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Monitoring the outcomes of Higher Level Stewardship: Results of a 3-year agreement monitoring programme

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Foreword

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Background

Agri-environment schemes (AES) were introduced in the 1980s in response to the recognition that agricultural intensification was having marked adverse effects on the landscape and wildlife of the UK. Within England, the Environmentally Sensitive Areas (ESAs) and Countryside Stewardship (CSS) Schemes were launched in the period 1987-1992. Monitoring broadly suggested that these schemes were successful in reducing the rate of loss of habitat, but that there was relatively little evidence for the successful enhancement of features of the highest conservation value.

In 2003, a review of AES recommended that the best elements of the ESA and CSS approaches be combined into a single scheme, Environmental Stewardship. This scheme was originally designed with three components: Entry Level Stewardship (ELS), Organic Entry Level Stewardship (OELS) and Higher Level Stewardship (HLS), to which Uplands Entry Level Stewardship (UELS) has subsequently been added. HLS was launched in 2006, with the aim of encouraging and rewarding high standards of environmental management, targeted on features of the greatest environmental value.

The need for rigorous monitoring of AES has been recognised since their introduction in 1987, and for the new schemes, Natural England has worked with Defra to plan and deliver the Environmental Stewardship Evidence Plan. The study described in this report is a major component of that plan, with the objective of providing a thorough evaluation of HLS, its component processes and its potential to deliver planned outcomes.

The findings will be used to help inform the targeting, implementation and development of current and future AES.

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Further information
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Summary

Introduction

Agri-environment schemes (AES) were introduced in the 1980s in response to the recognition that agricultural intensification was having marked adverse effects on the landscape and wildlife of the UK. Within England, the Environmentally Sensitive Areas (ESAs) and Countryside Stewardship (CSS) Schemes were launched in the period 1987-1992. Monitoring broadly suggested that these schemes were successful in reducing the rate of loss of habitat, but that there was relatively little evidence for successful enhancement of the nature and condition of high value environmental features.

In 2003, a review of AES recommended that the best elements of the ESA and CSS approaches be combined into a single scheme, Environmental Stewardship. This scheme was originally designed with three components: Entry Level Stewardship (ELS), Organic Entry Level Stewardship (OELS) and Higher Level Stewardship (HLS), to which Uplands Entry Level Stewardship (UELS) has subsequently been added. HLS was launched in 2006, with the aim of encouraging and rewarding high standards of environmental management, targeted on features of the greatest environmental value.

HLS is a competitive scheme with finite resources, targeted on areas and holdings that have potential to deliver the greatest environmental benefit. Targeting is facilitated through a strategy that identifies 110 target areas, each with a statement of local priorities. Outwith these target areas, regional theme statements set a framework for prioritising HLS delivery. At the beginning of HLS, an agreement was usually initiated by a Farm Environment Plan (FEP), undertaken by an independent surveyor, intended to provide an audit of the features on the holding and link these to proposed management approaches (HLS options). A *Natural England* adviser uses the FEP to select the correct options, set management prescriptions and apply Indicators of Success that describe successful management and the desired outcomes. The management options may be supported by supplements that provide for added management to address specific issues and underpinned by a capital works programme that provides support to delivery of the scheme goals. Where delivery of HLS has been particularly targeted at designated sites and areas (*e.g.* SSSIs), the basic agreement documentation may be augmented by a fuller management plan.

The need for rigorous monitoring of AES has been recognised since their introduction in 1987, and for the new schemes, Natural England has worked with Defra to plan and deliver the Environmental Stewardship Evidence Plan. The main purpose of the study described in this report has been the evaluation of HLS and its component processes and its potential to deliver planned outcomes. This project makes a significant contribution to the evidence base for the overall evaluation of Environmental Stewardship.

As of late September 2012, there were 9900 HLS agreements. The most widely adopted HLS management options, as measured by area, are **HL10** moorland restoration, **HL9** moorland maintenance, options for the maintenance and restoration of species-rich semi-natural grassland (**HK6** and **HK7**), maintenance of grassland for target features (**HK15**) and restoration of lowland heath. Some HLS options cover much less area, but are very frequently applied *e.g.* those applied to the margins of arable land. Thus as measured by frequency, the most widely adopted management options are **HK6, HK7** and **HK15**, but with arable options (*e.g.* **HE3, HE10, HF1, HF4, HF6, HF12** and **HF13**) also very widespread.

Objectives and structure of the monitoring

The work comprised three modules, covering different objectives of the project.

Module 1 comprised a baseline field survey of 174 agreements in their first year, combined with a desk assessment of agreement building and design. This module sought to assess the potential success of agreements, to build up a representative aggregate assessment of HLS and to provide a baseline from which future quantitative assessment of scheme success could be measured.

Module 2 was a focussed study of the contribution made by HLS to the delivery of grassland ecosystem goods and services, relative to delivery from ELS and typical intensive non-scheme management. The study examined and compared selected services provided by five grassland management regimes.

Module 3 comprised a study exploring the complementarity between agreements and the landscape context. The objectives of this module were to examine the extent to which agreements within the same areas together contribute to the HLS objectives and to test whether agreements occur in landscape contexts that are typical of their region, thus conveying landscape benefits. Because the field element of the survey was comparable with module 1, and this module surveyed agreements that were 2-4 years old, it was also possible to make a make a preliminary assessment of the success of these HLS agreements in achieving their desired outcomes.

Module 1: the Baseline Survey

Approach and methods

Between 2009 and 2011, the NERC *Centre for Ecology and Hydrology* undertook detailed baseline surveys of 174 new Higher Level Stewardship agreements with the objective of compiling data from a representative sample for England. The sample was partly stratified on the basis of ensuring target option groups could be assessed in adequate numbers. This robust baseline was designed to enable a future resurvey to demonstrate quantitatively the scale of scheme success but because of the focus on new agreements, it could only provide limited immediate feedback on HLS delivery. Hence, in the shorter term, the data collected would need to enable *Natural England* to evaluate how agreements are set up.

The outputs of the field survey comprised maps, vegetation data, condition assessments and site photographs. The maps included broad and priority habitats, FEP habitat features, linear features, point features and target notes, with information on dominant species and observed management. The vegetation data included quadrats, and within SSSIs full species lists. Condition assessments addressed the FEP features and where these included notified features within SSSIs a Common Standards approach was used. These data were complemented by the production of a site report (the Pre-appraisal Form) summarising the agreement documentation and the findings of the field survey, and providing a RAG (Red-Amber-Green) assessment of the likelihood that the Indicators of Success for each HLS option would be met in full and on time.

To enable an immediate evaluation of the potential for delivering HLS outcomes, each agreement was subjected to a structured appraisal process in which an expert panel considered the observations from the field survey alongside the agreement documentation available on the Genesis scheme administration system. This appraisal process considered *inter alia*:

a) Farm Environment Plan (FEP) accuracy
b) Effectiveness of targeting (at agreement level)
c) Option use
d) Use of prescriptions
e) Indicators of Success (IoS)

The appraisal then arrived at a considered judgement of the likelihood that each HLS agreement would deliver its:

- Option Level Outcomes
- Agreement Level Outcomes

In the third year (2011), this core programme was augmented by a study of 62 agreements drawn from 6 contrasting National Character Areas (NCAs), seeking to understand whether HLS was delivering benefits at the landscape scale (see **Module 3**). The agreements in this sample were two or more years old and it was thus possible to assess progress against some Indicators of Success (IoS).

Field Survey: Habitat Mapping

For the agreements surveyed, habitat mapping enabled estimates of the areas of all FEP habitat features and BAP Priority Habitats under each HLS management option. These data could be compared to the condition assessments undertaken. Finally for each HLS option an assessment was made of the likelihood of each IoS being met during the span of the agreement.

Overall, almost 60% of land under maintenance options was identified by the survey as Priority Habitat and there was good supporting evidence that HLS options had largely been targeted on appropriate habitat features. Woodlands constituted an exception, being largely mapped as non-priority habitat, although this result is not surprising, given that HLS woodland options focus mainly on small and fragmented farm woodlands.

Mapping of arable habitats was problematic, partly due to the important contribution made by rotational HLS options and partly because agreements were very new, meaning that many arable options had not been fully implemented at the time of the baseline survey.

Habitat mapping provided an opportunity to investigate whether maintenance and restoration options on grassland were being applied correctly. Priority Habitat accounted for 69% of the **HK6** maintenance area in contrast to 43% for **HK7** restoration, suggesting that these options had generally been well-targeted. Similarly the maintenance, restoration and creation options for moorland (**HL9-11**) had the expected distribution of priority habitats, although a mapping discrepancy was revealed between the present field survey and the *Land Cover Map 2007*, with 6% of the moorland area identified as Blanket Bog by the surveyors and 19% identified by LCM. Given the expertise of the field surveyors and their being able to measure peat depth directly, their site-specific classification is more likely to be accurate. The LCM may confound other Ericoid-or Graminoid-dominated habitats with bog, and hence for the analyses in this project upland heath and blanket bog were combined.

Taken as a whole, the conclusion of the habitat mapping exercise was that HLS options had largely been located on appropriate habitats. There were some instances of maintenance options being applied to areas of non-Priority Habitat, but in many of these cases the habitat quality was good, despite falling below the threshold for Priority Habitat.

Field Survey: Assessments of feature condition and Indicators of Success (IoS)

Although quadrats were recorded during the baseline survey and categorised within the *National Vegetation Classification*, the most relevant assessments for evaluating the potential success of HLS options were derived from field assessments of the condition of features using the FEP process. These were used to make a predictive judgement of outcomes in relation to option IoS *via* the RAG framework.

Some 1200 distinct feature assessments were conducted, of which 28% did not fail any feature criteria (condition A), 42% failed 1 criterion (condition B) and 30% failed two or more criteria (condition C). Habitat features most frequently in condition A included hedge-banks, upland calcareous grassland, grazing marsh and reedbeds, whilst those where condition B was especially common included arable margins, purple moor-grass and rush pastures, several moorland habitats and native semi-natural woodland. Although no features were predominantly in the poorest condition category (C), several were quite frequently scored as such, especially in BAP grasslands and lowland heaths.

When subjected to the RAG assessment, 61% of HLS options had passed or were predicted to achieve all their IoS, whereas only 21% had failed or would be expected to fail one IoS. The predicted success of arable options (**HE** and **HF**) was rather better, with 67% judged certain to succeed and only 7% likely to fail two or more IoS. The overall proportion of options where more than one IoS was failed or judged likely to fail was 18%, with particularly high rates of failure in some grassland options (**HK6, HK7** and **HK16**), **HL10** moorland restoration and options for lowland heathland.

Comparison of vegetation under HLS with that in the wider countryside

The quadrat data from the present survey were carefully compared with equivalent vegetation samples drawn from the Countryside Survey of 2007. This comparison focussed on a series of response variables derived from species attributes (*e.g.* Ellenberg indicator values and Grime indices) as well as species richness, grass:forb ratio and Ericoid cover.

Although there were some differences between the results for particular broad habitats, certain general trends were found. Most habitats under HLS tend to be more species-rich, to have fewer ruderals and fewer indicators of fertile conditions as well as a greater component of stress-tolerant species. Habitats with such attributes include woodland, improved and neutral grassland, bracken and arable land, and one could broadly define these attributes as being characteristic of land of higher environmental quality. However, three habitats (acid grassland, bog and fen/marsh/swamp) appeared to show the opposite pattern, with HLS vegetation reflecting more fertile situations where competitors and ruderals have high cover.

Outcomes of the Appraisal Panels

The panels assessed each agreement against eight criteria, six of which essentially examined the process of agreement building with the remaining two involving a predictive assessment of the success of implementation in terms of desired outcomes.

(i) **Farm Environment Plan (FEP):** The appraisals confirmed the value of the FEP process for building agreements, with 74% of FEPs having no worse than minor discrepancies that were judged unlikely to have a detrimental impact on outcomes. However, panel reviews of the prescriptions and indicators of success suggested that for large/complex sites there is a need to invest in basic site data over and above the basic requirements of a FEP.

(ii) **Targeting:** Agreements generally appeared well designed in relation to local and national HLS targets. There was, however, clearly some scope to apply such targeting more strictly, should resources for new agreements become limiting. Most examples were moderately well targeted, but whilst 28% of agreements were judged to be making a significant contribution to targeting priorities with no evidence of missed opportunities, in contrast, 18% of agreements were judged to be dominated by management of questionable benefit (in the context of targeting/theme statements).

(iii) **Option Choice:** Management implemented under HLS appears more specific to the target features than was the case with the previous schemes (Countryside Stewardship and Environmentally Sensitive Areas). There was relatively little evidence of missed opportunities, although there were instances of options being chosen with poor justification or where the panels felt that the HLS management was unlikely to succeed without further intervention. All options appeared optimally chosen in 14% of agreements, whilst in almost half (45%) of the agreements, the panels identified at least one mismatch between feature and option that might adversely affect outcomes. The panels identified five specific problem areas:

- The use of options for species-rich semi-natural grassland, with a particular issue of swards that were not species-rich and/or in condition A being placed into maintenance options
- Grassland management for target species, where the objectives were sometimes vague or poorly justified
- Woodland management was sometimes poorly justified and appeared to provide low added value
- The basis for use of 'more of the same options' was frequently unclear or poorly justified
- The use of options on semi-improved features (especially grassland) sometimes appeared to the panel to be designed more to increase the value of the agreement than to deliver specific outcomes.

