Natural England Commissioned Report NECR158

Assessment of the effects of Environmental Stewardship on landscape character

Correlative analysis of datasets to assess the degree of success in the delivery of Environmental Stewardship objectives

First published 29 September 2014

www.naturalengland.org.uk

NATURAL ENGLAND

Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. This project is supported by the Rural Development Programme for England, for which Defra is the Managing Authority, part financed by the European Agricultural Fund for Rural Development: Europe investing in rural areas.

Background

This study is one of three to correlatively analyse datasets to assess the degree of success in the delivery of Environmental Stewardship (ES) objectives. The studies are particularly relevant to ES, but do not discount the effects of earlier agri-environment schemes such as Environmentally Sensitive Areas and the Countryside Stewardship Scheme. The objectives for the project are to:

- Provide clear evidence of the extent to which existing ES scheme options have delivered against specific stated objectives or environmental outcomes by using appropriate extensive datasets, suitable for analysis both in spatial and temporal terms.
- Provide recommendations for future monitoring of ES option outcomes and requirements for data gathering or data coordination within and between existing monitoring schemes, including the potential for additional data gathering or modifications to monitoring protocols where this could be undertaken at little additional cost.

The aim is to evaluate how well Government funded agri-environment interventions are providing improved trajectories towards the planned objectives of the schemes.

This study looked at the extent and condition of key landscape features managed under ES by comparing the agri-environment scheme data with data collected for the Countryside Survey 2007. It also investigated the influence of features managed under ES on the cultural values of landscapes using previously collected data on perceptions of landscape.

The results of this report, NECR156 - *Assessment of the effect of Environmental Stewardship on improving the ecological status of grassland, moorland and heath* and NECR157 - *Assessing the importance of spatial location of agri environment options within the landscape to butterflies* will contribute to a wider analysis of similar linkages between management options and ES objectives, which will be used to help formulate and implement the next Rural Development Programme for England.

Natural England Project Manager - Chris Chesterton, 25 Queen Street, Leeds, LS1 2TW
chris.chesterton@naturalengland.org.uk

Contractor - Lisa Norton & Peter Henrys, Centre for Ecology & Hydrology (CEH); Andrew Crowe, Food and Environment Research Agency (fera)

Keywords - landscapes, Environmental Stewardship (ES), monitoring

Further information
This report can be downloaded from the Natural England website: **www.naturalengland.org.uk**. For information on Natural England publications contact the Natural England Enquiry Service on 0845 600 3078 or e-mail **enquiries@naturalengland.org.uk**.

ISBN 978-1-78354-140-9

Executive Summary

1. This study looked at the extent and condition of key landscape features managed under Environmental Stewardship (ES) by comparing the agri-environment scheme data with data collected for the Countryside Survey (CS) 2007. It also investigated the influence of features managed under ES on the cultural values of landscapes using previously collected data on perceptions of landscape.

2. Approximately 30% of the Countryside Survey sample area for England was under an Environmental Stewardship agreement at the time of survey with the maximum age of agreements being 2 years.

3. The analysis showed that, at the national scale, the density of walls and hedges within Environmental Stewardship agreements was not significantly different from the density of these features in the wider countryside. (i.e. where hedges and walls were present in land under agreement they were included in the agreement). There were significantly fewer ponds and in-field trees under agreement than in the wider countryside.

4. At the national scale, there was no significant difference in the condition of hedges or walls on land under agri-environment schemes compared to land not under agreement

5. Detailed analysis of land under agreement within CS sample squares, showed that approximately two thirds of hedges and one tenth of walls on agreement land were managed under an Environmental Stewardship option. For in-field trees and ponds the distribution and number of these features recorded in the Countryside Survey squares was insufficient to perform a statistical comparison.

6. At the 1km square level, land under Environmentally Sensitive Areas agreements had significantly higher proportions of hedges managed by cutting and laying, and coppicing than national averages. Double the proportions of walls on agri-environment land were in excellent or sound condition (50% compared to 25% nationally).

7. A number of landscape features applicable for management options under agri-environment schemes are considered to have a significant cultural value; these are individual trees, hedges, ponds, moorland, and walls. However only the area of land under Environmentally Sensitive Areas agreements, which has options more targeted towards enhancing these features than Environmental or Countryside Stewardship, had a positive correlation with landscape cultural value scores.

Contents

Executive Summary 1
1. Introduction 3
2. Hypotheses 4
3. Methods 5
3.1 Brief description of Countryside Survey (CS) approach 5
3.2 Assessing the extent to which agri-environment options on landscape features reflect their presence in the wider countryside using national data. 6
3.3 Assessing the extent to which the lengths, numbers and condition of landscape features differ between land that is under an agri-environment scheme and land that is not. 8
3.4 Assessing the degree to which ES related features contribute to the cultural service provided by the landscape 10
3.5 Investigation of the spatial inconsistencies between the the Countryside Survey and agri-environment agreement data 12
4. Results 15
4.1 National coverage of AES agreements and ES Options 15
4.2 Assessing the extent to which the lengths, numbers and condition of landscape features differ between land that is under an agri-environment scheme and land that is not. 22
4.3 Assessing the degree to which ES related features contribute to the cultural service provided by the landscape 27
5. Discussion 30
5.1 To what extent do Environmental Stewardship options on landscape features reflect their presence in the wider countryside, using national data? 30
5.2 To what extent do the lengths, numbers and condition of landscape features differ (and options associated with them) between land that is under an agri-environment schemes and land that is not, using CS square data. 30
5.3 Condition of features on land under agreement in CS compared to their condition in land not under agreement 31
5.4 To what degree do ES related features contribute to the cultural service provided by the landscape? 31
6. References 34
Appendix: Supporting Material 35
Comparison of CEH Land Class and National Character Areas 38

1. Introduction

This report is part of a series of studies commissioned to determine the extent to which environmental changes can be attributed to the impacts of agri-environment schemes, and within those schemes, individual agreements. The studies are particularly relevant to Environmental Stewardship, but do not discount the effects of earlier agri-environment schemes such as Environmentally Sensitive Areas (ESAs), and the Countryside Stewardship Scheme (CSS).

One of the main aims of Environmental Stewardship (ES) is to maintain and enhance landscape character. This is achieved through provision of agreement options which support the maintenance and restoration of iconic landscape features such as traditional field boundaries. In this study we have used the recording of a number of these features in the 2007 Countryside Survey in conjunction with agreement data from ES to assess the contribution that agri-environment schemes have made in maintaining landscape character. The landscape features which we have focused on are those for which ES contains a number of options and for which CS records data on both extent and condition. We have investigated both boundary and single 'point' features. CS records other linear and point feature types but data may not be suitable for assessing feature condition, e.g. hedge banks. At the time of the 2007 Countryside Survey, ES had only been running for two years although the land under agreement may have been under other agri-environment schemes before being entered into ES.

2. Hypotheses

In this study we test three hypotheses:

1. Agri-environment options for key landscape features reflect the extent to which those features are present in the wider countryside.
2. The condition of these features is better on land under agreement than it is on land outside of agreement.
3. Agri-environment schemes help to maintain or increase the cultural value of the landscapes they operate in.

3. Methods

To address these hypotheses we assessed the effect of ES on landscape character using two sets of analyses. The first concentrated on looking at the extent of features at two scales: national and 1km square. The second approach examined the potential contribution of landscape features supported by agri-environment schemes to the cultural value of different landscapes, and the change in the provision of cultural services in the countryside provided by agri-environment schemes. One note of importance is that our tests do not identify whether management actions under ES agreements have maintained or enhanced these landscape features. Differences in feature condition between ES and non-ES land may be due to the presence of ES management, or they may be due to an underlying process within the ES scheme which selects land with features in better condition. Spatial analysis was carried out using ESRI ArcGIS 10, statistical analysis using SAS software.

3.1 Brief description of Countryside Survey (CS) approach

Countryside Survey (CS) uses a randomly stratified sample of UK 1km squares to provide estimates of extents and condition of UK habitats. The most recent survey was carried out in 2007 and this analysis uses data from 2007 alongside agri-environment scheme coverage information provided by NE relevant to the time of the survey.

The underlying stratification for the selection of CS squares is based on CEH (formerly ITE) land classes (Bunce et al 1996; Figure A1[1]; Table A1). These are classifications of each 1km square in GB based on a series of 40 underlying physical variables including geological and climatic variables. The classification groups squares of similar types in England into 22 different land classes (including one joint England/Wales land class). The classification is much coarser than the National Character Area classification and does not specifically emphasise cultural landscape differences. However, there are inevitable links between land class and landscape features resulting from underlying soil types, altitude, climate etc. – all of which influence the types of features present in a landscape.

In this analysis, land classes have been used to provide a basis for comparing CS data on the landscape features described above to relevant options under the agri-environment schemes. CS includes a whole square mapping exercise (Maskell et al 2008) which includes a minimum linear feature length of 20m and no minimum size for ponds or trees. In practice, individual trees which do not reach 'breast height' (as in the standard tree measure of diameter at breast height [DBH]) will not be recorded unless in areas where tree occurrence

[1] Table and figures located in the Annex are prefixed by the letter 'A'.

is rare and trees are likely to be stunted in growth (upland areas). Pond mapping was undertaken according to guidelines from Pond Conservation and included seasonal ponds and dew ponds, as well as larger man-made ponds (Maskell et al 2008).

3.2 Assessing the extent to which agri-environment options on landscape features reflect their presence in the wider countryside using national data.

The aim of this analysis was to compare the extents of the following features, as targeted by agri-environment agreements, in relation to their general extents in the wider countryside (using the estimates from the Countryside Survey):

- number of in-field trees;
- length of hedges;
- length of stone wall; and
- number of ponds.

