36	85±29	19±9	4.7±4.5
	Downland turf	40	0±0	28±22	0±0
	Non-ESA grassland	12	0±0	4±4	0±0
	Winter wheat	23	8±4	64±49	1±0.6
	Cereal stubbles	17	186±29	91±78	8.8±4.7
	Winter 1996/97				
	Permanent grassland	80	4±3	3±2	0.2±0.2
	Chalk downland	37	25±8	33±21	0.9±0.7
	Downland turf	41	0±0	10±7	0±0
	Non-ESA grassland	17	10±10	35±26	0±0
	Winter wheat	33	1±1	0±0	0±0
	Cereal stubbles	17	287±57	10±10	16.3±12
Study design	Controlled Trial:60				
Baseline comparison	All data provided: 4				
Intra treatment variation	Again all data provided: 3				
Measurement of co-interventions	No information is provided on the management of the different farmland: 0				
Replication & measurement parameter	Replication is good as all fields types have >10 replicates per year: 5				
Sum of data quality	**72**				

Study 29	**Watson, A. *et al.* (1997)**	
Full Reference	Watson, A. & Rae, R. (1997) Some effects of set-aside on breeding birds in northeast Scotland. *Bird Study*, **44**, 245-251.	
Population and co-intervention details	Size of experimental area:	Changes with each field (see below for details).
	Species of farmland bird:	**Lapwing, skylark, corn bunting**
	Crop types:	Set-aside versus arable crop
	Location:	Northeast Scotland (see fig.1 of original paper)
	Site management:	No other management details reported
Intervention & Comparator	Study areas ranged in altitude from sea level to 230m. Fields <3ha and >10ha were excluded from the analysis. Also fields which were adjacent to woods were excluded so that it was truly open fields representing the areas farmland that were analysed. All sites (except three – H, J and K) had the same soil sub-group. Counts were based on song at dawn and dusk, when birds showed concentrated song and other conspicuous behaviour. Three counts were made at each field in mid-May/early June.	
Outcomes	The number of pairs per **10ha** across the sites	

	SItes	Size (ha)	Treatment	**Lapwing**	**Skylark**	**Corn Bunting**
	A	9.5	Set-aside	3.2	12.6	
		7.5	Control	1.3	8.0	
	B	7.6	Set-aside	9.2	25.1	
		9.3	Control	0	3.2	
		4.4	Set-aside		13.6	
		6.3	Control		3.2	
	C	5.3	Set-aside	1.9	26.5	
		4.9	Control	0	0	
		4.9	Set-aside		24.6	
		7.2	Control		4.2	
		5.1	Set-aside	1.9	17.5	
		4.3	Control	0	2.3	
	D	8.2	Set-aside	12.2	23.2	
		6.4	Control	0	4.7	
	E	3.2	Set-aside	3.1	9.2	3.1
		5.3	Control	0	1.9	0
	F	4.9	Set-aside	0	30.7	2.0
		4.0	Control	5.0	0	0
	G	8.2	Set-aside	7.3	12.2	
		6.1	Control	0	1.7	
Study design	Control Trial: 60					

Baseline comparison	All factors are presented within the original paper and are comparable: 4
Intra treatment variation	All factors recorded for each field:3
Measurement of co-interventions	No management details other than crop type reported: 0
Replication & measurement parameter	Replication was three visits per site, no variances are given and the number of pairs have been standardised to 10ha when none of the fields recorded in were that big: 5
Sum of data quality	**72**

Study 30	**Wilson, J.D. *et al* (1997)**	
Full Reference	Wilson, J.D., Evans, J., Browne, S.J., & King, J.R. (1997) Territory distribution and breeding success of skylarks (*Alauda arvensis*) on organic and intensive farmland in southern England. *Journal of Applied Ecology*, **34**, 1462-1478.	
Population and co-intervention details	Size of experimental area:	Detailed crop lists and area grown presented as table 1 in the original paper.
	Species of farmland bird:	**Skylarks**
	Crop types:	Cereal, Silage, Grazed pasture, Set-aside.
	Location:	Suffolk and Oxfordshire, U.K.
	Site management:	Organic versus Intensive farming methods are compared.
Intervention & Comparator	The study was carried out between March –July 1993-95 on lowland farmland in Suffolk (93-94) and Oxfordshire (94-95). Three study areas (2 in Oxfordshire and 1 in Suffolk) were under long-term organic management (O). The remaining four (3 in Oxfordshire and 1 in Suffolk) were managed intensively (I) in comparison with the organic sites, although fertiliser and pesticide usage varied between sites and years according to weather, crop requirements and farmers choice. Skylarks were censured at least twice per month between 05:00 and 12:00 GMT on the study farms using CBC methodology.	
Outcomes	Mean densities (territories ha^{-1}) on different crop types:	