(iv) **Prescriptions:** Most examples of option suites assessed utilised generic suites of management prescriptions. Although this approach can be adequate, there were numerous examples where the panel felt that better outcomes could be achieved by greater tailoring of prescriptions. The panel also noted, however, that the layout and content of prescriptions made tailoring difficult and potentially resulted in confusing, incomplete or conflicting lists of requirements. More than 35% of examples of prescription suites for the following options were felt to be deficient by the expert panel: **HC15, HK6, HK7, HK9, HK15, HK16, HL10, HQ6** and **HQ7**. The panel identified six specific issues with management prescriptions:

- Although the panel recognised that it was difficult to judge the appropriateness of moorland stocking rates, it was felt that some examples seemed unduly high
- Some restoration options (*e.g.* for grassland, fen and moorland) appeared inadequately supported by the proposed intervention or by documented managed plans *etc*.
- The use of generic prescriptions in circumstances where they were certainly inappropriate, and where tailoring of the prescriptions was needed
- Careless tailoring where gaps were left in the prescriptions, removing the essential safeguards that the generic prescriptions provide
- There were some inconsistencies and a lack of integration with management plans and stocking calendars
- Woodland options typically employed very general prescriptions, where the purpose and goals of the management were unclear

The results indicated a need to give advisers greater freedom to adapt prescriptions together with provision of training to help them do this appropriately. The panel also identified the need for better Quality Assurance (QA) procedures in respect of agreement development that would help advisers to recognise poor-quality tailoring of the management prescriptions.

(v) **Indicators of Success (IoS):** IoS were the issue most frequently identified as deficient by the appraisal panels in relation to HLS agreement building. The existing generic indicator suites often fail to give a clear sense of the progression that might be expected during the course of an agreement. There is also a widespread failure to customise indicators to match the existing condition of the site and/or meet objectives for the feature. The field surveyors felt that some indicators used frequently, including generic indicators, could not be measured objectively. The panels scored the following options most poorly: **HK15, HK16** and **HL10**, and recognised the following particular issues:

- Indicators used for woodland options were very general and failed to describe objectives clearly
- The use of very similar indicators for maintenance and restoration options
- Variation in condition of different parcels under the same option/agreement was often not taken into account in setting IoS
- A failure to distinguish areas of blanket bog and flushes within wider moorland – this is particularly important where a management plan is absent
- The IoS set for management of grassland for target features were typically vague or poorly described

- Links to the successful implementation of capital items were absent, where this would be appropriate
- Where SSSI features were being managed, IoS were often not linked to the targets set in favourable condition tables
- There were generally no IoS set for "more of the same" options, and it was consequently unclear what such management was supposed to achieve

As with management prescriptions, the results for IoS imply a need to give advisers both the freedom and the training to produce appropriate, customised indicators, and that this should be supported by QA procedures that will identify poor quality customisation. The results also suggest that some aspects of the generic indicator sets may need revision. The panel recognised that the recent implementation of *Natural England's* Integrated Site Assessment (ISA) programme might and help advisers to identify poor IoS and set suites that enabled objective assessment of progress in relation to the features being managed.

(vi) **Capital works:** The use of capital works was generally judged to be acceptable, though sometimes hard to assess. There was some evidence of slow implementation of works that could delay or even compromise the success of related annual management options. A further issue concerned the justification for capital programmes, which was not always clear for all items in relation to the overall environmental benefit provided by the agreement.

(vii) **Option Level Outcomes:** These assessments essentially involved a judgement by the panel, based on consideration of the RAG (Red-Amber-Green) assessments made in the field alongside the detail of the management proposed within the agreement. Those options where >30% of examples were judged unlikely to deliver outcomes were **HE10, HK6, HL10, HQ6** and **HQ7**, all of which are options with high value outcomes. It is important to recognise, however, that these judgements are predictive and tended to give the options the "benefit of any doubt" where there was uncertainty. These option-level outcomes can only be calibrated properly through future resurvey.

(viii) **Agreement Level Outcomes:** This assessment provided for a very broad-based judgement about the likely effectiveness of each agreement. Almost all agreements contained options where at least some outcomes were judged likely to be achieved. Almost 80% of agreements were judged at least likely to be effective in achieving <u>most</u> outcomes, albeit with some significant weaknesses, and 29% of agreements were judged at a higher level *i.e.* achieving all or most outcomes, with any weaknesses relatively minor and unlikely to affect the outcomes seriously. In a very broad sense, this left about 20% of agreements where for one reason or another, the panels identified issues within the agreement that suggested it fell below its arbitrary 'value' threshold. It should again be borne in mind that these were predictive assessments, predicated on the assumption that the land manager would achieve competent and effective delivery. As with the option-level outcome criteria, the actual success of agreement-level delivery can only be tested through resurvey.

Module 2: Ecosystem Goods and Services

Grasslands account for approximately 40% of global land cover, and therefore have a vitally important role in maintaining and increasing the delivery of biodiversity and ecosystem services. Grassland management and restoration to conserve and enhance biodiversity and delivery of such services is an important aim of many agri-environment schemes in Europe, including ELS and HLS in England. However, there is a critical lack of evidence of the effectiveness and appropriateness of the management prescriptions to deliver these policies.

In 2010-11 ecosystem services were measured directly and using well-founded proxies on a sample of sixty grassland sites across England grouped into 12 separate clusters based on soil type. Within each cluster, the study contrasted biodiversity and service delivery along a gradient of grassland management intervention strategies: i) existing species-rich semi-natural grasslands maintained under the **HK6** option; ii) high intervention restoration of such grassland (**HK7**); iii) re-creation of this high quality grassland type on ex-arable land (**HK8**); iv) low intervention restoration through reduced inputs (ELS option **EK2**); and v) intensively managed grassland outside either HLS or ELS (FEP habitat type: G01 improved grassland).

Grasslands outside agri-environment schemes were significantly more fertile and had less organic matter and carbon than the species-rich grasslands in HLS. The grasslands also had lower sand content, suggesting lower water infiltration capacity.

The grassland management regimes resulted in large differences in vegetation composition. Existing species-rich grassland conserved under **HK6** were compositionally similar to High Nature Conservation grassland and had the highest diversity of positive indicator species. However, a high proportion of these were considered to be in poor condition due to low cover of positive indicator species. In contrast, low intervention grassland (**EK2**) and those managed outside either ELS or HLS were highly dissimilar to species-rich grassland and positive indicator species were absent.

High fertility and the dominance of grasses mean that G01 improved grasslands and **EK2** grasslands are likely to provide higher levels of food production than the HLS grasslands (**HK6-8**). However, the greater diversity and abundance of legumes in the HLS grassland means they have a potentially greater capacity to maintain production of food in the absence of inorganic fertiliser addition and potentially under future environmental stress.

HLS grasslands also had a higher diversity of pollinator food plants, suggesting that they play a more important role in sustaining the pollination service within intensively managed landscapes than do ELS and G01 improved grasslands. All trends and significant effects were suggestive that diversity and abundance of potentially beneficial invertebrate groups (predators, herbivores and detritivores) were highest where HLS is used to conserve species-rich semi-natural grassland and lowest in the intensively managed grasslands.

Synthesis and application: Maintenance and restoration of species-rich grassland under the Higher Level agri-environment scheme can potentially enhance the delivery of ecosystem services, in particular soil carbon and nitrogen capture, greenhouse gas regulation and flood prevention through improved water infiltration capacity. Increased botanical diversity of these grasslands can potentially increase the supporting services of pollination and pest control.

Module 3: Assessing HLS Delivery within specific Landscapes

Assessing progress with HLS agreements after 2-4 years

Some initial feedback on progress with meeting the desired outcomes of HLS was obtained from assessments in the 6 NCAs, where the 62 agreements surveyed in 2011 were 2-4 years old and where the fieldwork employed the same methodology as the baseline survey. Some useful feedback from the IoS assessments was possible, although because these agreements were sampled so differently from those in **Module 1**, any comparison should be seen as indicative only.

The condition assessments undertaken in the NCA study comprised 313 assessments. The results of feature condition and RAG assessments produced a dichotomy whereby features were on average in better condition than in the baseline survey, but a higher proportion of red assessments were recorded. This difference probably reflects the possibility of making real-time assessments in these established agreements rather than the predictive assessments that were part of the baseline survey.

Key summary results emerging from the analyses of feature condition were:
- 39% of FEP features were in condition A
- 38% of FEP features were in condition B
- 23% of FEP features were in condition C

Corresponding summary results for the RAG assessment of IoS were:

- 46% of assessments had met or appeared likely to meet all their IoS
- 29% of assessments had one indicator assessed as likely to fail.
- 25% of assessments had >1 indicator assessed as likely to fail

Those options where IoS failed more than average included **HE10** enhanced grass margins, **HK7** restoration of species-rich semi-natural grassland, **HK8** creation of species-rich semi-natural grassland and **HL10** restoration of moorland.

Landscape and complementarity

A thorough desk assessment of the context of the 62 agreements using external datasets such as habitat inventories and land cover map 2007 suggested that HLS agreement and option selection and subsequent management was generally appropriate to landscape character. There was no firm evidence of added benefit (synergy, additionality and complementarity) from examining groups of agreement at the landscape scale. However, given the still early stage of the agreements, a full assessment was probably premature. The fact that the assessments of IoS in these 2-4 year old agreements appears to show some improvement in condition of features implies that HLS is making some contribution to the reinforcement of landscape character, but this might best be explored further at a future resurvey.

Stakeholder workshops for National Character Areas (NCAs)

Within Module 3, following the completion of field survey work and desk analysis, a workshop was held in five of the NCAs with the objective of feeding back to agreement holders and local stakeholders and obtaining their views on initial findings. The Dorset Downs & Cranborne Chase NCA was not covered in this way. The results of **Module 3** in characterising the habitats, landscape and HLS implementation of the NCA were presented, as well as provision of a summary of the field survey results. The participants took part in two group exercises: 1) to identify the priorities for HLS in the NCA, say how well the current pattern of option uptake reflected these priorities and state what effect ELS/HLS had on the landscape; and 2) to evaluate habitats and agri-environment options based upon a series of photographs, and were given the opportunity to feedback on their experience of HLS and its delivery.

Evidence from the workshops supports the contention that HLS options generally complemented the underlying landscape character in 3 out of the 5 NCAs assessed (Southern Pennines, Upper Thames Clay Vales and Dunsmore & Feldon NCAs). However where landscapes possess more unique characteristics (*e.g.* The Fens or The High Weald), more pro-active targeting of HLS agreements at characteristic landscape features may be needed if they are to enhance the landscape character of the area.

HLS options which were either judged very positive or positive in terms of their impact on landscape character were often considered compatible with agricultural systems and practices (whilst recognising the need for support), although those options which fit in with everyday farm management practice will, by their very nature, be most attractive. Only a few options (often associated with habitat creation) were considered potentially detrimental to the underlying landscape character by the consultees.

General conclusions

The emerging conclusions from this programme of agreement monitoring give a generally positive assessment of Higher Level Stewardship, its potential to deliver desired outcomes and likely contribution to the *Rural Development Programme for England* as measured by the Common Monitoring and Evaluation Framework (CMEF). Although the study identifies some deficiencies in delivery, HLS is shown to be a better targeted scheme than those previously operated.

The field survey and expert appraisal panels indicated some specific issues that should be rectified or improved within the overall implementation of HLS:

I. Option use – ensuring that options are targeted on appropriate features, where outcomes are achievable
II. Option justification – providing better clarity over management objectives, as maximising outcomes will be even more vital if HLS budgets reduce
III. Better setting of Indicators of Success
IV. Better documentation of decision making
V. Clarity over implementation *i.e.* how objectives will be achieved; and
VI. Establishing what would be an acceptable level of success for HLS?

If these issues are corrected, the inherent flexibility of HLS can be used to its full advantage.

The *CEH/Natural England/Defra* agreement monitoring project has:

a) created a representative baseline from which to judge future progress;
b) developed a process for evaluating the building of HLS agreements and proposed improvements;
c) made a novel assessment of the contribution of HLS to ecosystem goods and services;
d) provided some early insight into the delivery of the desired outcomes; and
e) provided a comprehensive review of Higher Level Stewardship as it is has been implemented in England.

Consequently, it is vital that the agreements included within the baseline dataset are resurveyed in due course, ideally in the final three years of the agreement period, so as to record real progress in a thorough and quantitative way and build on the outcomes of this major programme of work.

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Appendices

1 Development and Implementation of Higher Level Stewardship

Introduction

Agri-Environment Schemes were initially introduced in the 1980s in response to recognition that agricultural intensification was having profound impacts on England's most cherished landscapes and their associated wildlife.

The immediate catalyst was a growing awareness of the threat of drainage and cultivation on the Halvergate Marshes which could have irrevocably changed the unique landscape of the Norfolk Broads. This led to establishment of a pilot agri-environment scheme in 1985. The concept quickly evolved into the Environmentally Sensitive Areas Scheme (ESA), with 22 discrete areas being designated from 1987 to 1994. The basic premise of these and all subsequent schemes has been one of voluntary participation with participants compensated for the income forgone in delivering positive management of environmental features.

The ESA scheme as a whole was developed with objectives to conserve wildlife, landscapes and the historic environment, and later to promote public access. Individual ESAs were structured around delivering specific local priorities, set out in a framework of 'objectives and performance indicators'.