There are other types of linear features present in English agricultural landscapes, such as hedgebanks and earth banks. As earth bank management was only available as an ES management option from 2010, these were discounted from the analysis. Also, as CS did not specifically identify stone-faced hedgebanks, the two options associated with this type of feature (EB4 and EB5) were incorporated with the other hedge options. In this analysis the condition of linear features has not been considered, the analysis is only concerned with the extent of recorded features or options, though we acknowledge that hedges and walls can vary in their condition.

3.2.1 Spatial Analysis

Data for the lengths (hedges and walls) and numbers (trees and ponds) of the four feature types above were extracted from the CS database and summarised to give a mean density (km^{-2}) for each CEH land class. To enable comparisons by land class, the locations of holdings in ES were intersected with the CEH land class dataset for England in order to identify areas in the scheme by land class. Linkage of the spatial information on ES with detailed option information (including both entry and higher level options) made it possible to calculate the extents of relevant options (Table A2) for each land class and thus calculate a mean extent per km square for each land class within ES.

The analysis is limited by the lack of spatial accuracy related to the manner in which boundary options are recorded within the Entry Level Stewardship database (managed by

Natural England). Boundary options data are referenced to a single point location representing the total for the options across the entire holding. As a holding may contain land under more than one land class it is not possible to accurately determine the quantity of an option within each holding associated with a particular land class. The fact that these option data are not specifically linked to the actual locations with which those options are associated leads to significant potential for associated error. This analysis adopted the pragmatic approach of averaging data across the land classes within a land holding on a feature per area basis. This issue is further discussed later in the report.

3.2.2 Statistical Analysis

Mann Whitney U test, Chi square test and Spearman's rank correlation (Box 1) were used to test whether the extent of landscape features under the agri-environment options for ES reflected their extents in the wider countryside, based on land class averages from Countryside Survey. Chi square and Mann Whitney U tests indicate overall comparability for categorical (ponds, trees) and continuous (lengths) variables. Spearman's rank test was used to determine how well the quantities of features under management options in ES mirror the quantities of those features in the wider countryside across all land classes.

Box 1 – Brief description of Statistical tests

Mann Whitney U test - is a non-parametric statistical hypothesis test for assessing whether one of two samples of independent observations tends to have larger values than the other. The statistic is computed using the ranks of the data rather than their measured values.

Chi square test - is a non-parametric statistical hypothesis test for assessing whether the variation in a set of categorical data differs from a standard distribution of the sample variance.

Spearman's rank correlation - is a non-parametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function.

3.3 Assessing the extent to which the lengths, numbers and condition of landscape features differ between land that is under an agri-environment scheme and land that is not.

This analysis uses CS data for specific squares which include land both under ES (and for later analyses, Countryside Stewardship (CSS) and Environmentally Sensitive Areas (ESA)) and under conventional management. In contrast to the previous analysis which was effectively a very coarse comparison of extents of features under agreement across England based on averages by land class, this approach undertook to look for direct comparison for areas in and out of agreement within CS squares. This analysis applies a method similar to the previous analysis, namely to undertake an assessment of the stocks of features using the 1km square level CS data and the ES option information for the areas within the individual CS squares. The second part of the analysis uses CS square data to compare the landscape features within the square for land under agreement with land without an agreement.

This analysis focused on both the extent (length for hedges and walls, and number for trees and ponds) and the condition for hedges and walls. Condition measures for walls used a pre-existing description developed by ADAS (Countryside Commission 1996). Hedge condition measures were based on best available data from the mapping component of CS which consisted of recorded management criteria (no recent management, newly planted, cutting e.g. flail or saw [<3yrs], laying or coppicing [>5 yrs], both of the preceding). Whilst very detailed hedge condition information is recorded in CS on a sample of hedges in each CS square, without precise spatial information on hedges in agreement it is not possible to use these detailed assessments to assess scheme impact.

3.3.1 Spatial Analysis

The boundaries for 1km squares used in Countryside Survey were intersected with the boundaries for holdings with ES agreements to identify which areas of the surveyed CS squares were within and outside of agreement. The proportion of each holding within a CS square was calculated by dividing the intersected area for a holding by its total area. This proportion was used to estimate the quantity of features on the 'in-agreement' land.

3.3.1.1 Extent of features under agreement in CS squares compared with actual feature extent

ES options information for agreement areas within CS squares was extracted and calculated pro-rata for the area of land under agreement within the square. As referred to previously, data on location of ES options in the ES scheme database is held as points associated with

either the entire holding or a field within the holding. This does not allow identification of the specific feature with which a particular option is associated, and therefore extent of options across the whole polygon (for agreements with land inside CS squares) has been adjusted for the agreement area within the CS square (pro-rata). This introduces an additional source of uncertainty (statistical error) when undertaking the analysis between the options linked to a polygon within a CS square and the actual features present within that extent. This pro-rata option extent has then been compared with the actual lengths of landscape features relevant to those feature options recorded by CS for the land under agreement within the square. This analysis also provides a sanity check to ensure that the option information does not indicate that there are a greater number of features in the landscape than has been captured in CS.

3.3.1.2 Extent of features in agri-environment schemes in CS squares compared with non-agri-environment land in CS squares

The intersection of the in-agreement holdings and CS squares was used to identify landscape features that were within or outside of agri-environment agreement for each of ES, Countryside Stewardship (CSS) and Environmentally Sensitive Areas (ESA) schemes. Total counts/lengths of features inside and outside of agreement were calculated pro rata for the areas of the km square inside and outside of the schemes. Total densities of features inside and outside of agreement were calculated based on the areas of the survey square inside and outside of the schemes.

3.3.1.3 Condition measures associated with features identified as in and out of agri-environment schemes.

For the hedges and walls identified as on or outside land under agreement, the conditions of the features were compared. Condition measures are categorical variables with the hedge condition classed according to evidence of management while walls were classed according to state of repair.

3.3.2 Statistical Analysis

Mann Whitney U test, Chi square test and Spearman's rank correlation were used to test whether the extent of landscape features under ES options within squares was reflected in their extents in CS squares. Mann Whitney and Chi square tests indicate overall comparability for continuous (lengths) and categorical (ponds, trees) variables respectively. Spearman's rank test was used to identify where there are differences according to land class.

Similarly, Mann Whitney U and Chi square tests were used alongside Spearman's rank correlation to test whether land in a holding with an ES agreement (observed), differs from land outside of ES in terms of landscape features within the same CS squares. Chi square provided an overall comparison, testing whether the extents of different feature types differ across all squares and land classes. Spearman's rank shows the impacts of differences between and within land classes. Chi square frequency tests were used for categorical variables relating to condition, using the most frequent condition recorded for land in and out of ES within squares. Chi square tests were also used to investigate whether condition measures for walls and hedges on land within ES agreements within CS squares were different to those in the wider countryside. The Chi-Square test was performed using totals scaled to a common unit area (length per km^2).

3.4 Assessing the degree to which ES related features contribute to the cultural service provided by the landscape

This assessment makes use of the work undertaken by Research Box for Natural England to capture the cultural services and experiential qualities of landscape (Natural England 2009, 2011) and the subsequent work done in collaboration with Research Box on mapping cultural services according to landscape characteristics using CS data (Norton et al. 2011). The work focuses on the National Character Areas outlined in the above reports and extends the list of scoring metrics used by Norton et al. (wood, water, relief, coastal areas) to include additional features supported by the agri-environment schemes which featured in the Research Box study. The five biophysical landscape characteristics used in the original study reported in Norton et al. (2011) were; area of woodland, area of standing open water, area of coastal habitats, altitude and relief.

In order to target appropriate features to include in this work an initial review was carried out to identify a list of features recorded in CS which are:

- covered by agri-environment scheme options;
- listed as important characteristics of the relevant National Character Areas; and
- were shown to positively influence people's experience of nature (cultural services) in the Research Box work.

This information is presented in Table A3, which also indicates the numbers of CS squares in each of the NCAs in the Research Box study. This information has not been used in any analysis but is provided to show that CS data is not representative at the NCA level, with some NCAs containing no CS squares and others several. As described above, CS is based

on the CEH land classes which represent a far coarser land stratification which does not focus on cultural landscape features. Hence, it is not appropriate to treat this analysis as an exercise to provide measures of cultural service provision at NCA level. Rather it provides an indication of national level provision of services using the underlying CS stratification, based on social data collected within selected NCAs on the premise that features highlighted within those NCAs have national significance for cultural service provision (as in Norton et al. 2011). The review of important characteristics defining NCAs confirmed that the variables already used to provide cultural service scores were important (see above) and indicated that there were some additional features covered by CS metrics and included within agri-environment schemes which could be used to provide valuable information about the cultural services offered by landscapes.

Five further biophysical variables, for which there is evidence of impact on people's experiences of nature, were added following the review, they are:

- numbers of individual trees;
- lengths of woody linear features;
- numbers of ponds;
- area of moorland; and
- lengths of walls.

A similar scoring approach was adopted as used previously in the Research Box study. Scores included both a 'probability' that each land class contained the features in question and an assessment of the extent to which cultural services were delivered by those features within that land class. As in the original study, this assessment was made separately for each of the CS data variables listed above based on expert judgement, using the following scale: none (0), low (1), medium (2), high (3). For most variables (features), a higher score reflected an increased probability of finding the feature in question within the land class and a greater extent of that feature (in % cover). The exception was broadleaved woodland, where the research indicated that extensive cover was less highly valued than a mixture of woodland and open areas (e.g. fields).

The scores for each of the variables within each land class were summed to provide an overall score for that land class. In simply summing the scores, an assumption was made that all variables (features) are equally important. It is also important to note that no distinction was made between the eight separate cultural services examined in the research:

History, Sense of place, Inspiration, Calm, Leisure/Activities, Spiritual, Learning, and Escape. The judgement 'score' derived for each 'feature' within each land class relates to all in combination - and that scores relate only to features within the CS km squares. Many cultural services relate to the landscape features that can be seen, but are not necessarily in the immediate vicinity (and are sometimes at a considerable distance). This measure, therefore, takes no account of features that are visible but which lie outside of the grid square.