		April		May		June	
Crop	*n*	**O**	**I**	**O**	**I**	**O**	**I**
All cereal	75	0.38	0.17	0.26	0.11	0.16	0.06
Winter cereal	67	0.36	0.15	0.30	0.09	0.11	0.08
Silage	29	0.22	0.08	0.25	0.04	0.24	0.03
Grazed Pasture	22	0.05	0.02	0.07	0.00	0.10	0.01
Set-aside	23	0.56	0.36	0.56	0.30	0.33	0.26

Study design	Control trial: 60
Baseline comparison	Soil type was not recorded but all other factors were reported: 3
Intra treatment variation	All factors were reported: 3
Measurement of co-interventions	Details on management of the farms was reported: 1
Replication & measurement parameter	The experiment was well replicated with the number of fields under each management between the seven farms: 10
Sum of data quality	**77**

APPENDIX 3: Exploration of Reasons for Heterogeneity within Land-based Scheme Results

Table A1: Multivariate meta-regression coefficients and significance for *a priori* reasons for possible heterogeneity within the Arable Stewardship Pilot Schemes effectiveness.

Explanatory variable	*Coefficient*	*Std. Err.*	*z*	*p*	*Lower 95% CI*	*Upper 95% CI*
Time Running	-0.007	0.055	-0.13	p = 0.895	-0.12	0.10
Location	0.187	0.140	1.33	p = 0.183	-0.09	0.46
Granivorous Passerine	-0.722	0.717	-1.01	p = 0.314	-2.13	0.68
Skylark	-0.641	0.721	-0.89	p = 0.373	-2.06	0.77
Gamebird	-0.835	0.714	-1.17	p = 0.242	-2.23	0.56
Corvid	-1.820	1.287	-1.41	p = 0.158	-4.34	0.70
Thrush	-0.897	0.721	-1.24	p = 0.214	-2.31	0.52

Table A2: Multivariate meta-regression coefficients and significance for *a priori* reasons for possible heterogeneity within the Countryside Stewardship schemes effectiveness.

Explanatory variable	*Coefficient*	*Std. Err.*	*z*	*p*	*Lower 95% CI*	*Upper 95% CI*
Granivorous Passerine	**4.936**	**2.23**	**2.21**	**0.027**	**0.57**	**9.31**
Skylark	3.340	2.49	1.34	0.180	-1.54	8.22
Thrush	4.775	2.46	1.94	0.052	-0.04	9.59
Corvid	4.103	2.32	1.77	0.077	-0.05	8.66
Cereal	Dropped					
Grazing Pasture	**20.931**	**7.22**	**2.90**	**0.004**	**6.77**	**35.09**

Table A3: Multivariate meta-regression coefficients and significance for *a priori* reasons for possible heterogeneity within the Organic schemes effectiveness.

Explanatory variable	*Coefficient*	*Std. Err.*	*z*	*p*	*Lower 95% CI*	*Upper 95% CI*
Time Running	-0.050	0.19	-0.27	0.786	-0.42	0.31
Time of year	-0.205	0.15	-1.33	0.183	-0.51	0.10
Granivorous Passerine	0.025	0.29	0.09	0.931	-0.55	0.60
Skylark	-0.423	0.38	-1.10	0.269	-1.17	0.33
Thrush	0.062	0.39	0.16	0.876	-0.71	0.83
Gamebird	-0.089	0.32	-0.28	0.781	-0.72	0.54

Table A4: Multivariate meta-regression coefficients and significance for *a priori* reasons for possible heterogeneity within Set-aside schemes effectiveness.

Explanatory variable	*Coefficient*	*Std. Err.*	*z*	*p*	*Lower 95% CI*	*Upper 95% CI*
Cereal	-1.489	1.31	-1.13	0.257	-4.06	1.08
Pasture	-0.942	1.47	-0.64	0.521	-3.82	1.93
Brassica	0.331	1.59	0.21	0.835	-2.78	3.44
Granivorous Passerine	-0.439	0.75	-0.58	0.560	-1.91	1.03
Skylark	-1.503	0.78	-1.89	0.078	-3.08	0.03
Corvid	2.181	1.61	1.36	0.175	-0.97	5.33

Table A5: Multivariate meta-regression coefficients and significance for *a priori* reasons for possible heterogeneity within Stubble schemes effectiveness.

Explanatory variable	*Coefficient*	*Std. Err.*	*z*	*p*	*Lower 95% CI*	*Upper 95% CI*
Comparison crop	-0.165	0.25	-0.65	0.517	-0.66	0.33
Location	-0.057	0.37	-0.15	0.879	-0.79	0.67
Granivorous Passerine	**1.496**	**0.26**	**5.85**	**0.001**	**1.00**	**2.00**
Skylark	Dropped					
Corvid	**1.755**	**0.23**	**7.72**	**0.001**	**1.31**	**2.20**

Due to the low number of data-sets for the Wild Bird Cover option, it was deemed inappropriate to undertake a formal investigation of heterogeneity using meta-regression (Thompson & Higgins; 2002).