Outside ESAs, however, there was a continuing threat to distinctive landscapes and their characteristic environmental features. A pilot Countryside Stewardship scheme was launched by the Countryside Commission in 1992, targeting specific landscapes outside ESAs and prioritising the management of those features that made these target landscapes distinctive. The scheme was transferred to MAFF in 1997 and gradually expanded in scope, notably including the launch of options targeting arable wildlife in 2002.

Monitoring and evaluation of both schemes identified a similar pattern of outcomes; essentially that although there was evidence of success against some objectives, especially in relation to conserving landscapes and historic features and, increasingly, facilitating public access, the picture for wildlife outcomes was less clear (Ecoscope, 2003). There was clearly success in reducing the rate of loss of key habitats and maintaining management on features that might otherwise have been abandoned, but there was much less evidence for successful enhancement. It was concluded that agreements provided insufficient clarity about the nature and condition of individual features being managed and the outcomes desired for them; and that there was insufficient flexibility to define objectives and desired outcomes at feature and management option scale.

The limitations of the existing schemes were highlighted by two key developments. Firstly, the development of the UK Biodiversity Action Plan from 1995, involved the setting of targets for the maintenance, restoration and creation of defined Priority Habitats, and for the conservation of threatened Species. Although the ESA and Countryside Stewardship schemes were recognised as key to delivery of the UK Biodiversity Action Plan, the structure of the schemes did not provide an optimal framework for realising the desired benefits. Secondly, there was increasing awareness that some adverse environmental impacts of agricultural intensification (*e.g.* on populations of farmland birds or on water quality) could only be addressed by responses delivered at very large scales. Indeed, natural resource protection was not an explicit objective of the ESA and Countryside Stewardship Schemes. Addressing these issues would require a step change in the design and delivery of agri-environment measures.

Development of Environmental Stewardship

In 2003 a review of agri-environment schemes in England recommended that the best elements of the ESA and Countryside Stewardship schemes be combined into a single new scheme. The review also picked up the recommendation of the 2002 report from the Policy Commission on the Future of Farming and Food that the 'reach' of environmental management be extended through the establishment of a 'broad and shallow' agri-environment scheme that would be attractive to land managers across a high proportion of the countryside.

The resulting scheme, Environmental Stewardship (ES), was launched in 2005 as a comprehensive scheme open to all land managers and with five primary objectives:

- Conservation of Biodiversity
- Maintenance and enhancement of Landscape Quality and Character
- Protection of the Historic Environment
- Protection of Soils and Reducing Water Pollution (Natural Resource Protection)
- Provision of opportunities for people to visit and learn about the countryside

In addition the scheme has two secondary objectives of contributing to flood management and conserving genetic resources. Subsequently, in 2008, contributing to climate change adaptation and mitigation was also adopted as a new over-arching objective.

Environmental Stewardship was initially launched with three distinct elements:

Entry Level Stewardship (ELS) is open to all farmers and land managers across England. It offers a wide menu of management options, each worth a set level of points, with land managers having to achieve a tariff of 30 points per hectare to enter the scheme. The applicants select the options themselves, although latterly some support and advice has been available through the Environmental Training and Information Programme. Management delivered through ELS includes field boundary management, options providing resources (stubbles, wild bird seed mixes) for farmland birds, and buffer strips designed to protect water bodies from diffuse pollution.

Organic Entry Level Stewardship (OELS) is essentially the same as ELS, but with management options designed to add to the environmental benefits of organic farming. It recognises the extra costs and benefits to the environment from farming to organic standards and offers payments designed to help offset the costs of organic conversion and certification.

Higher Level Stewardship (HLS) is designed to encourage and reward much higher standards of environmental management, and as such is highly targeted at features of the greatest environmental value. It has been designed so that the environmental features present and their condition are characterised at the outset, and provides an option framework that gives clarity over the feature(s) targeted and the desired outcome(s), supported by the use of indicators of success to enable the land manager and scheme adviser to judge progress at appropriate intervals in the duration of the agreement.

More recently a fourth element has been added:

Uplands Entry Level Stewardship was introduced in 2010. It essentially operates as an extension to ELS that is available to those with land in the Severely Disadvantaged Area. It was developed to replace the Hill Farming Allowance, and to move support for livestock farming within the SDA onto an environmental basis. As well as offering ELS type management, points can be accumulated from adherence to requirements.

Taken together these different elements meet the needs set out in the 2003 review, with 'ELS' elements addressing the need for a broad and shallow agri-environment scheme open to high levels of participation and HLS providing an outcome-focused, narrow and deep scheme, facilitating effective management of our greatest value environmental features.

Introduction and Delivery of Higher Level Stewardship

The introduction of ES began in 2005 with the launch of ELS/OELS, with HLS introduced in 2006. As pre-existing ESA and Countryside Stewardship agreements would run their 10-year course, there has been a significant lag-time in the widespread renewal of these into ES in some former ESAs. In the great majority of cases the HLS agreement is underpinned by an ELS agreement; hence the scheme is integrated. However, the main focus of the project described in this report has been the evaluation of HLS and its component processes and associated outcomes, and thus further discussion of scheme development and delivery will focus primarily on HLS. Natural England and Defra have initiated a series of separate projects to monitor and evaluate ELS.

HLS is a competitive scheme with finite resources; agreements are made available to land managers who are able to deliver the highest levels of environmental benefit. The intention from the start was to develop a transparent and evidence-based targeting approach that provided clear guidance to advisers and land managers over priorities. The chosen approach has been to develop a spatial targeting strategy based on the collation and analysis of key environmental datasets for all objectives, thus identifying those areas where HLS has potential to address the widest range of priorities and where higher levels of uptake to deliver landscape-scale benefits would be desirable. This has resulted in the identification of 110 **target areas**, each with a statement setting out the local environmental priorities. It was recognised that outside target areas there would still be significant local opportunities, and hence complementary **theme statements** were produced for each region, setting out priorities.

The basis for developing an HLS application is the Farm Environment Plan (FEP), an audit of the presence and condition of environmental features present on each holding of interest, derived from the collation of field and desk-based information. The process for commissioning a FEP has evolved over time, and is now undertaken on the basis of a pre-assessment of likely suitability for HLS, but the FEP remains the basic building block of a management agreement. It also has some value as a baseline assessment of the agreement, although this value may be limited by the level of detailed information presented.

The *Natural England* adviser uses the FEP and the accompanying application to negotiate an agreement that is acceptable to both parties, ensuring that the features of highest environmental interest are placed into appropriate management options. HLS has been designed as a flexible, outcome-focused scheme; the framework of options available is designed to provide an appropriate option for all features and with clarity over management objectives, particularly in relation to whether management is designed to maintain, restore or create the feature. Whilst some **management prescriptions** are mandatory, others can and should be tailored to promote optimal management of the features present. Desired outcomes are set through **indicators of success** which should provide a framework that describes successful management in a way that can be recognised by both agreement holder and adviser. Agreements are established for 10 years, and the indicators of success should enable progress towards the desired outcome to be tracked during this period.

Management options are paid for annually on an area basis, with a fixed payment rate determined by the income forgone in delivering management. As well as the basic management options, **supplements** are available to support management that delivers added benefit in specific situations, such as hay cutting, raising water levels or enabling grazing on difficult sites.

Annual management options may also be supported by **capital works programmes**, designed to bring about specific enhancements that support delivery of annual management options or address wider environmental objectives on the agreement. Examples might be to support the introduction of grazing management through establishment of fencing or to provide stiles or gates to facilitate access. It is important that capital works programmes are delivered promptly if maximum benefit is to be derived from the agreement.

HLS has been targeted at sites of high environmental value, many of which are designated as Sites of Special Scientific Interest (SSSI). Particularly where such sites are complex and involve management of multiple habitats or for associated species, the agreement can (and ideally should) be supplemented by a **management plan**, and it would be expected that indicators of success for the HLS agreement would be consistent with the desired condition as described in *Natural England*'s Favourable Condition Tables for the SSSI. This potentially adds an additional level of complexity to the establishment of some HLS agreements.

Natural England manages the delivery of Environmental Stewardship using the **Genesis** system. Within Genesis, the Electronic Document Records Management (EDRM) system provides an audit trail of documentation used to develop the agreement; other quantifiable information about the agreement, including details of the management being delivered (amount/location), and associated costs are captured as data, and can be interrogated using the GenRep interface. As of September 2012, the uptake of HLS represents almost 9900 live agreements.

Monitoring of HLS

The need for rigorous monitoring was recognised from the introduction of the schemes in 1987. The key drivers for monitoring are:

- To demonstrate value for money in support of public funding;
- To enable reporting against scheme targets at national and international (EU) level;
- To understand the effectiveness of management and to feed this back into scheme development and design.

Natural England works with Defra to plan and deliver the ES Evidence Plan, of which monitoring is a significant element. Over the 25 years of AES delivery, a significant body of evidence for scheme outcomes has been collected, across all scheme objectives.

The development and delivery of monitoring programmes has reflected the structure and objectives of individual schemes, hence strategies and detailed approaches have evolved over time. For ESAs, monitoring was tailored to the specific objectives and structure of individual areas with, essentially, 22 separate monitoring programmes, albeit with some commonality of approach. For Countryside Stewardship, a national scheme delivered within a framework of target landscapes, a different approach was needed. Hence the focus of monitoring was on appraising potential and actual delivery at the individual agreement level, and drawing broad conclusions about the scheme from evaluating the results of the sample as a whole. A significant driver for all monitoring activities has been to obtain an understanding of the effectiveness of delivery that can be fed into scheme development and refinement, a process of continuous improvement.

One of the principal drivers for monitoring now is the requirement for all EU member states to report to the EC on the outcomes of their Rural Development Programmes. Basic reporting is required annually with formal evaluation required at the *ex-ante*, mid-term and *ex-post* stages of each programme. The outcomes to be evaluated are specified as a suite of indicators in the Common Monitoring and Evaluation Framework. The complexity of these indicators has increased with successive Rural Development Programmes, and those for the 2007-13 programme are defined as addressing inputs, outputs, results and impacts. Results and impacts are the primary focus of outcome monitoring; results are evaluated at the measure level, with England's result indicators requiring evidence for the 'success of management' designed to support each scheme objective. Impact indicators are more complex, being set at the programme level and requiring evaluation of impacts at a high level, involving the need to link actions undertaken through the programme with trends in high level datasets. This evaluation framework is designed to provide a holistic picture of the benefits provided through the Programme.

However, the evolution of the design of England's monitoring programmes has also been increasingly influenced by the need to evaluate the contribution made by AES to a broader range of policy initiatives and considerations, in particular targets for biodiversity (UKBAP, Biodiversity 2020, Farmland Bird Target), water quality (Water Framework Directive) and landscapes, as well as understanding the broad contribution made to sustainable development. Most recently, the publication of the Natural Environment White Paper and, among other NEWP commitments, the development of Nature Improvement Areas (NIA) will make specific demands of AES monitoring activities.

These monitoring requirements have led to the incorporation of various monitoring approaches into the ES programme:

- Development of Integrated Site Assessments (ISA), involving condition assessments on individual SSSI units and HLS options undertaken by *Natural England* advisers;
- Agreement Scale Assessments, involving holistic assessments of the quality of agreements, and the management being delivered within them, across the range of scheme objectives;
- Thematic Assessments of the effectiveness of scheme management, focusing on delivery of particular scheme options or the impact on specific features (*e.g.* farmland birds, historic features etc.). These may sometimes take the form of:
  - Long-term repeat monitoring of the same sites, to provide evidence for the cumulative impacts of scheme management;
  - Periodic review and evaluation of scheme performance that draws on the outputs of a range of studies.

The project described in this report represents one significant element of the ES Evidence Plan involving the development and delivery of an extended programme of agreement-scale assessments of HLS agreements. The focus on new agreements for much of the project was deliberate: firstly, recognising that the enhanced outcomes envisaged by HLS will take time to deliver, a thorough agreement appraisal will enable an interim assessment of the effectiveness of HLS processes, leading to a proxy assessment of potential effectiveness at option and agreement scale that can inform the ex-post evaluation of the current RDPE; and secondly, that the field data collected will provide a sound baseline dataset against which actual progress can be measured in due course.

The project has been delivered as a partnership between *Natural England* and the *Centre for Ecology and Hydrology*, with specialists from both organisations contributing to the design, delivery and reporting of the programme.

2 Rationale for Monitoring HLS

The national context of HLS: option frequency

Higher Level Stewardship offers a wide range of management options that are designed to address specific environmental features or groups of features and within a framework that differentiates between objectives to maintain, restore or create the target feature. As well as the core management options, a variety of supplement options are available that provide for management that underpins or adds value to the objectives of the core option. For instance, the supplement **HK18** provides additional support for haymaking and can be used in conjunction with various core options for grassland management, where haymaking would add value to the environmental benefit conveyed by the core option. Within HLS, support can also be provided for delivery of ELS options over and above what was included to meet the threshold required in any underpinning ELS agreement; inclusion of such 'more of the same' options in an agreement is apparent through the use of ELS options with an H prefix; *i.e.* **HK2** is additional provision of the ELS option **EK2**. Such options should only be applied where they afford significant additional benefit or protection to features targeted by HLS management. Unlike ELS, HLS has no specific options targeted at organic farming.