Rather than analyse the total score, we investigated the proportional change between the cultural service scores based on the 5 measures in Norton et al. (2011) and the score with the agri-environment features included. This analysis was restricted to the NCAs surveyed for the Natural England report NECR024 (Natural England 2009) where it was possible to determine which agri-environment features would contribute to the cultural service score.

3.4.1 Statistical Analysis

Simple linear regression was used to investigate the extent to which cultural service scores for land classes change when landscape features supported by agri-environment schemes are included alongside key variables of cultural significance.

3.5 Investigation of the spatial inconsistencies between the the Countryside Survey and agri-environment agreement data

Before discussing the results of the analysis it is important to assess the success of bringing together the data on agri-environment agreements and the Countryside Survey. Whenever data from different sources are brought together, those data need to be merged into a common framework for analysis. In the case of the Countryside Survey and agri-environment data there are significant differences in the way the data are represented spatially. Countryside Survey has mapped features to their exact location within the sample square, allowing us to know exactly where in the landscape these features occur. In the case of the agri-environment scheme data, management option information is recorded at a single point associated with a polygon (which may be a field or a holding) rather than one indicating the exact location where the option is implemented. This is understandable as the extra overhead of recording this exact location, which in the case of rotational options (which do not include the linear options investigated in this study) may move between years, is not required to manage the agreement. It does however introduce issues related to matching up the highly resolved spatial data on landscape features in the Countryside Survey and those features referenced in the agri-environment scheme agreements. For example, an agreement may include pond management options relevant to a pond which if accurately

mapped would not fall inside the CS square, but rather in the area of the agreement polygon (holding or field) which falls outside of the CS square (Figure 1a). A pragmatic approach (see Section 3.3.1) was taken in order to try to account for this potential mismatch and provide some information on the extents of agreement options within CS squares.

The most significant problem is for landscape features where a single point represents the total quantity of an option for an entire agreement. In order to deal with this, the project team made the assumption that the option is spread out uniformly across the agreement area. Hence the analysis is performed on density of features rather than total quantity.

a) b)

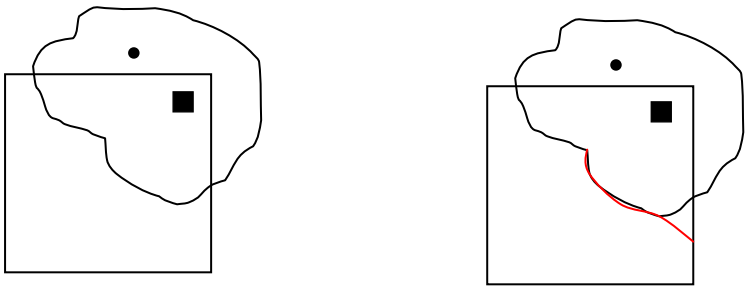

Figure 1 Illustrations of potential issues relating to spatial data formats. The irregular polygon represents the whole agreement holding area. The large open square represents the 1km CS square. The single dot represents the true location of an option which is referenced to an arbitrary location (filled square) within the holding. The red line in (b) represents a single recorded linear feature within the CS square.

A second spatial issue concerns shared borders between agreement and non-agreement land. Because both the agreement and non-agreement areas are likely to be bordered by linear features, when calculating the extents of linear features within each of those areas, any bordering linear features are likely to appear in both agreement and non-agreement calculations (i.e. be double-counted). In practice the linear features bordering a land parcel will be the responsibility of a particular land owner, though this is not even always clear on the ground and in some instances different landowners may be responsible for different sides of the same feature. A further issue resulting from the way that linear data is held in CS is to do with linear features not being directly linked to polygons and possibly extending beyond the boundaries of those polygons, see example in Figure 1b (red line).

In a case such as that illustrated in Figure 1b, the intersection of polygons from CS with those from ES would result in features on the red line being included in data for both “within” and “outside of” ES. Given the nature of the data and the impossibility of identifying an

absolute truth, double accounting seems the least biased option. These pragmatic decisions have been taken to enable these analyses to be performed, but it is acknowledged that they do have some impact on the precision of the outcomes.

4. Results

4.1 National coverage of AES agreements and ES Options

Table 1 presents the areas under agreement for the active agri-environment schemes in 2007. It is theoretically possible for the same parcel of land to be included in an Environmental Stewardship agreement and a Countryside Stewardship or Environmentally Sensitive Area agreement at the same time, which means that the total geographic area under agri-environment schemes may not be equal to the sum of area under agreement.

In 2007 the total utilised agricultural area was 17.737 million hectares (Defra 2011), meaning that 25% of agricultural land was in an Environmental Stewardship agreement. The majority (ca 86%) was in the Entry Level Scheme.

4.1.1 Assessing the extent to which agri-environment options on landscape features reflect their presence in the wider countryside using national data.

Table 2 presents the total counts and lengths of features that had been entered into an ES agreement in 2007 and how they split across the relevant options. Mann-Whitney U tests were performed on the land class means for the four landscape features, comparing the means of land under agreement and of the wider countryside. The analysis shows that across all the land classes, the mean density of hedges under ES options (3998m per km^2) was not statistically different to the density of hedges in the wider countryside (according to CS average land class figures, 3314m per km^2) ($p=0.65$, Table 3; Figure 2). The density of walls under ES options (1072 m per km^2) was also not significantly different to the density of walls recorded across land classes in CS (1789 m per km^2) ($p=0.89$,Table 4; Figure 3). It should be noted that in Tables 3 and 4, the 'mean difference' figures for comparisons between ES and Countryside Survey is the mean difference between paired ES and wider

Table 1 Areas under agreement for active schemes in 2007.

Scheme	Number of agreements	Area under agreement (ha)
Entry Level plus Higher Level Stewardship	1844	304929
Entry Level Stewardship	30238	3873008
Higher Level Stewardship	106	27122
Organic Entry Level plus Higher Level Stewardship	209	45387
Organic Entry Level Stewardship	1878	242043
Countryside Stewardship		1321392
Environmentally Sensitive Areas		580036

Table 2 Uptake of the options investigated in this study within the active Environmental Stewardship agreements in 2007. Option code descriptions are provided in Annex Table A2.

Feature	Option Code	Quantity		Feature	Option Code	Quantity
In-Field Trees		Count		Stone Wall		Length (m)
	EC1/OC1	67070			EB11/OB11	18223143
	EC2/OC2	353779			UB11	226393
	HC5	328			UB17	103
	HC6	380				
	Total	421557			Total	18449639
Hedges		Length (m)		Pond		Count
	EB1/OB1	79742732			HQ1	473
	EB2/OB2	88282254			HQ2	1160
	EB3/OB3	34336666			HD9	60
	EB4/OB4	1824390				
	EB5/OB5	1726479				
	EB8/OB8	12060859				
	EB9/OB9	7392007				
	EB10/OB10	6046570				
	HB11	649654				
	HB12	1804013				
	Total	233865624			Total	1693

Table 3 Total and mean difference between the density (m km2) of hedges in land classes in the wider countryside (CS) and under ES options within each land class. Rank correlation (rs) is tested between land class means for CS and ES (21 land classes).

		CS	**ES**
Hedges	Mean Density (m km^{-2}) across land classes	3314	3998
	Standard error	350	575
	Mean Diff		683
	P Value		0.65
	Rank Correlation Coefficient (r_s)		0.77
	P Value		**0.00**

Table 4 Total and mean difference between the density (m km-2) of walls in the wider countryside (CS) and under ES options within each land class. Rank correlation (rs) is tested between land class means for CS and ES (21 land classes).

		CS	**ES**
Walls	Mean Density (m km^{-2}) across land classes	1789	1072
	Standard error	503	215
	Mean Diff		-717
	P Value		0.89
	Rank Correlation Coefficient (r_s)		0.71
	P Value		**0.00**

countryside land class means, and it does not equate to the national mean difference across all land classes.

The density of trees under ES options (11 per km) was significantly less than the density of trees in the wider countryside across all land classes (41 per km), with land classes being ranked in similar order in both the ES and CS data (Table 5). The number of ponds with ES options (0.49 per km) was significantly less than the number of ponds in CS across all land classes (1.5per km) with land classes being ranked similarly in both the ES and CS data (rank correlation analysis; Table 6).

Table 5 Differences between the density of individual trees in the wider countryside (CS) and under ES options (21 land classes). Significance of differences in counts between the wider countryside and ES land was tested using Chi square. The relationship between trees in the wider countryside and on land under ES is tested using Spearman rank correlation.

		CS	**ES**
Trees	Mean Number of trees (km-2) across land classes	41	11
	Standard error	3.96	1.17
	Mean Diff		-30
	P Value		**0.00**
	Rank Correlation Coefficient (r_s)		0.47
	P Value		**0.05**

Table 6 Differences between the density of ponds in the wider countryside (CS) and under ES options (21 land classes). Significance of differences in counts between the wider countryside and ES land is tested using Chi square. The relationship between ponds in the wider countryside and on land under ES is tested using Spearman rank correlation.

		CS	**ES**
Ponds	Mean Number of ponds (km^{-2})	1.50	0.49
	Standard error	0.26	0.05
	Mean Diff		-1
	P Value		**0.00**
	Rank Correlation Coefficient (r_s)		0.82
	P Value		**0.00**

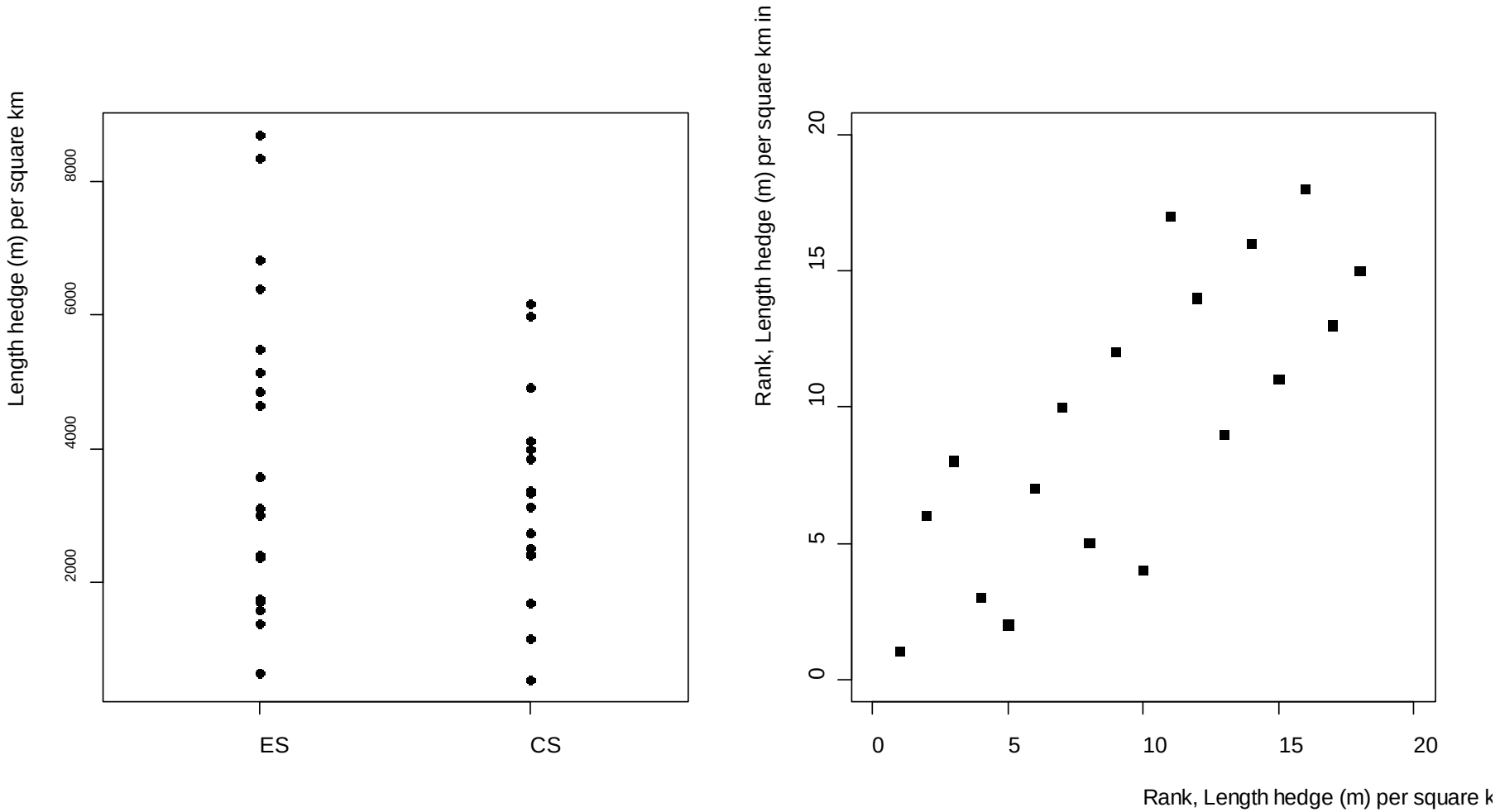

Figure 2 Plot of the spread of values for the density of hedges (m km^{-2}) from Countryside Survey and under Environmental Stewardship (ES) options by CEH land class, and a comparison of ranks between the two.

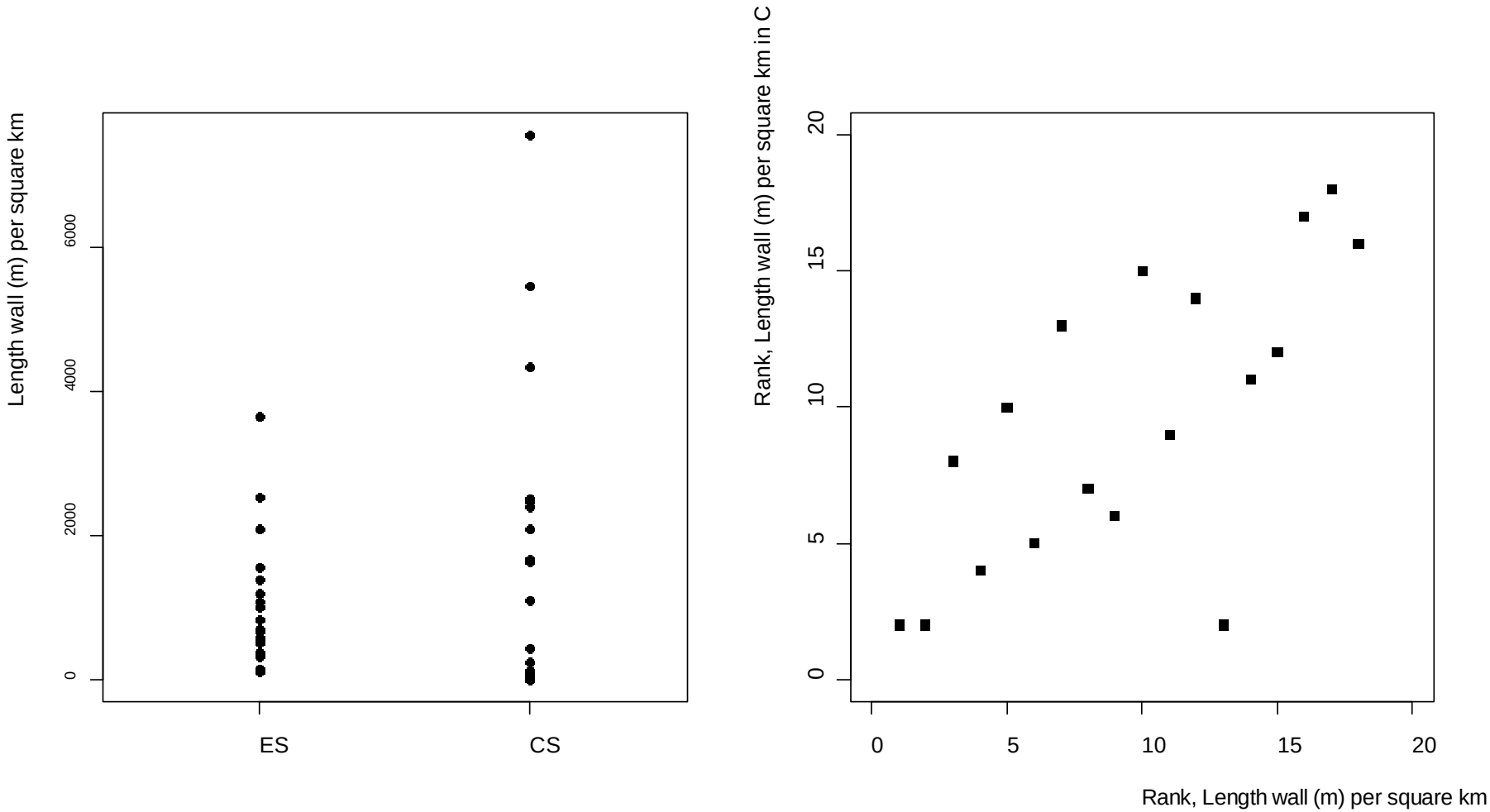

Figure 3 Distribution of densities of walls (m km^{-2} in the wider countryside (CS) and under Environmental Stewardship (ES) options by CEH land class, and a comparison of ranks between the two.

4.2 Assessing the extent to which the lengths, numbers and condition of landscape features differ between land that is under an agri-environment scheme and land that is not.

The proportion of land under agreement in each of the squares varied according to scheme type, with the greatest proportion in Environmental Stewardship (Table 7). As has been noted previously, land can be under both ES and either CSS or ESA agreements, however this does not affect the results of the analyses used in this part of the study.

4.2.1 Extent of features under agreement in CS squares compared with actual feature extent

The results show that the ES options for hedges and walls (listed in Table A2) do not cover all such features present on agreement land, such that on average approximately two thirds of hedges are under agreement, while only around 10% of the length of walls are included in an agreement (Table 8).

Table 7 The extent of land in CS squares under agreement in 2007 (total number of CS squares = 289)

Scheme	**No of squares with agreement land**	**Total area under agreement in squares (km^2)**	**% of agreement land in CS sample**
CSS	116	30.8	10.6
ESA	41	20.6	7.1
ES	215	87.7	30.3

Table 8 Mean density of hedges and walls under ES options within CS squares compared to recorded density from CS data. Significance of the difference in densities between option and total features has been tested using Mann Whitney U test. Spearmans rank correlation is used to test whether squares with higher total density of features also have higher density of features in ES options. Significant results have been highlighted in bold.

	Density ($m\ km^{-2}$) CS	**Density ($m\ km^{-2}$) ES**	**Mean Diff**	**P value**	**r_s**	**P value**
Hedge	6799.27	4686.63	2112.63	**0.00**	0.43	**0.00**
Wall	4627.75	455.76	4172.00	**0.00**	0.86	**0.00**

Only one square contained trees (in scheme) and no squares contained ponds in areas of land both ‘in’ and ‘out’ of ES. Hence it was not possible to carry out an analysis investigating the extent to which relevant ES options related to either pond or tree number.