Options are classified broadly according to the nature of the features targeted. For instance, **HB** options address management of boundary features; **HD** options address management of cultural or historic features; **HK** options address management of grasslands and so on. Inevitably given that some options target widespread features and others rare and/or specialised features, the take-up of individual options varies markedly, as does the land area to which these options are applied. In planning the present investigation of HLS options, it was important that the baseline survey provided adequate coverage of all the most important options and supplements, both in terms of their frequency and the hectarage to which they had been applied, but it was also recognised that there would be insufficient coverage of some of the more specialised and uncommonly encountered options, and that these might be better targeted through separate thematic studies.

Table 2.1 provides information on uptake of the 40 most extensively applied annual land management options and supplements in England to the end of September 2012, all of which had been implemented on at least 5,565 ha of land, and with some options applied to more than 100,000 ha. It should be noted that both in this table and the next (Table 2.2.), areas are not exclusive *i.e.* several options can apply to any piece of land under management The most extensive options were those applied to moorland and rough grazing, with **HL10** moorland restoration covering almost 300,000 ha and **HL9** maintenance of moorland extending over *ca* 100,000 ha. Related supplements (**HL12, HL15** and **HL16**) also cover large areas of upland England. Other options each extending over more than 25,000 ha of land include those for the maintenance and restoration of species-rich semi-natural grassland (**HK6** and **HK7**), maintenance of grassland for target features (**HK15**) and restoration of lowland heath (**HO2**). Three supplements that may overlay a range of options have areas in excess of 30,000 ha *i.e.* **HR1** for cattle grazing**, HR2** for native breeds at risk and **HR8** providing support for group applications.

Other HLS management options and supplements are very widely applied throughout England, but result in relatively small areas under management. This is especially the case for options applied to arable land, where delivery typically takes the form of narrow strips, field corners and small plots, and the majority of the field area may not be under HLS management. Table 2.2 presents the options and supplements that have been applied most frequently in England *i.e.* represented on more than 550 agreements.

Table 2.1: HLS Option usage: 40 most extensive options (by area) implemented in England. Table lists the number of agreements containing each of these options and the total area under management by each option. Options marked with an asterisk are “More of the same” (related to ELS)

	Agreements Containing Selected Options	Option Area (Ha)
TOTAL - AGREEMENTS and AREA under HLS	9,895	5,542,552.21
HC7 - Maintenance of woodland	1,965	15,126.11
HC8 - Restoration of woodland	1,641	9,862.02
HC12 - Maintenance of wood pasture and parkland	402	11,446.88
HC13 - Restoration of wood pasture and parkland	294	13,565.90
***HD2** – Take archaeological features out of cultivation	678	5,565.00
***HD3** - Low depth, non-inversion cultivation on archaeological features	315	8,505.73
***HD5** - Management of archaeological features on grassland	1,150	16,114.37
***HE3 –** 6m buffer strips on cultivated land	1,565	5,627.93
***HF6** - Overwintered stubble	1,132	14,587.03
HF12 – Enhanced wild bird seed mix plots	1,811	5,849.60
HF13 - Uncropped cultivated areas for ground-nesting birds - arable	1,184	6,252.44
HG7 - Low input spring cereal to retain or re-create an arable mosaic	656	6,754.19
***HK3** - Permanent grassland with very low inputs	665	5,930.94
HK6 - Maintenance of species-rich, semi-natural grassland	2,442	26,450.34
HK7 - Restoration of species-rich, semi-natural grassland	3,836	49,292.96
HK9 - Maintenance of wet grassland for breeding waders	586	13,797.33
HK10 - Maintenance of wet grassland for wintering waders & wildfowl	885	17,372.36
HK11 - Restoration of wet grassland for breeding waders.	364	6,448.88
HK15 - Maintenance of grassland for target features	3,083	49,388.04
HK16 - Restoration of grassland for target features	1,304	21,244.55
HK17 - Creation of grassland for target features	904	9,648.50
HK18 - Supplement for haymaking	1,543	12,164.92
HL7 - Maintenance of rough grazing for birds	452	19,817.66
HL8 - Restoration of rough grazing for birds	412	14,949.96
HL9 - Maintenance of moorland	249	100,078.89
HL10 - Restoration of moorland	840	296,990.86
HL12 - Management of heather, gorse and grass	197	103,578.10
HL13 - Moorland re-wetting supplement	62	6,532.68
HL15 - Seasonal livestock exclusion supplement	463	123,302.18
HL16 - Shepherding supplement	166	76,165.59
HO1 - Maintenance of lowland heathland	187	8,202.68
HO2 - Restoration of lowland heath	382	33,190.75
HP5 - Maintenance of coastal saltmarsh	127	9,354.73
HR1 - Supplement for cattle grazing	1,775	95,790.30
HR2 - Supplement for native breeds at risk	1,086	45,624.70
HR5 - Bracken control supplement	584	14,588.36
HR6 - Supplement for small fields	1,365	5,903.04
HR7 - Supplement for difficult sites	887	18,901.01
HR8 - Supplement for group applications	93	78,056.26
HR8WF - Supplement for group applications (Water Framework Directive)	49	22,930.58

Table 2.2: HLS Option usage: 40 most frequently used options in England. Table lists the number of agreements containing each of these options and the total area under management by each option, with the exception of the linear options (**HB11**, **HB12** and **HN3**) where the length in metres is given. Other legend as for Table 2.1

	Agreements Containing Selected Options	Option Area (Ha) or length (m)
TOTAL - AGREEMENTS and FREQUENCY under HLS	9,895	5,542,552.21
HB11 - Maintenance of hedges of very high environmental value (2 sides)	703	1,080,973.87
HB12 - Maintenance of hedges of very high environmental value (1 side)	847	1,457,331.46
HC7 - Maintenance of woodland	1,965	15,126.11
HC8 - Restoration of woodland	1,641	9,862.02
HC10 – Creation of woodland outside of the SDA and ML	487	453.48
HC11 - Woodland livestock exclusion supplement	609	3,530.76
HC15 - Maintenance of successional areas and scrub	829	3,442.57
HC20 - Restoration of traditional orchards	599	741.46
***HD2** - Take archaeological features out of cultivation	678	5,564.93
***HD5** - Management of archaeological features on grassland	1,150	16,114.37
***HE2** - 4 m buffer strips on cultivated land	556	1,147.39
***HE3** - 6 m buffer strips on cultivated land	1,565	5,627.93
HE10 - Floristically enhanced grass margin	1,505	4,570.46
***HF1** - Management of field corners	1,188	2,482.20
***HF4NR** - Nectar flower mixture	1,541	3,388.52
***HF6** - Overwintered stubble	1,132	14,587.03
HF12 - Enhanced wild bird seed mix plots	1,811	5,849.60
HF12NR - Enhanced wild bird seed mix plots	930	3,264.08
***HF13** - Uncropped cultivated areas for ground-nesting birds - arable	1,184	6,252.44
HF14 - Unharvested, fertiliser-free conservation headland	540	1,316.57
HG7 - Low input spring cereal to retain or re-create an arable mosaic	656	6,754.19
***HK3** - Permanent grassland with very low inputs	665	5,930.94
HK6 - Maintenance of species-rich, semi-natural grassland	2,442	26,450.34
HK7 - Restoration of species-rich, semi-natural grassland	3,836	49,292.96
HK9 - Maintenance of wet grassland for breeding waders	586	13,797.33
HK10 - Maintenance of wet grassland for wintering waders and wildfowl	885	17,372.36
HK15 - Maintenance of grassland for target features	3,083	49,388.04
HK16 - Restoration of grassland for target features	1,304	21,244.55
HK17 - Creation of grassland for target features	904	9,648.50
HK18 - Supplement for haymaking	1,543	12,164.92
HL10 - Restoration of moorland	840	296,990.86
HN1 - ASD to Nov 2010 Linear and open access base payment	1,291	0.00
HN3 - ASD to Nov 2010 Permissive footpath access	890	1,441,565.46
HN8/HN9 - Educational access - base payment and payment per visit	969	0.00
HQ2 - Maintenance of ponds of high wildlife value > 100 sq m	788	0.00
HR1 - Supplement for cattle grazing	1,775	95,790.30
HR2 - Supplement for native breeds at risk	1,086	45,624.70
HR5 - Bracken control supplement	584	14,588.36
HR6 - Supplement for small fields	1,365	5,903.04
HR7 - Supplement for difficult sites	887	18,901.01

On the basis of frequency, the most commonly encountered options are those for species-rich, semi-natural grassland (**HK6** and **HK7**) and grassland for target features (**HK15**). However, it is notable that several options applied to arable land have been included in at least 1000 agreements *i.e.* **HE3, HE10, HF1, HF4, HF6, HF12** and **HF13**. Other options that are especially widespread include those for farm woodlands (**HC7** and **HC8**), managing grassland with archaeological features (**HD5**) and underpinning provision of access (**HN1**). Four supplements (**HK18, HR1, HR2** and **HR6**) are represented in over 1,000 agreements.

By the end of September 2012, almost 10,000 HLS agreements had been established in England, covering over 5.5 million hectares of land. The extent of land in this agri-environment scheme confirms the need for HLS to deliver comprehensive agreements with a wide range of environmental benefits. Moreover, the importance of HLS demands that there be a rigorous assessment of the benefits that accrue and of the progress with meeting the desired outcomes of the scheme.

Project rationale and components

As part of the *Rural Development Programme for England (RDPE), 2007-13, Defra* is required to report on the impact of HLS in relation to indicators set out by the European Commission under the Common Monitoring and Evaluation Framework (CMEF)**. Reporting effectively on the CMEF 'result' indicators requires provision of evidence for the *success* of management designed to provide benefits against each of the primary scheme objectives. Clearly, in addition to this EC requirement, it is also important** to gather objective evidence that demonstrates the contribution that ES is making towards a range of domestic policy priorities and delivery initiatives, thereby demonstrating that agri-environment schemes deliver desired outcomes in a cost effective way. *Defra* works with *Natural England* to design an ES evidence plan that includes the monitoring and evaluation of ES, with *Natural England* taking the lead on delivery of the agreed programme.

To address the multiple objectives of HLS and provide the evidence base needed for reporting on CMEF indicators, the monitoring programme must be designed to measure and evaluate outcomes at a range of temporal and spatial scales. This requires a programme built from a series of component projects that look at aspects of scheme delivery in a complementary way. This project therefore represents one major component of the wider ES evidence plan, collecting information about the quality of delivery at an agreement-scale.

The agreement is the unit whereby different HLS objectives are delivered, through applying options that combine to deliver multiple objectives and maximise synergy. By undertaking a detailed and holistic assessment of a sample of HLS agreements we can assess whether agreements and the features within them are being targeted and addressed effectively by management and gather data that will subsequently enable the success of management to be measured. Additionally, as there may be significant lag times before sustainable outcomes can be reliably measured, field and desk assessments can be combined to enable short-term proxy judgements of potential success. Although every agreement is unique in its composition of options, their application and the context within which they are applied, when taken together, the assessment of options across a range of situations provides a representative basis for assessing the effectiveness of application and the likelihood of outcomes being delivered. *Natural England* and *Defra* therefore initiated this work with *CEH* in 2008 as a partnership project, to design and deliver a baseline programme of monitoring on a representative selection of agreements, with four fundamental aims:

I. To provide an independent evaluation of the potential of HLS to deliver against each of its objectives;
II. To provide an independent assessment of quality of delivery of HLS (a QA function);
III. To provide a baseline against which the success of HLS could be tracked through follow-up visits during the course of the agreement;
IV. To contribute to building internal [*Natural England*] capacity for HLS monitoring through:
    a) Testing and developing novel techniques for data capture
    b) Developing field assessments for wider application.

To address these aims, the project team developed a programme of work with the following broad objectives:

1. To identify a representative national sample of agreements that would enable an ***aggregate assessment of HLS*** as a whole.

2. To undertake ***baseline*** field surveys to enable a future quantitative assessment of the success of these agreements and of HLS as a whole. This baseline would comprise mapping of the extent of features and assessments of their condition on each agreement.

3. To ***assess the potential success of each agreement*** by examination of the process by which each agreement was developed alongside the baseline field assessment and exploring how this reflected the rationale for agreement choice.

4. To examine the extent to which agreements within the same area (National Character Area: NCA) ***together contribute to the HLS objectives*** for these particular parts of England.

5. To test whether HLS agreements occur in landscape contexts that are typical of their particular region such that HLS delivers ***landscape benefits*** as well as those specifically addressed by options for access and education, biodiversity, historic environment and resource protection.

6. To explore opportunities to understand the contribution made by management to selected ecosystem services.

Over the three-year period of the partnership the programme of work undertaken addressed these objectives through three separate, though complementary modules:

Module 1 *Baseline Survey and Assessment of Agreement Building and Design:* This was the core of the overall programme addressing the first 3 aims detailed above, together with objectives 1-3. Delivery of this module was undertaken in all three years of the project, with the approach adapted in each year to ensure the broad utility of the baseline in the future. The selection of agreements was based upon the inclusion of specific option groups, providing for the maintenance and restoration of semi-natural habitats and/or conservation of target species.