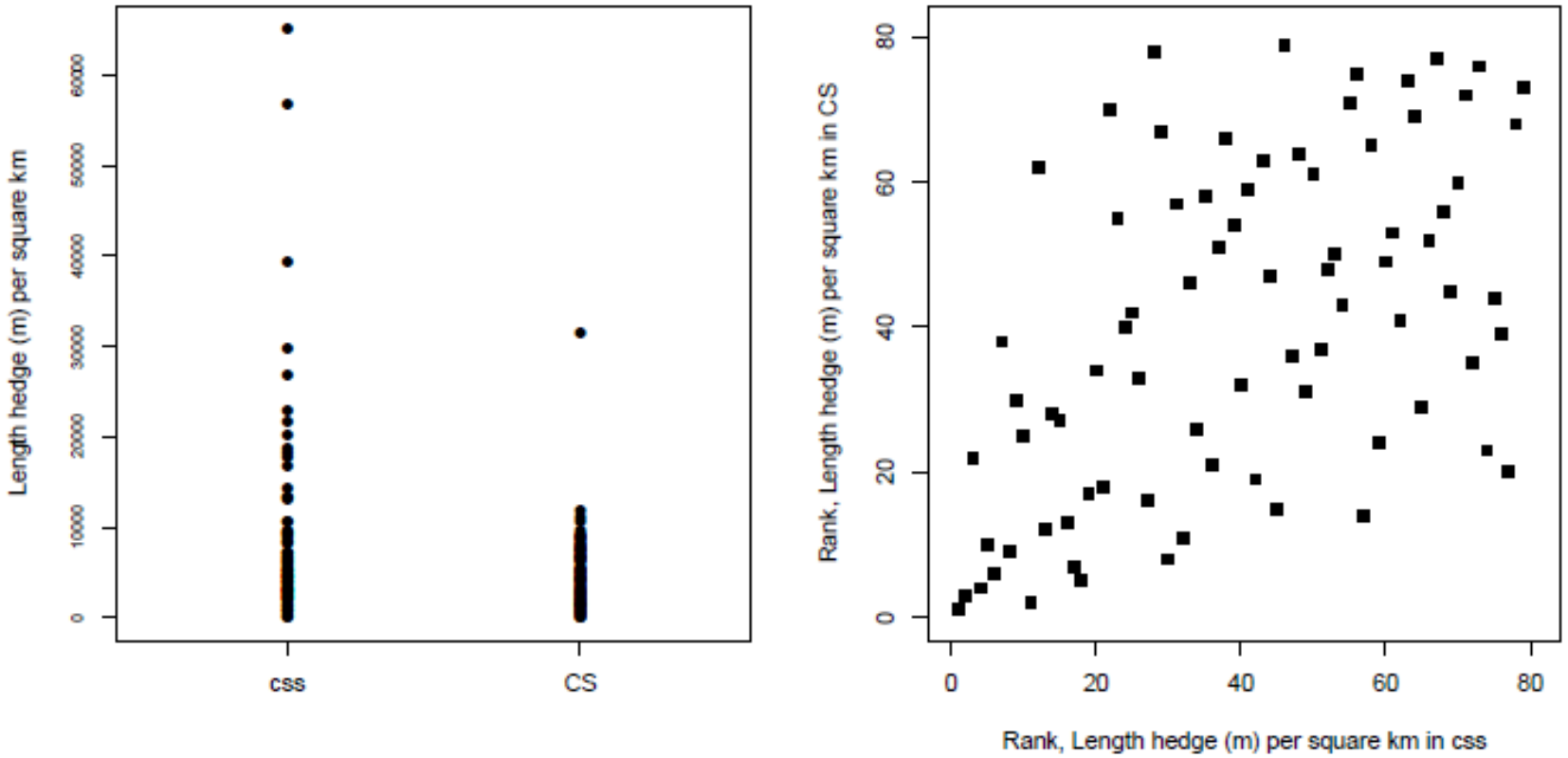

Figure 4 Density of hedges (m km^{-2}) in outside of (CS) and within (CSS) land under Countryside Stewardship agreements and comparison of ranks between the two.

4.2.2 Extent of features in land under agreement in CS compared to the extent in land not under agreement

When looking at the within-square comparison of feature density, there was a significantly greater density of hedges (Figure 4) and ponds in land under CSS than in land outside of CSS (Table 10). There were no significant differences for features in either of the other two schemes. Significant rank correlation coefficients indicate strong relationships across all land classes between feature extents within and outside of agreement for both CSS and ES (Table 9). The numbers of ponds and trees within and outside of agreement land under the ES scheme were not sufficient to carry out an analysis for these features.

4.2.3 Condition of features in land under agreement compared to their condition in land not under agreement

4.2.3.1 National level

Condition measures for hedges did not differ significantly for hedges inside and outside of any of the three agri-environment schemes, with the majority of hedges being managed in a rotation <3 yrs with a flail or saw (Figure 5, Chi square test, P>0.10 in all cases). Similarly, there were no significant differences between the condition of walls inside or outside of agreement land within CS squares (Figure 6, Chi square test, P>0.10 in all cases).

Table 9 Means for density of hedges and walls and numbers of trees and ponds in areas within and outside of agri-environment agreement areas. Significance of the difference between the density of features on land within and outside of agri-environment schemes was tested using Mann Whitney U test for hedges and walls, and chi square test for trees and ponds. Significant results have been highlighted in bold. The relationship between the density of features for land within and outside of agri-environment scheme was tested using Spearman Rank Correlation.

	Density outside of AES	**Density within AES**	**Mean Diff**	**P Value**	**r_s**	**P Value**
CSS	m km^{-2}	m km^{-2}				
Hedge	4960.59	9262.04	**4301.45**	**0.021**	**0.59**	**0.0000**
Wall	5752.37	9404.63	3652.27	0.92	**0.73**	**0.0014**
	km^{-2}	km^{-2}				
Trees	51.17	101.16	49.99	0.55	**0.56**	**0.0000**
Ponds	3.19	15.54	**12.35**	**0.034**	-0.23	0.53
ES	m km^{-2}	m km^{-2}				
Hedge	9307.75	7076.84	-2230.90	0.83	**0.43**	**0.0000**
Wall	5016.99	5019.58	2.60	0.98	**0.67**	**0.0000**
ESA	m km^{-2}	m km^{-2}				
Hedge	8431.72	6909.21	-1522.50	0.25	0.26	0.31
Wall	14243.35	8065.82	-6177.53	0.62	0.44	0.09

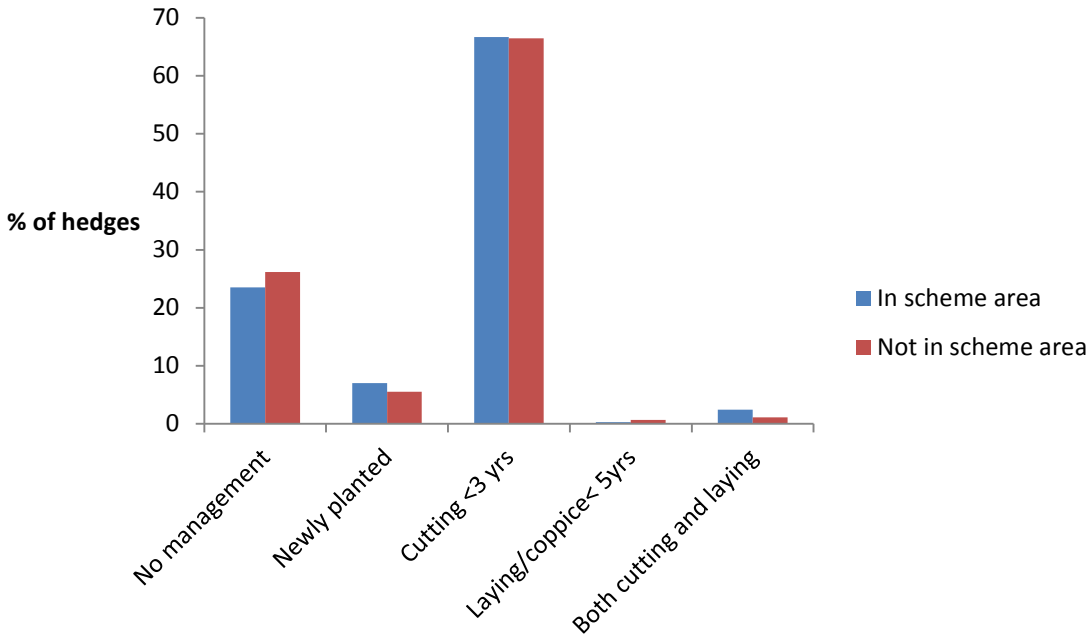

Figure 5 Proportions of hedges under different management regimes (condition) for land 'in' and 'out' of the Countryside Stewardship scheme in CS squares.

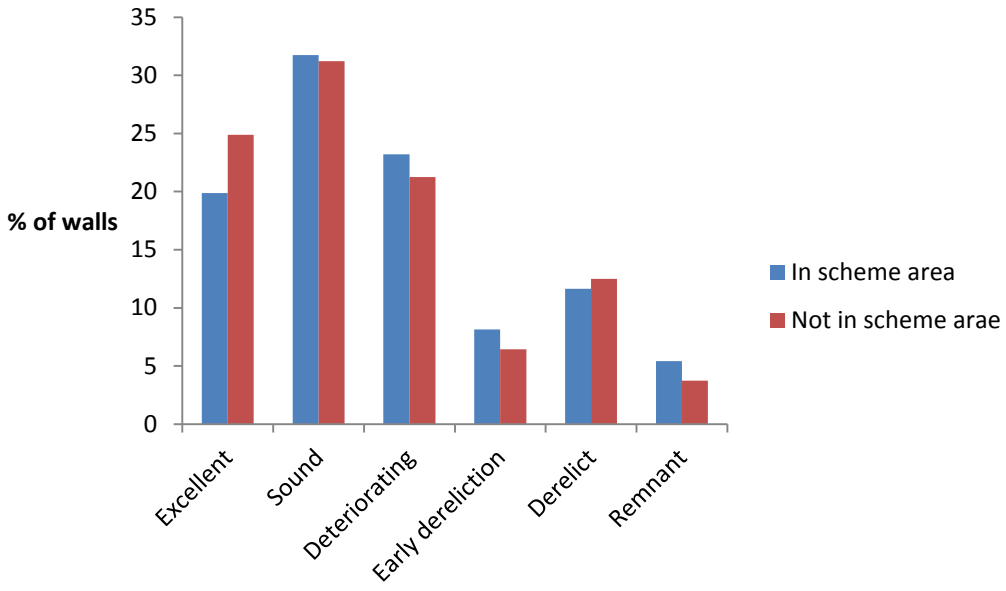

Figure 6 Measures of wall condition for land 'in' and 'out' of the Environmental Stewardship scheme in CS squares.