Thus in 2009, the survey sampled and visited 100 agreements, with 50 chosen on the basis of containing **HK** options providing management of high value grasslands *i.e.* species-rich semi-natural grassland, wet grasslands for waders and wildfowl and grasslands for target features, and 50 chosen on the basis of containing **HF** or **HG** options providing management for arable biodiversity. The frequency of these option groups was such that many agreements sampled contained both grassland and arable management, and hence there were >50 agreements contributing to each stratum. The survey consequently had a focus on management options that were both frequent and extensive (see Tables 2.1-2.2), and in doing so, also sampled examples of other option groups that were present on these agreements.

In 2010, the **Module 1** survey sampled and visited 50 agreements, chosen on the basis of containing **HL** options providing for management of moorlands and rough grazing. Because of the large areas under these options and the difficult terrain involved in survey work meant that only 50 agreements were surveyed. As well as the core upland options targeted, fieldwork augmented the sample for other options present, especially grassland and woodland options.

In 2011, when most of the field activity was directed at **Module 3**, the resource available for **Module 1** was directed at augmenting the baseline for selected option or feature types that had been poorly represented in the first two years of the study. Twenty-four agreements were sampled that contained options for the management of either lowland heathland (**HO** options), wetland habitats (**HQ** options) or contained **HK** options delivering for BAP lowland calcareous grassland in the south and east England. The selection of these agreements was further prioritised on the basis of them also including **HJ** options intended to deliver resource protection benefits.

Module 2 *Ecosystem goods and services:* In recent years, the rationale for agri-environment schemes has evolved to encompass not only the sustainable management and restoration of valued habitats and other features but also how scheme delivery can be targeted to maximise the delivery of ecosystem services. Indeed in Europe as a whole, agri-environment schemes are the key policy instrument for the planning and implementation of large-scale ecological restoration required to deliver sustainable agriculture and ensure the continued provision of such services. In the UK, conserving ecosystem services is a key element of the 'sustainable intensification' agenda. Therefore in 2010, the project developed **Module 2** to investigate and, if possible, quantify the effectiveness and appropriateness of a range of ES options, representing different levels of intensity of grassland management, for restoring biodiversity and enhancing ecosystem function and associated services in grassland. A replicated sample was devised to compare measures of ecosystem service delivery from grasslands under HLS options for maintenance (**HK6**), restoration (**HK7**) and creation (**HK8**) of species-rich grassland with basic low-input management (as represented by ELS option **EK2**) and with intensively managed, non-AES grassland.

Module 3 *Complementarity between agreements and the landscape context*: Work within **Module 1** addressed most HLS objectives to some degree (*i.e.* access and education, biodiversity, historical environment and resource protection) but did not provide an effective framework for assessing the landscape objective of HLS. In 2011, therefore, a significant proportion of the project resource was directed at **Module 3**, aiming to understand how HLS interacts with the landscape and its component features to deliver environmental benefits *i.e.* dealing with the fourth and fifth project objectives. This was achieved by targeted assessments of the nature and quality of delivery of 62 agreements in 6 contrasting landscapes, as defined by Natural Character Areas (NCAs). For this work, assessments were concentrated on clusters of agreements within each chosen NCA that were at least 3-years into the HLS agreement, and therefore with all management in place. Within this module, three new objectives were explored:

i. To assess how HLS management contributes to landscape character (*i.e*. as defined by NCA descriptions) through developing and testing a methodology that allows specific landscape assessments to be made objectively and consistently;
ii. To assess the extent to which clusters of HLS agreements achieve complementarity/synergy, delivering benefits that are not only greater than the sum of the component agreements, but also specific benefits that demand a landscape scale approach to environmental management; and
iii. To compare these deliverable benefits with those set down in the profiles and statements of environmental opportunity for the relevant NCA and thus to assess how HLS targeting might be extended and improved as an approach.

As the HLS agreements surveyed for this module had been in place for at least 2-3 years, it was possible to make a fair assessment of progress against Indicators of Success (IoS) and particularly those due to be achieved in year 2. Therefore, this module could also contribute to an additional project objective:

7. To make a preliminary assessment of the success of HLS agreements in achieving their desired outcomes.

3 Assessment of Higher Level Stewardship: Field survey and appraisal

Introduction

This chapter describes the approaches taken to delivery of **Modules 1** and **3**. This represented the core of the project:

- to provide a rigorous and consistent baseline against which the success of HLS delivery at agreement-scale could be tracked in the future; and
- to develop a process for evaluation of the potential of HLS to deliver its desired outcomes at option and agreement-scale through structured assessment of each agreement.

The **Module 1** baseline was constructed through field survey of 174 agreements in their first year. The construction and design of these agreements was measured through a structured appraisal by panels of specialists with expertise in agri-environment schemes and land management. The approaches followed in the baseline survey are described in 3a: **Constructing the baseline**.

For **Module 3**, a field survey of 62 agreements located in 6 National Character Areas (NCAs) was undertaken to gauge the extent to which groups of HLS agreements achieve complementarity and synergy, and assess how HLS is implemented in a landscape context. The modified approach used in the NCA survey is outlined in 3b: **Survey of National Character Areas**.

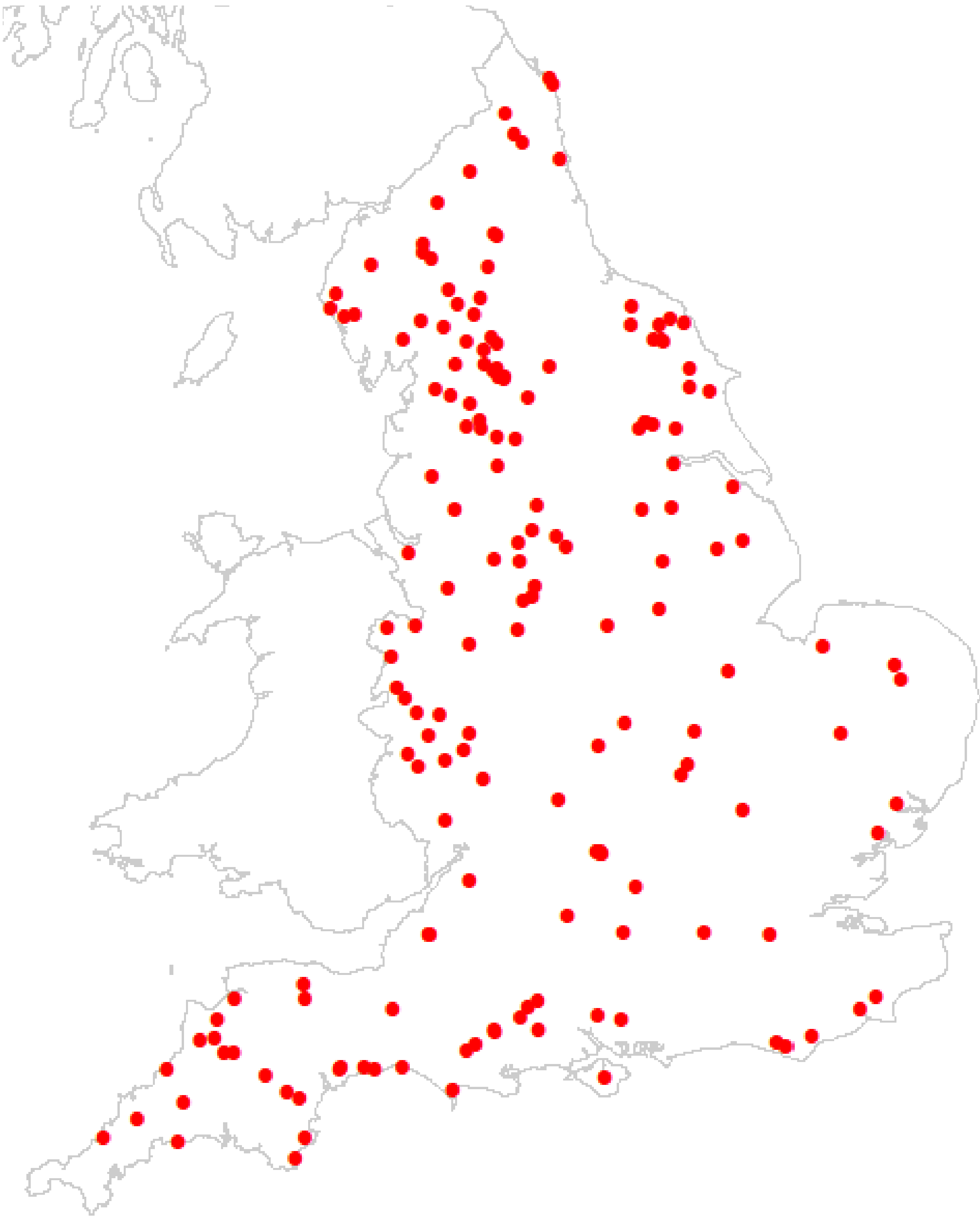
This represents the first comprehensive evaluation of HLS delivery, using a two-stage process: field survey and structured desk assessment of agreement quality. The approximate locations of the 174 agreements assessed in **Module 1** are given in Figure 3.1, and those from **Module 3** in Figure 3.8.

Components of the survey: Rationale

Although the agreements surveyed in **Modules 1** and **3** differed in age, many aspects of the survey approach and subsequent analysis were similar:

- Meticulous mapping of broad and priority habitats, as well as point and linear features to produce a detailed, accurate and consistent description of the area under HLS.
- Gathering of quantitative data on vegetation composition to allow habitats to be described accurately, their condition assessed and comparison made with national datasets
- Application of standard assessment techniques such that the present survey could be compared directly with other elements of *Natural England's* monitoring programme.
- Assessment of *Indicators of Success* (IoS) in order either to gauge the likelihood that the agreement would achieve its desired outcomes (baseline survey and NCA study) or to measure progress in the early years of the agreement (NCA study).

Figure 3.1: Map of England indicating locations of the 174 agreements of the baseline survey



In addition, for **Module 1,** each HLS agreement was subjected to a structured appraisal by a panel of experts who evaluated the agreement documentation alongside the results of the field survey in order to make judgements about both the quality of each individual agreement and its component options, and hence to make an assessment of its potential to contribute to the overall objectives of Environmental Stewardship in England.

3a Module 1: Constructing the baseline

Fieldwork approach: data gathered

The 174 HLS agreements sampled were all surveyed in the summer following the beginning of their agreement, although some were renewals of previous ESA or Countryside Stewardship Scheme agreements. The field survey took place across three summers:

- In 2009, the sample comprised 100 lowland agreements that contained a minimum of 50 agreements with arable (**HE** and **HF**) options and at least 50 with grassland (**HK**) management options; a significant proportion contained both option groups. The sampling in 2009 also achieved good coverage of options for scrub and woodland, and for the historic environment.
- In 2010 the selection of 50 agreements was stratified to target agreements containing options from the **HL** group (moorland and rough grazing) especially **HL9** maintenance of moorland, **HL10** restoration of moorland and **HL11** creation of upland heathland, but also including rough grazing options **HL7** and **HL8,** primarily targeted at management for upland birds. These agreements provided additional coverage of woodland and grassland options, but did not increase the sample of arable options.
- In 2011 work focussed on 24 agreements containing options that had been poorly represented thus far in the study, specifically **HO** options for lowland heath, **HQ** options for fen, lowland raised bog and reedbed and **HK** grassland options **HK6-8** on calcareous grassland. Further targeting was undertaken to preferentially sample where **HJ** options were also present on the agreement. 2011 agreements were all in the lowlands and further increased the information on arable and woodland options.

The approaches used for field mapping of habitats and features were largely a development of techniques used for Countryside Survey (Carey *et al.,* 2008) and adapted previously for the monitoring of Countryside Stewardship. Condition assessment methodologies were adapted from the Farm Environment Plan Handbook (Natural England, 2008). However, as many aspects of HLS are novel, existing methodologies were subject to some adaptation and augmentation. Surveys were undertaken by three field teams comprised of two surveyors, working through the summers of 2009, 2010 and 2011. The quality and consistency of the surveys was optimised by using as far as possible the same team of experienced field surveyors with a background in *Countryside Survey*. The teams were given intensive training by *Natural England* and CEH in both HLS and the survey methodology, and issued with detailed manuals for mapping and field survey. Use of a small expert team should have minimised variation in the data.

The survey aimed as far as possible to integrate existing monitoring requirements and frameworks with the approach specific to this project. Hence, the standard field survey methodology was augmented to include a) collection of data to enable the condition of notified features within SSSIs to be assessed using Common Standards Monitoring (CSM) methodologies; and b) an assessment of progress towards Indicators of Success (IoS), which are defined for features under management within most HLS options. The use of CSM was incorporated in part to facilitate updated assessments of SSSI features, where possible, but also because it enabled an element of informal comparison with recorded assessments, albeit other variables, such as the time since assessment and methodological issues, could not always be taken into account. The field survey essentially followed a consistent methodology for all agreements surveyed in 2009 and 2011, and for land surveyed in 2010 below the moorland line. The approach to surveying large areas of unenclosed moorland in 2010 required some modification and in these areas field data were collected on the basis of the Moorland Management Unit (MMU) rather than the RLR parcel. In order to obtain consistent field data from each agreement, a structured approach was followed as summarised in Box 3.1.

Box 3.1: Summary of field survey approach

A. Prior to survey

- From the Genesis database, *Natural England* provided a standard body of information for each agreement comprising the FEP, agreement documentation, associated maps, favourable condition tables for SSSIs where relevant and other background information (*e.g*. management plans, historical environment reports *etc*) as available/necessary.
- Methodological manuals were produced for a) field survey and condition assessment (Carey *et al* 2011); and b) habitat mapping (Carey and Mountford, 2010). These were issued to the field teams to accompany detailed training in the approaches to be used. The methods were adapted from those used in *Countryside Survey and the FEP Handbook*.
- The field teams and CEH coordinators liaised with local *Natural England* advisers and agreement holders to facilitate access as necessary and discuss any special aspects of site management that might affect the survey.
- This documentation, aerial photographs of the target agreements and Ordnance Survey MasterMap baseline imagery were loaded onto either (2009-10) a Trimble PDA (TDS Nomad 800L) or (2011) a GETAC E100A tablet computer to be used for data recording in the field. The GETAC E100A enabled the use of Microsoft Access for more complex recording requirements. The surveyors entered survey information onto these base maps.
- In 2011, the CEH Informatics Liaison Officer adapted the recording forms into Microsoft Access format such that completed information could be downloaded frequently and incorporated directly into the main project database.
- The agreement was examined to establish the areas of HLS and ELS within the holding. The HLS area and a surrounding envelope of ELS land were earmarked for survey:
  a) If the agreement area (ELS and HLS) was ≤100 ha, it was expected that the entire agreement could be surveyed, whereas
  b) If the agreement area was ≥100 ha (as in many moorland agreements surveyed in 2010), a priority area for assessment was demarcated that included parcels under all or most of the HLS options represented in the agreement.

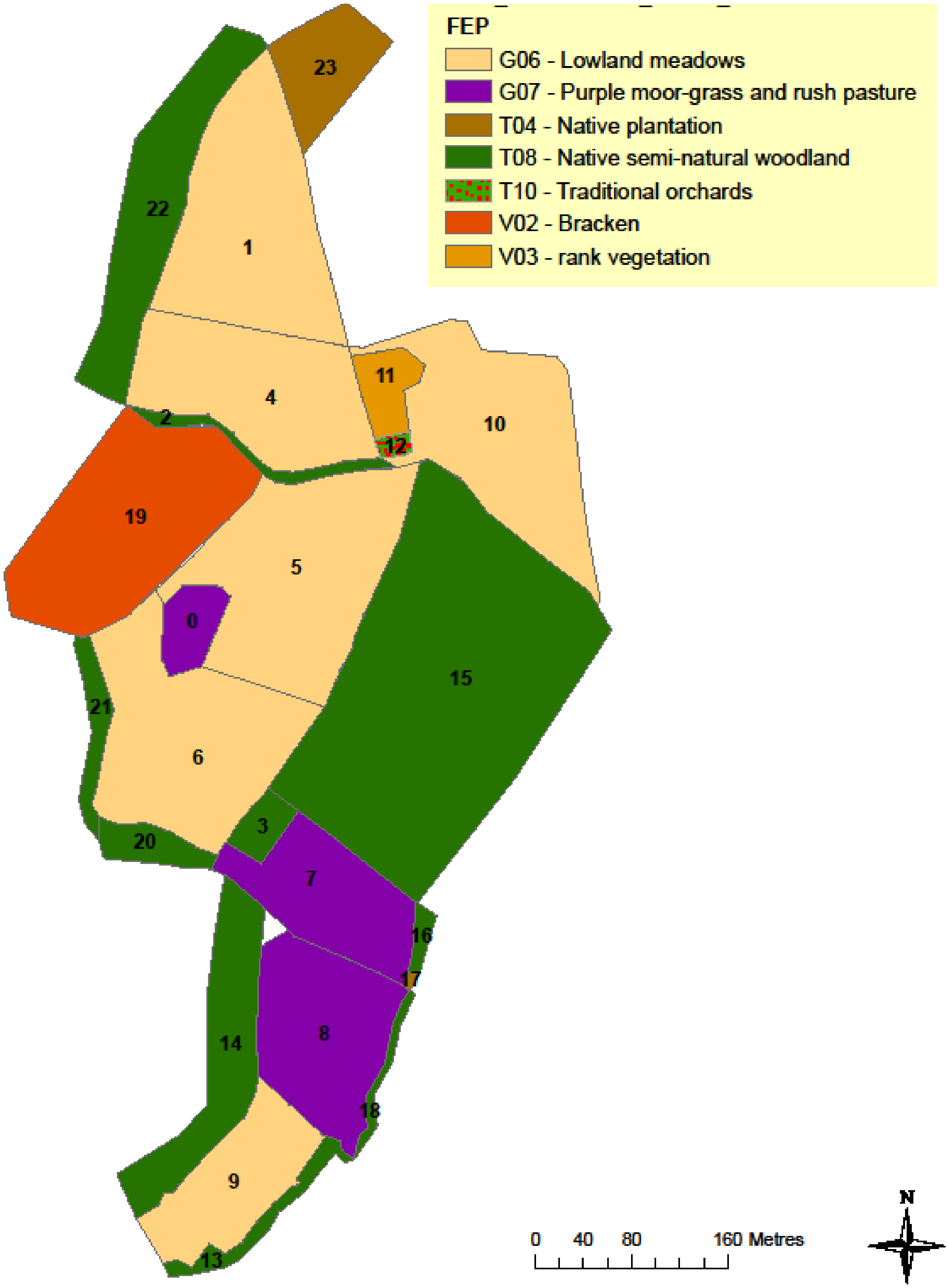
B. Field survey – described in full in Carey *et al.* 2011

- The environmental features present (habitat polygons, linear and point features) were mapped using *ArcPad* together with relevant attributes of these features (*e.g.* broad and priority habitats, FEP habitats, dominant species, boundary type, diameter at breast height of veteran trees, *etc*). The mapping covered all the assessed parcels or MMUs (see example in Figure 3.2).
- In HLS options, each surveyed parcel was described in terms of FEP features, management and standard attributes to enabled feature condition to be assessed. At least five randomly located vegetation quadrats were recorded in each assessed enclosed parcel. Quadrat size varied with habitat type: a) 1m^2 for grassland and arable margins; b) 4m^2 for heathland and wetland; and c) 100m^2 for woodland/scrub.
- In open enclosed moorland, quadrat points were determined randomly in advance and their grid coordinates entered into the GPS facility on PDA or computer. In large MMUs at least 20 quadrats were recorded per MMU.
- Where the agreement included SSSI land, a condition assessment of the notified feature was performed using a generic CSM methodology, including a structured walk with 20 stops across the SSSI unit, with at least five of these recorded as full quadrats.
- As far as possible, management prescriptions for each option in each surveyed parcel were checked to ascertain whether they had been applied successfully and seemed appropriate for the objectives of the option and agreement.
- Using field observations, IoS applying to each option were assessed using a RAG (Red Amber Green) classification to test whether they had been met already or were likely to be met within the duration of the agreement (Green) or seemed likely to fail (Red) – instances where there was doubt were noted as Amber.
- Delivery of any capital works was assessed, looking at progress and to judge whether the works provided necessary support to land management activities.

C. Post Survey

- All field data were jointly reviewed to ensure that there was a consistent and comprehensive body of maps, quadrat data, condition assessments and photographs for each agreement. A summary document (PAF: Pre-Appraisal Form) was prepared for each site to a consistent format, presenting the key components of the agreement and summarising the survey results.

Figure 3.2: Exemplar map of the priority habitats found by field surveyors on one HLS agreement. Numbers within polygons refer to individual mapped units to which a range of attributes were attached *i.e.* Priority Habitat, Broad Habitat, FEP feature, species and management



Survey outputs

Most of the findings of the field survey, together with background about each agreement were compiled into a Pre-appraisal form. This was combined with the mapped outputs from the survey into individual agreement dossiers that were transferred to *Natural England* prior to the expert panel assessment. Box 3.2 lists the main outputs from the survey, both as used within the present project and as available for further use in monitoring agri-environment schemes and designated areas such as SSSIs.

Box 3.2: Summary of survey outputs

A. Original survey data

- Maps of agreements depicting broad and priority habitats, FEP habitat features, their main species (with % cover) and management observed (see Figure 3.2).
- Maps of agreements showing linear features (*e.g.* hedges, walls, fences, track-ways *etc*), together with their condition and management.
- Maps of agreements with point features and target notes. For example, point features might include veteran trees (together with their diameter at breast height), presence of an eyesore or occurrence of particular species of interest.
- Quadrat data *i.e.* plant species recorded together with percentage covers, vegetation height, extent of bare ground *etc*.
- Condition assessments of habitat features (or access) based on the FEP assessment, together with management information.
- Additional CSM compliant data for SSSIs, including species lists, quadrat data and assessment of condition for designated features.
- Digital photographs showing features of interest and with relevance to the assessment of the agreement. The position of each photograph was located with a GPS reading, together with the direction of the view. An example of the many photographs taken is given in Figure 3.3.

B. Summarised survey outputs in Pre-appraisal Form (PAF)

- Area of ELS (i.e. the whole agreement) and HLS management present on the agreement, together with the total area mapped and assessed during the present survey.
- HLS options represented on the agreement and those assessed as part of the survey. Any designations (*e.g.* SSSIs) applied to all or part of the agreement are listed.
- Features recorded in original FEP documentation
- HLS targets and themes addressed by the individual agreement.
- Summary of HLS options from the original documentation: listing the FEP features addressed by each option, the RLR parcels where the option is applied, the extents of each option within these parcels and their condition as documented in the FEP.
- Summary of HLS options as recorded in the present survey: listing the features mapped and their condition within each surveyed parcel.
- Capital works: their type, extent and cost
- Results of RAG assessments for indicators of success: by individual option/parcel combinations
- For SSSI features, results of the condition assessment.

Note: The PAF also contained preliminary commentary on the quality of the FEP, FEP map, agreement map, use of options, capital works, management prescriptions, indicators of success and management.

Box 3.3: **Summary of criteria assessed within the Appraisal Panel Score-sheet**. Listing the sections of the score-sheet, the nature of the appraisal required from the panel and the type of ranking (in italics) produced. Criteria scored as n/a indicated either that the criterion could not be assessed or that the component (*e.g*. FEP or Indicators of Success) was absent from the agreement documentation held on *Genesis*.

⇨ **Farm Environment Plan:** The panel provided a judgement on the accuracy of the FEP, in relation to the areas mapped and surveyed by CEH. *Five point scale from 4 (high quality) to 1 (lowest quality) with 0 indicating FEP not completed or rudimentary*

⇨ **Appropriateness of Agreement Targeting:** Panel provided a judgement of fit against the target/theme statements for the area where the agreement was located. *Four point scale from 4 (high quality) to 1 (lowest quality)*

⇨ **Use of Options:** The panel provided a judgement on the appropriateness of option choice in relation to the features identified in the FEP. Were the options chosen reasonable aspirations and/or goals for the feature(s) present? *Four point scale from 4 (high quality) to 1 (lowest quality)*

⇨ **Accuracy of Agreement Map:** The panel judged whether there were any errors in producing the agreement map that could lead to inappropriate management and/or incorrect use of options/associated payments. *Three point scale from 3 (high quality) to 1 (lowest quality)*

⇨ **Management prescriptions:** The panel assessed the prescription set for each option for comprehensiveness and appropriateness. *Four point scale for each option from 4 (high quality) to 1 (lowest quality*) – *0 indicating no prescriptions*. In 2010, for assessments of unenclosed moorland additional assessments were made of any **Stocking calendar** [*Five point scale for each option from 4 (high quality) to 1 (lowest quality) with 0 indicating calendar absent where one required*] and **Burning plan** [*Five point scale exactly as for stocking calendar*]

⇨ **Indicators of Success (IoS):** The panel assessed the indicators of success for comprehensiveness and appropriateness in the context of each option used. *Five point scale for each option from 4 (high quality) to 1 (lowest quality) – 0 indicates IoS absent.*

⇨ **Capital works:** The panel assessed the appropriateness and timely delivery of capital works programmes. *Both components of the criterion using a four point scale from 4 (high quality) to 1 (lowest quality).* **A)** Do the capital works enable or support delivery of the agreement's objectives? **B)** Have capital works essential to the implementation of HLS management options been properly completed in the early months of the agreement? Only part A) is discussed in this report, as in many cases it was too early to judge B fairly.

⇨ **Option Level Outcomes:** Is it likely that the intended outcomes of each option will be achieved within the lifetime of the agreement? *Six point scale for each option from 5 (high quality) to 1 (lowest quality), with * being used where the panel member was unable to determine the likely outcome.*

⇨ **Feature Level Outcomes [Moorland features in 2010 only]:** taking into account the options, management plans (including stocking and burning) supplements and capital works, does the agreement provide an effective framework for delivering outcomes? *Five point scale for each option from 4 (high quality) to 1 (lowest quality) with 0 indicating that the panel member was unable to assess the outcome for a particular feature*

⇨ **Agreement Level Outcomes:** Is the agreement likely to be effective in delivering against multiple objectives and will it produce synergies between them? *Seven point scale from 5 (high quality) to -1 (lowest quality i.e. likely to damage the area of the agreement)*

Figure 3.3: Exemplar photograph taken during the field campaign for the present project (see also Box 3.2). This photograph shows the margin between the arable crop and hedgerow under management option **HE10** floristically enhanced grass margin (non-rotational)

Appraisal panels

Field data and photographs were combined with the agreement documents and the Pre-Appraisal Form (PAF) to create an agreement dossier. A panel of experts drawn from within the project team and elsewhere in CEH and *Natural England* used these dossiers to evaluate each individual agreement against a set of standard criteria relevant to the different stages of agreement building and to the delivery of outcomes *i.e.* the FEP, Agreement Targeting, Option Selection, Prescriptions and Indicators of Success. Prior to convening the panel, each member individually made an evaluation of each agreement using a structured score-sheet (see Box 3.3). The Scores recorded by individual panel members were presented at a joint meeting, chaired by a moderator who did not assess the agreements, and a final “panel score” agreed for each criterion for each agreement. The results of this structured review were then used to assess the overall likelihood of the agreement delivering against its objectives at both option and whole agreement scales. Both assessments and overall panel score are manifestly qualitative judgements of potential, but the 2-stage process and debate at meetings provided both consistency and rigour.