4.2.3.2 Assessment at CS Square level

For hedges, management regimes in CS squares with agri-environment schemes were more similar to the national figures[2] (Carey et al 2008) with the exception of ESA, where they were significantly different ($p < 0.002$). Proportions of hedges with no management were approximately 10% lower in CS squares with agri-environment schemes than in the wider CS sample, except for in ESA where they were 10% higher (Figure 5). Similarly proportions of hedges managed by laying or coppicing or cutting and laying were broadly similar to levels nationally except in the ESA schemes where they were up to 5 or 6 times more common.

Comparisons of the lengths per unit area of walls in each of the 5 condition measures (Figure 6), between CS squares containing agri-environment land, and the national figures, showed significant differences ($p < 0.0001$). Double the proportions of walls on agri-environment land were in excellent or sound condition (50% compared to 25% nationally) and around half the national figures were either deteriorating or in the early stages of dereliction[8].

Lack of spatial resolution for agri-environment option information and relative paucity of agri-environment options in the CS squares compared to the actual extent of features make it difficult to pick up any signal of change resulting directly from the agri-environment schemes.

4.3 Assessing the degree to which ES related features contribute to the cultural service provided by the landscape

The results are shown in Figure 7. The top left panel shows the increase in scores resulting from the addition of the 5 further variables. This is a significant increase ($p< 0.001$) which is independent of the original land class scores; i.e. all land classes show similar increases with a slope not significantly different to 1. The range of scores remained broadly comparable with or without the addition (4-9, pre addition 7-16 post-addition).

Tests to identify whether there were relationships between changes in cultural score and particular schemes (i.e. were scores for particular land classes linked to the presence of agri-environment schemes) were carried out. This analysis showed that changes in score were linked to the extent of ESA, with higher scores where there was more ESA land

[2] http://countrysidesurvey.org.uk/sites/default/files/pdfs/reports2007/CS-UK-Results2007-Chapter05.pdf

present (simple linear regression, slope coefficient, $p<0.01$) (top right panel, Figure 7). There was no similar relationship for either CSS or ES (bottom panels, Figure 7).

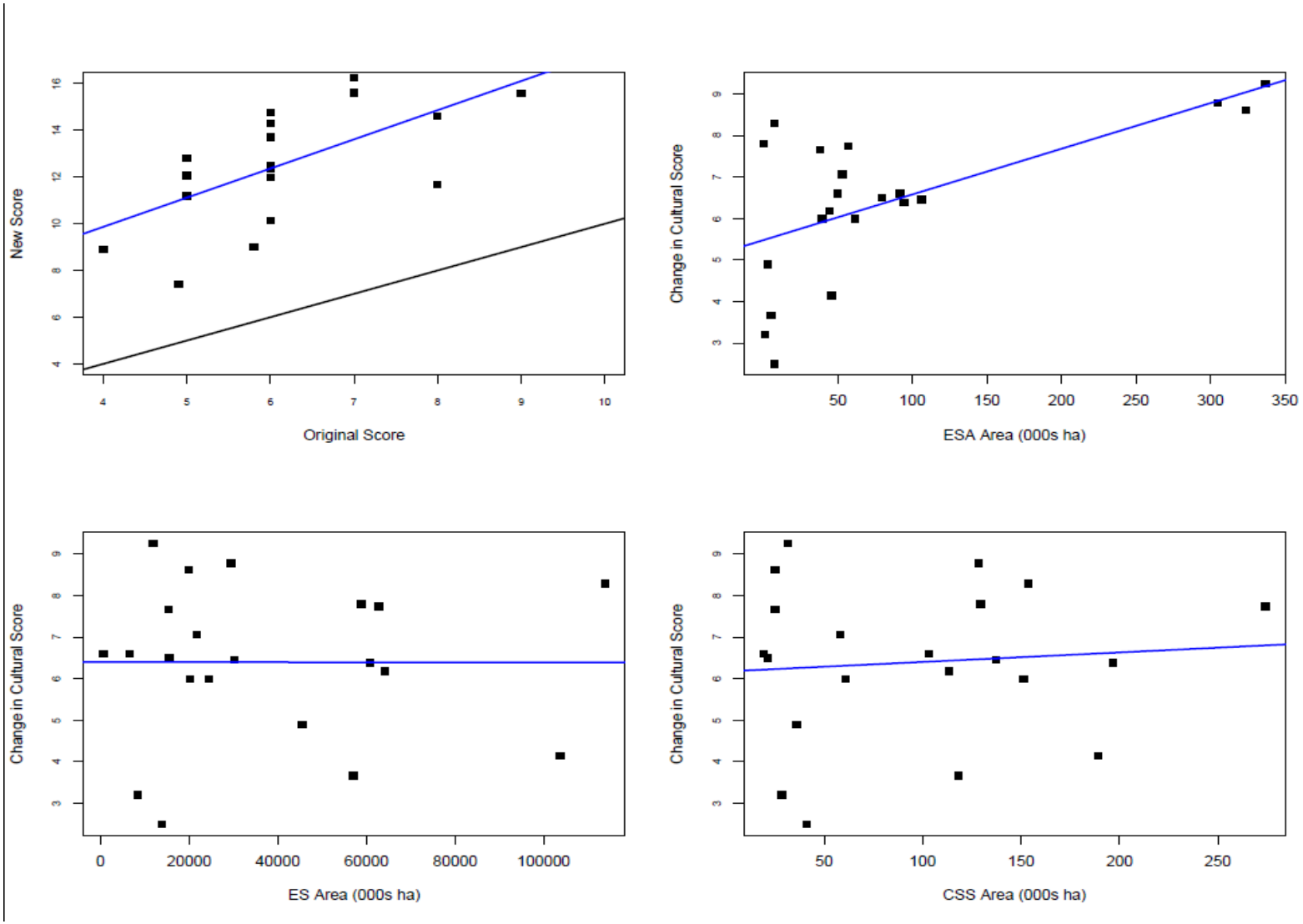

Figure 7 Comparison of cultural service scores pre and post inclusion of landscape features (top left panel) and change in cultural scores in relation to area (ha) under agri-environment schemes (ESA, CSS and ES).

5. Discussion

5.1 To what extent do Environmental Stewardship options on landscape features reflect their presence in the wider countryside, using national data?

This analysis has been carried out using several different approaches to try and tackle the potential issues of spatial incongruity with the agri-environment data. The final analysis reported on indicates that the density of hedgerows and walls on land under ES options was not significantly different from the density of hedges and walls in the wider countryside. Whilst results for trees and ponds appear more 'sensible' they almost certainly fall foul of the same issues as the hedge and wall data. A key issue affecting the potential calculation of the true extents of features in the agri-environment schemes is the way in which the data is held. While option data is not specifically referenced to the exact locations where the options have been implemented, it will be impossible to provide accurate location-specific figures for comparison with CS data. The scanned Farm Environment Records and Farm Environment Plans do provide a potential source of this information but would require digitising within a GIS to enable comparison.

5.2 To what extent do the lengths, numbers and condition of landscape features differ (and options associated with them) between land that is under an agri-environment schemes and land that is not, using CS square data.

CS squares provide a small but representative sample of land under the agri-environment schemes. However, given the issues outlined previously, it is unsurprising that the results comparing features in CS compared to features in agri-environment schemes indicate that options cover a small proportion of features present on land under agreement. As with previous results, the spatial inconsistencies in the data mean that this analysis is likely to be unreliable.

Although the coverage of the various agri-environment schemes in England is adequately reflected in their coverage in the CS squares (Table 8), the issues discussed above affect the validity of the analysis carried out here. However, the results indicate (in line with expectation) that in 2007 ES options did not cover the total length of features present within areas of land under agreement, with approximately two thirds of the length of hedges and ten percent of the length of walls covered by the different options for those features.

5.3 Condition of features on land under agreement in CS compared to their condition in land not under agreement

The analysis carried out at the national scale (3.2) showed that there were no significant differences in the condition of hedges and walls between land under agri-environment agreement (ES) and land not under agreement. In CS squares the walls and (for ESA only) hedges in squares which contained agri-environment land were in better condition than those in CS squares with no agri-environment land (analyses 3.3.1.2).

These results are subject to the problem of mis-matches between the actual locations of options and the polygons which intersect with CS squares. In some cases the lengths associated with particular polygons under agri-environment areas in CS squares are clearly not only associated with the polygons in the square (due to their excessive length). Comparison of squares containing agri-environment land with the wider set of CS squares does indicate that the locations of the schemes may either be biased towards areas with more favourable condition for walls and hedges or else influencing their condition. However, without the ability to directly relate particular features to schemes it is impossible to attribute the more favourable condition to management under schemes. The differences between CS squares in ESA areas and those elsewhere in terms of hedge management were significant, but included both 'no management' and high quality management which may result from different drivers. 'No management' may result from lack of financial resources or expertise, whereas high quality management requires both financial resources and expertise.