The panel process followed fundamentally the same approach in each year, except that in 2010 a more detailed appraisal was made of options addressing unenclosed moorland to encompass assessments of stocking calendars and burning plans alongside prescription sets, and an additional criterion (Feature Level Outcomes) was introduced to assess whether the agreement provided an effective framework for delivering outcomes across all the features present (both biodiversity and historical).

Certain options, including some supplements *e.g.* for use of native livestock, small fields *etc*, and options for educational access could not be assessed fairly by the panels.

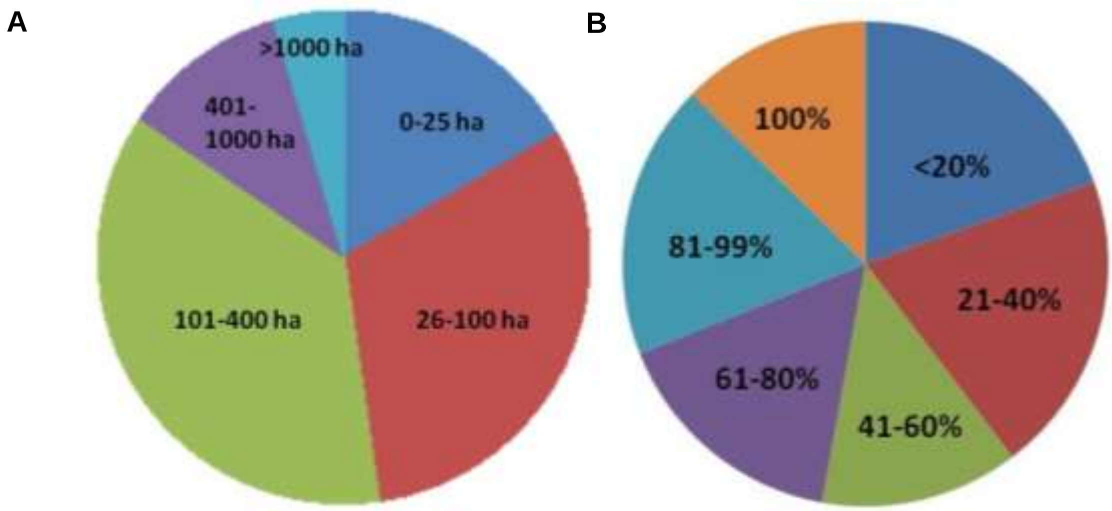
The Nature of the Sample: Summary statistics for the baseline survey

The HLS agreements contributing to the baseline varied markedly in size (Figure 3.4A) from as little as a hectare to well in excess of 1000 ha. Overall, however, the majority of holdings were of small-medium (26-100 ha) or medium (101-400 ha) size, especially within the lowland grassland and arable agreements surveyed in 2009.

Larger holdings were represented more frequently in the 2010 (upland) sample, for which three-quarters of the agreements assessed were >100ha in extent and 28% over 400ha. The smaller targeted sample surveyed in 2011 was distributed evenly through the size classes, although the largest holding was <700 ha in extent.

HLS is a part-farm scheme and is usually targeted at the features on an agreement of greatest environmental value. The agreements surveyed varied in terms of the proportion of the overall holding that was under HLS management (Figure 3.4B). However, there was no clear trend in this proportion with relatively even numbers in each category from <20% of the holding under HLS to the entire holding. At a very general level, there was a slight trend to smaller holdings having a greater proportion of land under HLS and larger holdings have a smaller proportion of the land within the scheme, although exceptions were found with large moorland agreements and agreements owned by conservation bodies where much of the area might be under HLS options. Some agreements with an apparently small proportion of land under HLS land included significant effort devoted to management of boundary features (hedgerows) or to access and education, rather than to the management of blocks of land for biodiversity and historical or landscape value.

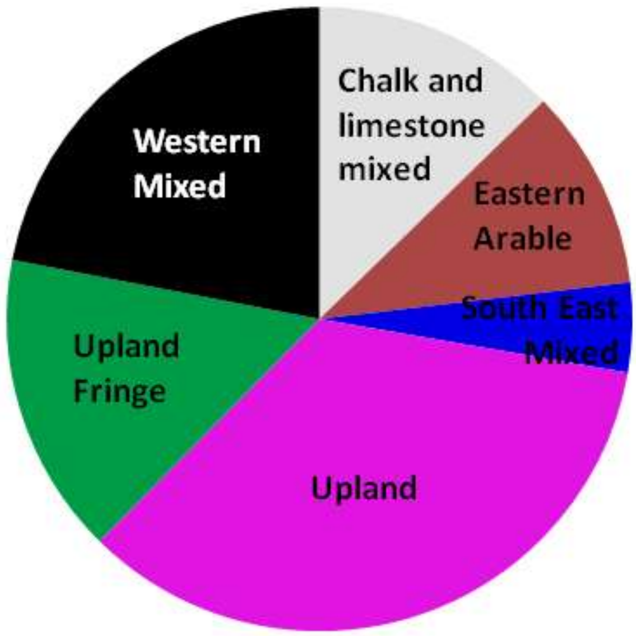
Figure 3.4: HLS baseline survey 2009-2011 (174 holdings): A) Proportion of sample in each of 5 size classes of holding; and B) Proportion of sample in each of 6 categories for percentage of holding under HLS



In terms of cultural landscape, the surveyed holdings were located across all six Agricultural Landscape Types (Figure 3.5) that are found in England. The Agricultural Landscape Type (ALT) framework classifies landscape by a common set of characteristics and attributes reflecting its cultural use. The criteria used comprise the character of agricultural practice combined with land use, the dominant land form, plus the underlying geology and soil type. The building blocks for the ALTs are the National Character Areas. It is therefore possible to subdivide each ALT into its constituent parts should a finer scale of analysis or characterisation be required.

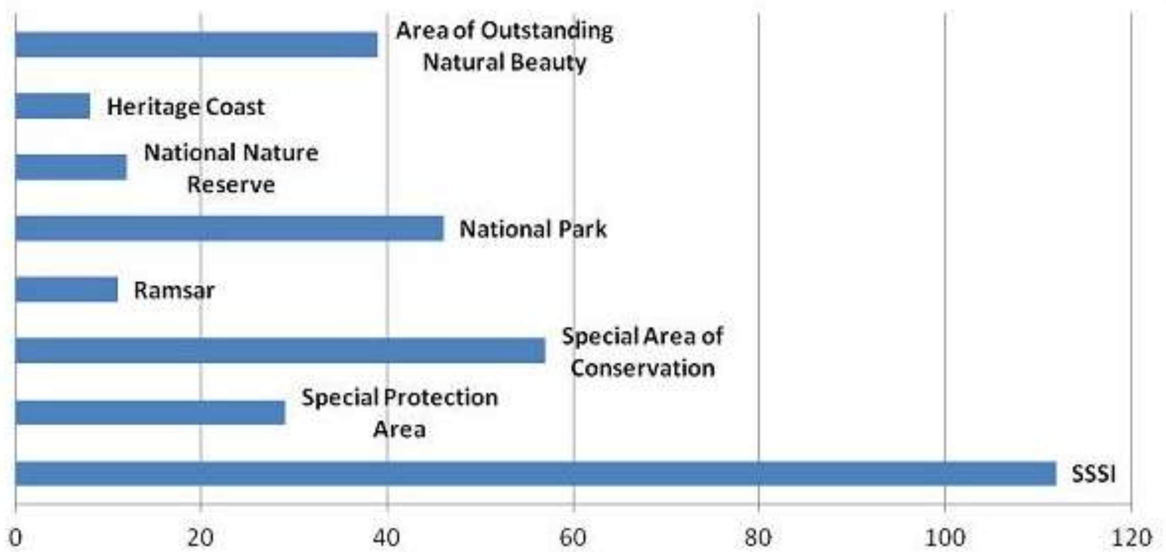
Although the survey only specifically sampled 50 upland agreements (recorded in 2010), exactly half the baseline holdings (87) were found in either Upland or Upland Fringe landscapes. This apparent discrepancy is explained by the fact that these additional upland and upland fringe holdings largely comprised grassland, wetland and woodland options rather than the moorland and rough grazing options targeted in 2010. Most of the remaining holdings were in landscapes of mixed farming, especially in the west or on chalk and other limestones, and with relatively few (8 holdings) in the southeast mixed farming landscape type. Just over 10% of the surveyed holdings were within an Eastern Arable landscape.

Figure 3.5: HLS baseline survey 2009-2011 (174 holdings): Proportion in each of 6 Agricultural Landscape Types [One holding unclassified]



Higher Level Stewardship is designed to be used for the creation, restoration or maintenance of areas of importance for their nature conservation, archaeology or landscape value. Hence there is a strong correlation between HLS and areas that are designated as important for one or more of these factors, whether local, national or international (Figure 3.6). Indeed, HLS has been used as a key mechanism for delivery of management intended to secure favourable or recovering condition on SSSIs, and for effective management of other designated sites; for instance, a *Defra/*NE PSA target was set to bring 95% of SSSI land by area into favourable or recovering condition by December 2010 and this emphasised the use of HLS to deliver the remedies required to bring about feature recovery. This emphasis is reflected in our sample with almost two-thirds (64% - 112 agreements) of the agreements surveyed including some SSSI land and 8 holdings (4.6%) included parts of more than one SSSI. The proportion of holdings with some SSSI land was slightly higher in upland agreements and those included in the targeted survey of less frequent habitats in 2011.

Figure 3.6: HLS baseline survey 2009-2011 (174 holdings): Numbers of holdings with land given a conservation designation



Some of these agreements also had international designations such as Special Protection Areas (29 within SPAs: under the Birds Directive), Special Areas of Conservation (57 within SACs: under the Habitats Directive) and/or under the Ramsar Convention on Wetlands (11 agreements). Two holdings included parts of World Heritage Sites selected by UNESCO. Other designations address landscape and amenity value and 46 (26.4%) of the surveyed holdings lay in National Parks, including agreements from the 2010 upland survey in the North York Moors, Peak District and Yorkshire Dales. The survey of 2011 also included several agreements in the Lake District (wetland sites) and South Downs (chalk grassland) National Parks. A further tranche of agreements lay within areas covered by national landscape and heritage designations *e.g.* 39 agreements (22.4% of those surveyed) were wholly or partly within AONBs and 8 by Heritage Coasts. Other designations included County Wildlife Sites, Registered Parkland and Scheduled Ancient Monuments, the latter being especially frequent in the upland sample of 2010.

Despite this range of designations, some holdings had no designated land at all, especially in the arable lowlands. Eight holdings lay immediately adjacent to freshwater SSSIs, usually a river, but occasionally a lake, where part of the function of the HLS agreement should be to protect the quality of the water-body.

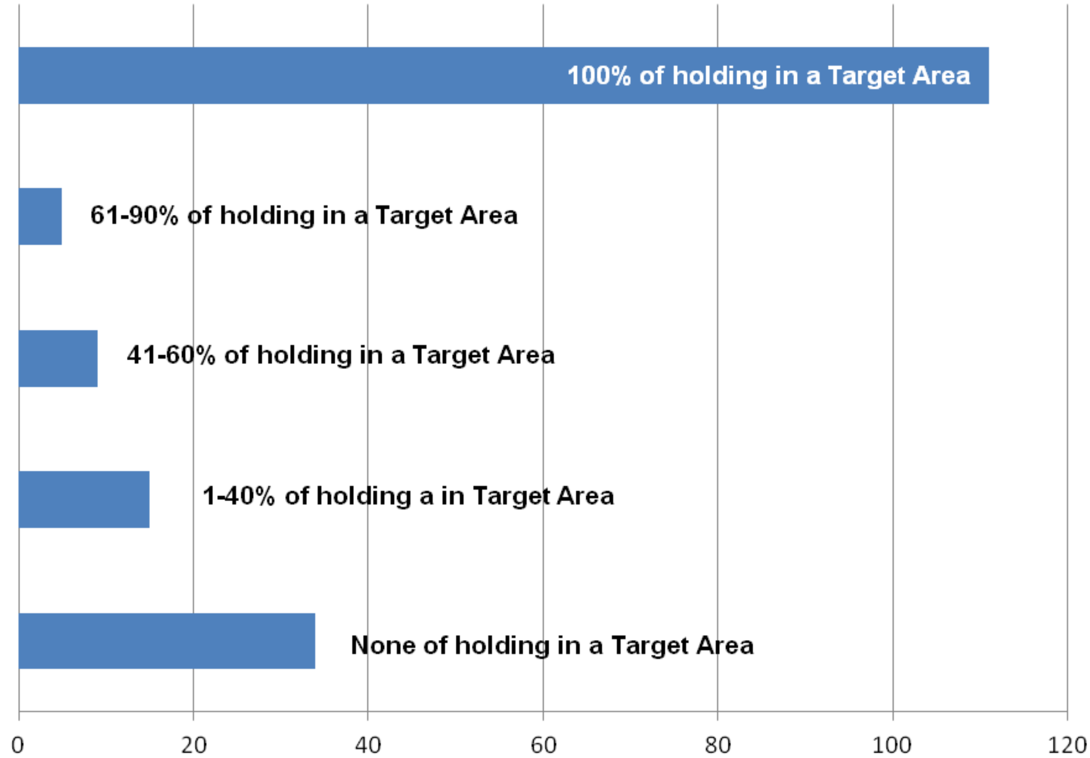
HLS is a targeted scheme and agreements should be placed where they can be expected to provide the greatest environmental benefits. To facilitate this, *Natural England* developed and introduced an updated (known as Phase 2) spatial targeting framework in 2008/9. This framework was developed by superimposing data-layers related to each of the scheme objectives to identify spatially defined areas where the greatest number of priorities coincided. These "Target Areas" showed where multiple outcomes could be delivered most effectively and efficiently. For each target area a statement has been produced that defines the local priorities for HLS management and it was intended that a high proportion of HLS agreements should be located within these defined areas. An agreement within a target area will be expected to deliver most of its core management against priorities defined in the statement, but it is not likely that it will address all priorities for the Target Area.