In general, for all these analyses, we would recommend that if the analysis is to be attempted in the future, that the agri-environment data would need to be provided in a format that exactly locates the options to features within the holding.

5.4 To what degree do ES related features contribute to the cultural service provided by the landscape?

Inevitably, if you include more of the features present in a landscape as part of a cultural score for that landscape you are likely to increase the overall cultural score of the landscape, unless, of course, those features detract from the cultural value of the landscape. The addition of landscape features (which correspond to the features targeted by ES and the earlier agri-environment schemes) to cultural landscape scores increased the scores across all land classes. The lack of significant differences in landscape feature scores between land classes, indicates that the features chosen are important and valued components of landscape across the country. The fact that no particular land class has increased its cultural score more greatly relative to others indicates that there is no single land class which offers

all the features of high cultural value, but rather that each land class contains a subset of features which have a similar total contribution to the cultural value assigned to that land class. For instance some land classes may contain greater areas of moorland and associated walls, whereas others will contain more trees and hedges. It is likely that this pattern of heterogeneity in landscapes, i.e. between land classes and on a smaller scale between NCAs is very important in maintaining the cultural value assigned to different types of feature.

The Environmentally Sensitive Area scheme was targeted specifically at high quality landscapes and sought to maintain and enhance those landscapes. Of the three schemes studied, ESA was the most land class specific and therefore was expected to show the best relationship between uptake and change in score. The results of this analysis indicate that land classes containing greater amounts of ESA do show a greater change in cultural score when agri-environment scheme features are taken into account. The lack of significance between the area under agreement and the increase in cultural value for Environmental Stewardship may have roots in the fact that the majority of the agreements (which come under the Entry Level Scheme) are non-targeted. Potentially the Higher Level Scheme agreements could be looked at separately, as these are much more targeted to preserving and enhancing the features present in a particular location.

The methodology employed here is inevitably somewhat crude which may influence the fact that land classes seem to offer cultural services across a relatively narrow range of values. Alternatively this may support the finding that all landscapes offer something valuable[3]. It should also be noted that this approach has employed a slightly different semi-quantitative scoring system than that used in Norton et al. (2011) as it proved difficult for the authors to consistently replicate the scores arrived at by the Research Box team. The approach taken here is more transparent, using clear relationships between amounts of features or landscape types and scores rather than a more subjective case by case approach.

Whilst it was possible to carry out some coarse level analysis of the scheme data against CS data at both national and 1km square scales, the analysis was constrained by lack of sophistication of the agri-environment data. Data on options being held at points associated with polygons cause issues of spatial inaccuracy regarding exactly where the landscape features under agreement are located. Fully geo-located (digital) data relating to boundary and in-field features would have allowed a more accurate and sophisticated analysis to be carried out.

[3] http://publications.naturalengland.org.uk/publication/48001?category=31019

The analyses carried out indicate that at the national scale, where hedges and walls were present in the landscape in 2007, they were well represented in ES options. Trees and ponds were less well represented. At a national scale condition measures for hedges and walls did not differ between land under agreement and land not under agreement.

Thirty percent of land in the CS sample was under ES in 2007 with 7 and 10% under ESA and CSS schemes. Apart from significantly higher lengths of hedges and numbers of ponds on land under CSS, there were no significant differences between the length/numbers of features on land under agri-environment schemes and on land not under a scheme. On ES agreement land within CS squares, ES options did not cover all possible hedges and walls. Walls on agri-environment land were in better condition than those on land outside of schemes. Hedges under ESA were in better condition than hedges outside of schemes, but there was no such difference for hedges managed under other schemes.

6. References

Bunce R.G.H., Barr C.J., Clarke R.T., Howard D.C., Lane A.M.J. 1996. The ITE Merlewood Land Classification of Great Britain. Journal of Biogeography 23, 625-634.

Carey, P. D., Wallis, S., Chamberlain, P. M., Cooper, A., Emmett, B. A., Maskell, L. C, McCann, T., Murphy, J., Norton, L.R., Reynolds, B., Scott, W.A., Simpson, I.C., Smart, S.M. & Ullyett, J. M. 2008. Countryside survey: UK results from 2007.

Countryside Commission. 1996. The condition of England's dry stone walls. Countryside Commission Leaflet CCP482.

Defra. 2011. Agriculture in the United Kingdom 2011.

Maskell, L. C., Norton, L. R., Smart, S. M., Carey, P. D., Murphy, J., Chamberlain, P. M. & Barr, C. J. 2008. Countryside Survey. Field Mapping Handbook. http://www.countrysidesurvey.org.uk/sites/default/files/pdfs/reports2007/CS_UK_2007_TR1.pdf (Accessed: 17/02/14).

Natural England. 2009. Experiencing landscapes: capturing the cultural services and experiential qualities of landscape. *Report NECR024*. http://publications.naturalengland.org.uk/publication/48001 (Accessed: 17/02/14)

Natural England. 2011. Experiencing Landscapes: Towards a judgement-making framework for 'cultural services' and 'experiential qualities'. Report NECR045 http://publications.naturalengland.org.uk/publication/162029 (Accessed: 17/02/14)

Norton, L.R., Inwood, H., Crowe, A, Baker, A. 2011. Trialling a method to quantify the 'cultural services' of the English landscape using Countryside Survey data. Land Use Policy 29, 449-455.

Appendix: Supporting Material

Figure A1 Map of the CEH Land classes for England. Black lines indicate boundaries of National Character Areas.

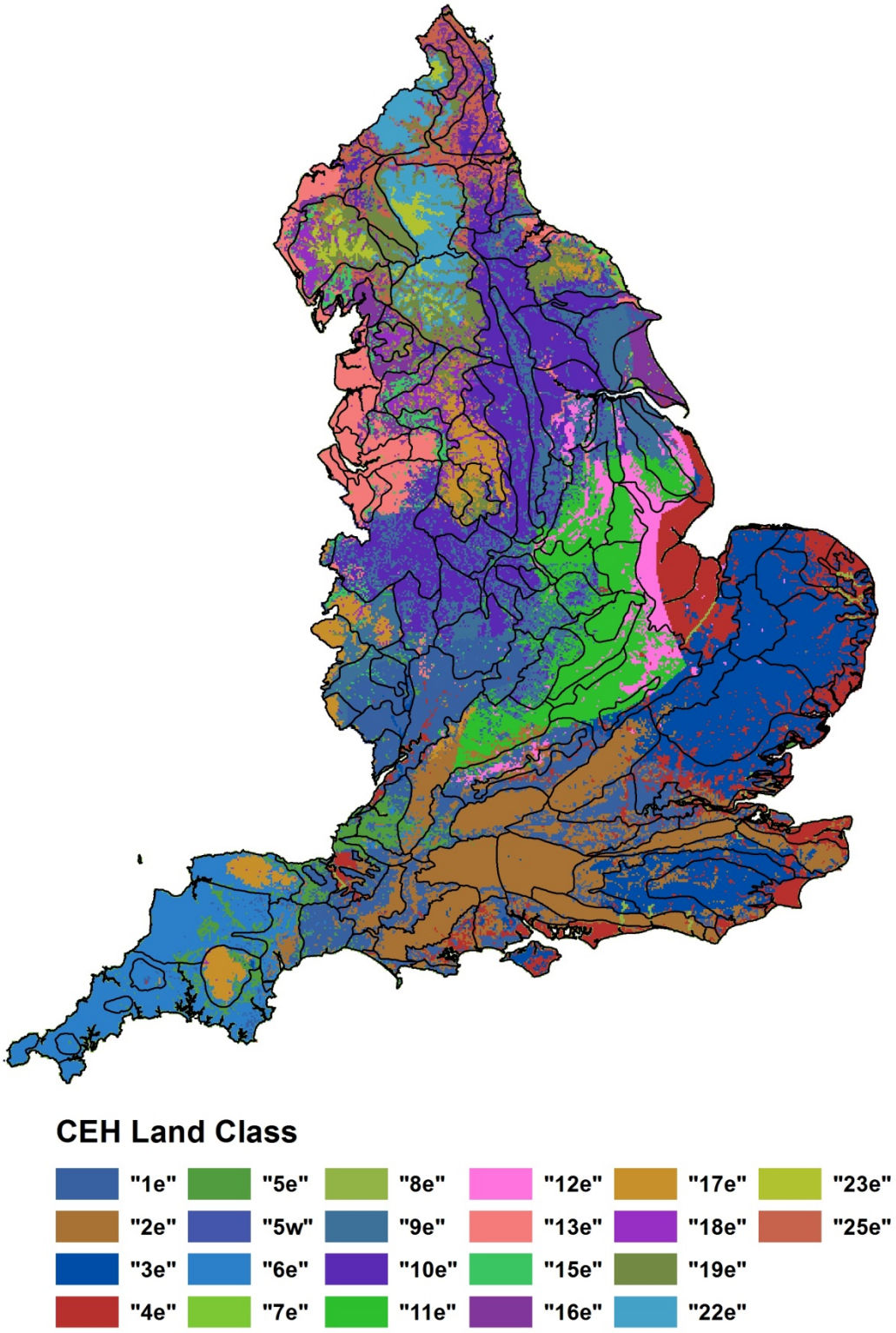

Table A1 Definition of CEH Land Classes and their geographic location.

Land Class	Description	Location
1e	Undulating country, varied agriculture, mainly grassland	S England
2e	Open, gentle slopes, often lowland, varied agriculture	S England
3e	Flat arable land, mainly cereals, little native vegetation	East Anglia/ S England
4e	Flat, intensive agriculture, otherwise mainly built-up	East Anglia/ S England
5e[1]/5w[2]	Lowland, somewhat enclosed land, varied agriculture and vegetation	[1]S W England/ [2]England-Wales Border
6e	Gently rolling enclosed country, mainly fertile pastures	S W England
7e	Coastal with variable morphology and vegetation	All England
8e	Coastal, often estuarine, mainly pasture, otherwise built-up	All England
9e	Fairly flat, open intensive agriculture, often built-up	N Midlands/ N E England
10e	Fairly flat plains with intensive farming, often arable / grass mixtures	N Midlands/ N E England
11e	Rich alluvial plains, mainly open with arable or pasture	E Midlands
12e	Very fertile coastal plains with very productive cropping	East Anglia
13e	Somewhat variable land forms, mainly flat, heterogeneous land use	N W England
15e	Valley bottoms with mixed agriculture, predominately pastoral	N W England
16e	Undulating lowlands, variable agriculture and native vegetation	N W England
17e	Rounded immediate slopes, mainly improvable permanent pasture	All England
19e	Fairly flat plains with intensive farming, often arable / grass mixtures	N England
22e	Margins of high mountains, moorlands, often afforested	N England
23e	Upper, steep, mountain slopes, usually bog-covered	N England
25e	Lowlands with variable land use, mainly arable	N England

Comparison of CEH Land Class and National Character Areas

While both the CEH Land Class and National Character Areas are national scale land classification schemes, there are significant differences between the two. The CEH Land Classification takes a mainly geophysical approach, including climate, geology, topography and coastal features as input to the classification. Some human geographic variables are also included such as urban areas and transport features. The CEH Land Classification system evolved from early work to classify land in Cumbria (Bunce & Smith 1978) into the national classification used in the Countryside Survey 2007 (Carey et al 2008), which differentiated between land classes in England, Scotland and Wales. As it's geophysical basis mirrors the drivers of ecological processes, its main use has come in scaling up ecological surveys to provide national statistics.

In comparison, the National Character Areas take much more account of the human geography. In addition to physical and ecological features, the NCA process takes account of historical and cultural information. Whereas the CEH classification is based upon multivariate statistical analysis, the NCA approach relies more on descriptive classification based on interpretation of GIS data and field observation to define the classification. The NCA approach is a more natural framework to deliver policy on as the classification process has been developed to fit well with current planning and conservation strategies.

The key differences between the two classifications in England are that the National Character Area classification has a many more units (159 NCAs) compared to the CEH Land Class system (22 Land Classes). The NCAs also represent discrete spatial units with boundaries defined by natural or cultural boundaries, while the CEH Land Classes are individual 1km grid cells which may be separated from other grid cells of the same land class by other land classes.

This study makes heavy use of the Countryside Survey data, the sampling design of which was based upon the CEH Land Classes. Therefore this study was also undertaken using the CEH Land Classes in order for the statistical tests to have enough replicates to produce a good estimate of the density of features present. To perform the same analyses using the NCAs as the spatial basis, a much larger sample would be needed in order for the statistical power of the study to be sufficient to detect differences between NCA's.

Table A2 Landscape features present in the Countryside Survey and the associated options available under Environmental Stewardship.

Feature	Option Code	Option Description
In-field Trees	EC1/OC1	Protection of in-field trees on arable land
	EC2/OC2	Protection of in-field trees on grassland
	HC5	Ancient trees in arable fields
	HC6	Ancient trees in intensively managed grass fields
Hedgerows	EB1/OB1	Hedgerow management on both sides of a hedge
	EB2/OB2	Hedgerow management on one side of a hedge
	EB3/OB3	Enhanced hedgerow management
	EB4/OB4	Stone-faced hedgebank management on both sides
	EB5/OB5	Stone-faced hedgebank management on one side
	EB8/OB8	Combined hedge and ditch management (incorporating EB1 Hedgerow management)
	EB9/OB9	Combined hedge and ditch management (incorporating EB2 Hedgerow management)
	EB10/OB10	Combined hedge and ditch management (incorporating EB3 Enhanced hedgerow management)
	HB11	Management of hedgerows of very high environmental value (both sides)
	HB12	Management of hedgerows of very high environmental value (one side)
Stone Wall Options	EB11/OB11	Stone wall protection and maintenance
	UB11	Stone wall protection and maintenance on or above the Moorland Line
	UB17	Stone wall restoration
Pond Options	HQ1	Maintenance of ponds of high wildlife value (less than 100 m^2)
	HQ2	Maintenance of ponds of high wildlife value (more than 100 m^2)
	HD9	Maintenance of designed/engineered water bodies

Table A3 Character features for National Character Areas (NCA), their inclusion in the landscape character studies, their presence in the Countryside Survey data and relevance to Environmental Stewardship. Original study refers to Norton et al. (2011), RB = Research Box.

NCA (number of CS squares in NCA)	Characters relevant to CS recording	Covered in Original CS study	Not in CS study but relevant to ES/HLS	Important in the RB study	In this study
Arden (2)	Wooded farmland	x		x	x
	Rolling landform	x		x	x
	Small fields		x	x	x (linear density)
	Winding lanes				
	Dispersed isolated hamlets				
	Oak trees in grassland/heathland remnant		x	x	x
	Long river meadows		x		We score rivers
	Well hedged irregular fields		x	x	x
	Larger semi-regular fields				
	Geometric patterns on former commons				
Dark Peak (3)	Elevated plateaux	x		x	x
	Gritstone ridges				
	Blanket bog/DSH/Acid grassland		x	x	x
	Wooded valley heads	x		x	x
	In-bye with farms, hedges, grassland		x	x	x (hedges)
	Coniferous woodland	x		x	x
	Reservoirs	x		x	x

NCA (number of CS squares in NCA)	Characters relevant to CS recording	Covered in Original CS study	Not in CS study but relevant to ES/HLS	Important in the RB study	In this study
Fens(11)	Flat open landscape				Inverse Lin. Density
	Rivers, drains and ditches	x		x	x
	Grassed river banks		x		
	Sparse woodland cover	x		x	x
	Shelterbelts		x	x	x
	Orchards		x	x	x
	Glasshouses				
	Islands for settlement				
	Grassland		x		
	Trees		x	x	x
	Hedges		x	x	x
Bedfordshire and Cambridgeshire claylands (6)	Gently undulating	x		x	x
	Variable woodland cover	x		x	x
	Village edge grasslands				
	Brickfields/landfill/industrial				
	Open, intensive arable landscape				Inverse Lin. Density
	Ditches	x	x		
	Poor hedges		x	x	x
	Few hedgerow trees		x	x	?
	Flood plain grassland		x		
	Riverine willows		x	x	x
	Large hedges		x	x	x

NCA (number of CS squares in NCA)	Characters relevant to CS recording	Covered in Original CS study	Not in CS study but relevant to ES/HLS	Important in the RB study	In this study
Dorset heaths (0)	Open landscape		x		Inverse Lin. Density
	Lowland heath		x		
	Stunted pines		x	x	x
	Gorse scrub		x		x
	Conifer blocks	x		x	x
	Mosaics of heathland, farmland, woodland and scrub		x	x	
	Floodplain pastures		x		
	Willows		x	x	x
Lancashire coal measures (0)	Elevated landscape	x		x	x
	Extensive tracts of low grade agricultural land				
	Isolated pockets of low grade agricultural land				
	Mine workings				
	Derelict land, landfill and spoil heaps				
	Small woodlands – poor condition	x		x	x
	Hedges – poor condition		x	x	x
	Hedgerow trees – poor condition		x	x	x
	Small ponds		x	x	?
Yorkshire wolds (2)	Large regular fields, drove ways and enclosure roads with wide verges		x		
	Woodland on steep slopes	x		x	x
	Escarpment and foothills	x		x	x
	Parkland and estates including woodlands	x		x	x

NCA (number of CS squares in NCA)	Characters relevant to CS recording	Covered in Original CS study	Not in CS study but relevant to ES/HLS	Important in the RB study	In this study
Durham magnesium limestone plateau (2)	Minor streams		x	x	x
	Remnant broadleaved woodland	x		x	x
	Gently undulating low upland plateau	x		x	x
	Species rich limestone grassland		x		
	Colliery land				
Eden valley (5)	Productive improved pasture and arable land		x		
	Rolling and hilly	x		x	x
	Pasture – low management intensity		x		
	Lowland heath		x		
	Woodland – large areas of estate and farm woodland	x		x	x
	Mature hedges/tall		x	x	x
	Hedgerow trees		x	x	x
	Small copses and shelterbelts	x		x	x
	Walls (sandstone)		x	x	x
Lincolnshire coast and marshes (1)	Open agricultural landscapes		x		
	Flat coastal plain to east, more undulating in the west	x			x
	Sparse woodland and hedge cover (increasing to west)	x		x	x
	Ditches, streams and dykes		x	x	x

NCA (number of CS squares in NCA)	Characters relevant to CS recording	Covered in Original CS study	Not in CS study but relevant to ES/HLS	Important in the RB study	In this study
Northern Thames basin (3)	Broadleaved woodland	x		x	
	Open landscape		x		Inverse Lin.Density
	reservoirs	x		x	x
	Tree-lined valleys	x		x	x
	Regular field shapes		x	x	
North Downs (1)	Chalk grassland		x		
	Slope	x		x	x
	Ridge top woodlands	x		x	x
	Arable fields		x		
	Shaws – thickly timbered hedgerows		x	x	x
Devon Redlands (3)	High banks and flower filled hedges		x	x	x
	Hilly	x		x	x
	Fields of different shapes and sizes		x	x	Inverse Lin.Density
	Woodlands – large and small	x		x	x
	Flood meadows, not many trees		x		
Exmoor (4)	Treeless heather and grass moorlands		x	x	x
	Beech hedgebanks and windbreaks		x	x	x
	Earthbanks and stone walls		x	x	x
	Wooded lower slopes and deer parks	x		x	x
	Upland landscape	x		x	x