In developing the targeting strategy, it was recognised that individual features of high environmental value and priority would still be found outside Target Areas. To assist advisers in assessing the importance of such features for inclusion in HLS, regional 'Theme Statements' were produced. In areas covered by Theme Statements, agreements should deliver significant benefits for one or more themes prioritised at the regional scale.

All the agreements surveyed in 2010 and 2011 were set up under the Phase 2 spatial targeting framework, but a few of those agreements from the fieldwork campaign of 2009 were established prior to its finalisation *i.e*. based on a draft (Phase 1) version.

Figure 3.7 summarises the numbers of agreements within the sample that lay within a Target Area, distinguishing those situated wholly within an area from those where part or all of the holding lay outside the HLS Target Area. Of the agreements in the baseline survey, 111 (64%) were entirely within Target Areas and a further 7 (4%) were largely within such areas. Only 34 agreements (19.5%) were wholly outwith the Target Areas, and thus had their environmental priorities for HLS influenced by the regional theme statements. A few holdings (24 *i.e.* 14%) only had a small proportion (<60%) of the land within a Phase 2 Target Area. Several of the agreements that included land both within and outwith Target Areas were non-contiguous *i.e.* comprising blacks of land well separated from each other.

Figure 3.7: HLS baseline survey 2009-2011 (174 holdings): Numbers of holdings within HLS Target Areas. As well as those wholly within or wholly outwith such Target Areas, some holdings include land in both categories – the figure indicates the overall proportion of land in Target Areas



3b Module 3: Survey of National Character Areas: early progress with HLS

Fieldwork approach: data gathered

Six National Character Areas (NCAs) in England were selected covering a range of contrasting landscape types situated in different areas of the country, and which had both sufficient background information and at least 40 active HLS agreements from which to select a sample for field survey. Discussion between the partners in the research programme identified the following contrasting NCAs as suitable (see Figure 3.8):

Dorset Downs & Cranborne Chase	Dunsmore and Feldon
The Fens	High Weald
Southern Pennines	Upper Thames Clay Vales

Figure 3.8: Map showing the location of the six NCAs. Ten agreements were surveyed in each NCA, except in Dunsmore & Feldon and the Fens where 11 agreements were surveyed. The positions of surveyed agreements are not shown

The environmental priorities for each NCA were identified from NCA descriptions, statements of environmental opportunity and target area statements and used to identify key HLS options. The *Genesis* database was then searched to identify those HLS agreements within each NCA that had been under agreement for at least 2 years. Ten or eleven agreements per NCA were identified for survey randomly from the population of those that contained the key HLS options.

The field survey methodology was essentially the same as that described for the baseline study, with the five lowland NCAs using the approach for 2009 whilst the Southern Pennines NCA was studied using the upland variant of the method employed in 2010. The main difference between the survey of agreements for the NCA study (**Module 3**) and that for baseline agreements (**Module 1**) lay with the treatment of landscape and with the post field survey assessment of progress in meeting desired outcomes.

To make a consistent assessment of landscape, individual forms specific to each NCA were designed based upon its key landscape characteristics, as set out in the NCA description. These characteristics were divided into those key rural landscape characteristics that apply to the entire NCA and those that define the sub-zones of the NCA for a) physical landform and settlement pattern; b) hedges, trees, woodland and semi-natural features; c) enclosure pattern and form; d) agricultural land management; and e) other features.

During the survey, the incidence of relevant characteristics was assessed within the agreement area and the surrounding land, stating whether the characteristic was present and, if so, whether it was prominent, occasional or localised. Numerous photographs were taken of landscape features found within the agreements and the landscape context within which the holding was situated.

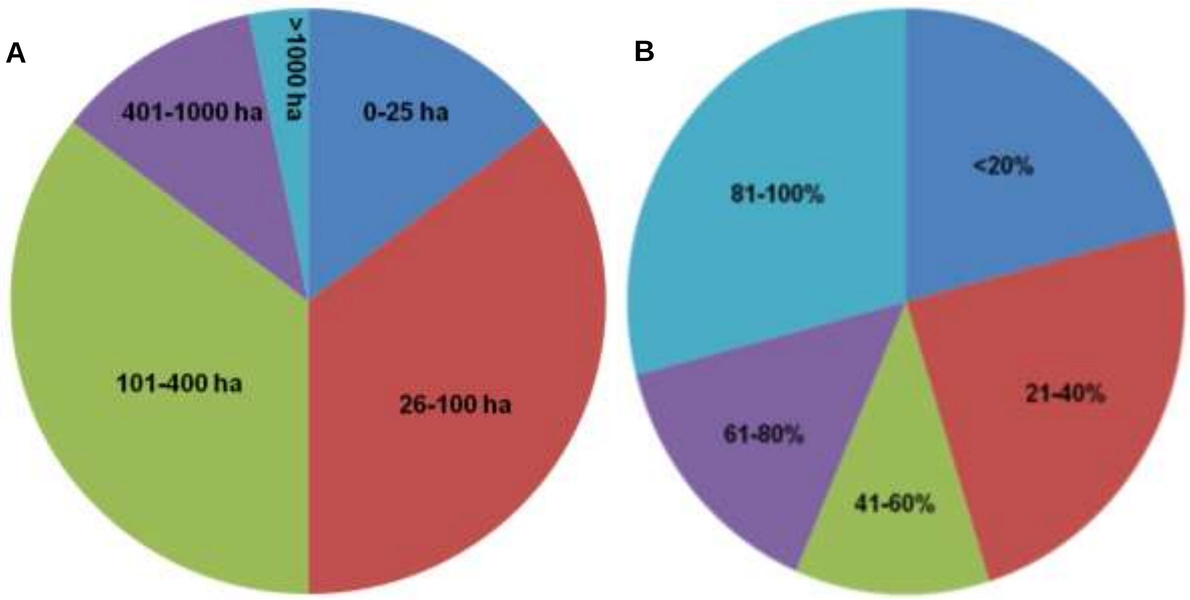
In contrast to the baseline survey, the 62 holdings included in this part of the study had been under agreement for at least 2 years and could be expected to have made some progress toward meeting the goals of the agreement. The surveyors were therefore able to review the management prescriptions for each option and judge whether they had been applied successfully or appeared appropriate to the objectives of the option and agreement. The survey was also able to make a thorough assessment of progress towards the IoS for each option, especially for those indicators set for the first years of the agreement.

Summary statistics from the survey of NCAs

When data from the six NCAs are combined, the relative proportions of holdings in five size range categories were similar to those for the 174 baseline agreements (Figure 3.9A). However, the individual NCAs showed different patterns in the size of holding, reflecting current and historic land-use and modern socio-economic trends.

The samples for the Fens and Dorset Downs NCAs had several very large holdings, though in the Fens this was balanced by a group in the small/medium category (26-100 ha). The large Fenland holdings were mainly in the coastal marshes, where extensive salt-marshes were included in HLS holdings. The High Weald, Dunsmore & Feldon and Upper Thames Clay Vales NCA samples had a predominance of small to medium holdings, with most surveyed agreements being <200 ha, although all three areas had a few holdings in the 201-500 ha category. Finally in the South Pennines NCA, more than half of the surveyed holdings were <100 ha in extent (mainly on the edges of the moorland plateaux and the upper parts of the narrow Pennine valleys) but with two very large holdings covering large parts of the plateau.

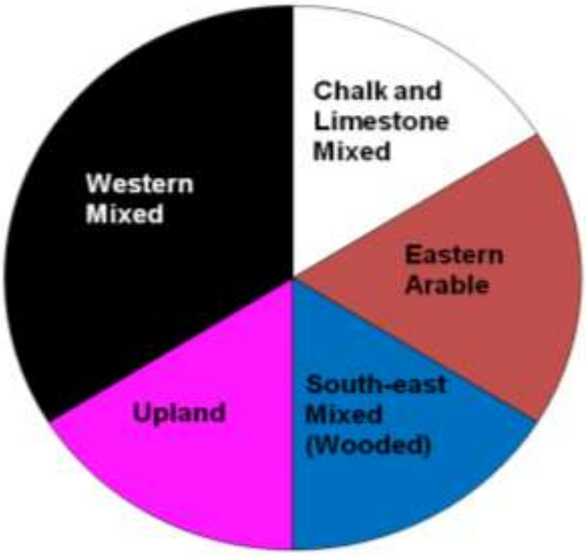
Figure 3.9: HLS survey 2011 of 6 National Character Areas (62 holdings): A) Proportion in each of 5 size classes of holding; and B) Proportion in each of 5 categories for percentage of holding under HLS



The percentage area of each holding under HLS management was recorded and Figure 3.9B shows the relative proportions of the 62 surveyed agreements classified in five categories reflecting the extent of HLS land. As with the data on holding size, the combined information for the 6 NCAs presents a similar pattern to the baseline survey, but some individual NCAs had distinct patterns in the proportion of the holding that is devoted to HLS options. Three NCAs (Dorset Downs & Cranborne Chase, High Weald and South Pennines) reflected the overall pattern, with samples fairly evenly distributed from <10% to >80% of the holding under HLS. However in the Dunsmore & Feldon NCA, the area under HLS was generally lower (<40% of the holdings). Although both the Fens and Upper Thames Clay Vales NCAs had a tendency toward having a higher proportion (>70%)

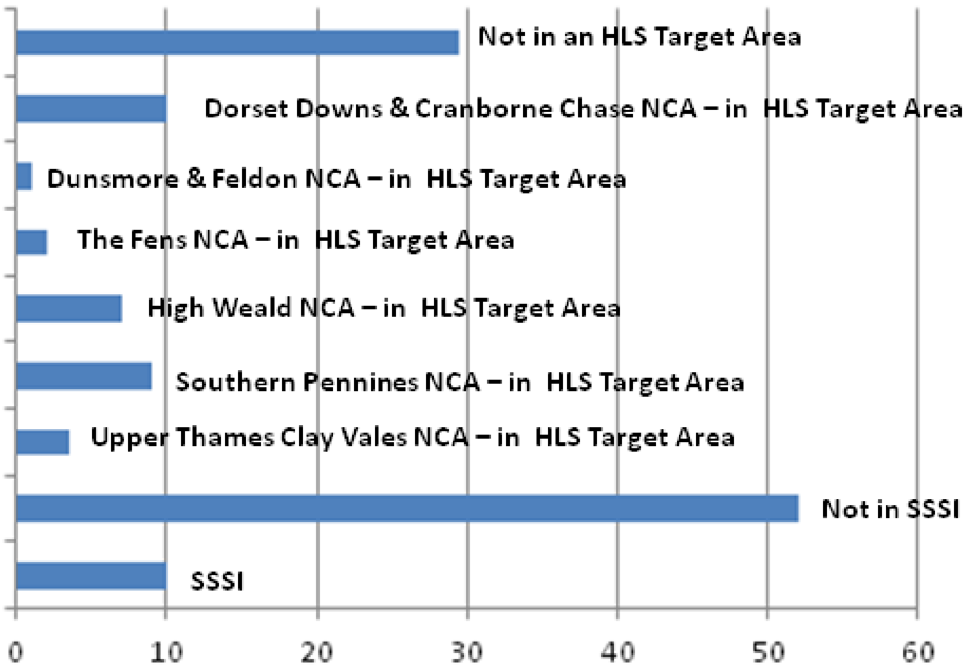
of the holding in HLS, in the Fens both large and small holdings had extensive HLS, whilst in the Upper Thames holdings with relatively complete coverage by HLS were mainly small in size.

Figure 3.10: HLS survey 2011 of 6 National Character Areas (62 holdings): Proportion in each of 5 Agricultural Landscape Types



As the definition of an NCA is based upon similar criteria to those used to define Agricultural Landscape Types (see Chapter 3a), it is not surprising that the cultural landscapes within which the surveyed agreements were located follow the NCAs closely (Figure 3.10). Thus all Dorset Downs & Cranborne Chase agreements were in a Chalk and Limestone Mixed farming landscape, all sites in the Fens were in Eastern Arable, all High Weald agreements were within the South-east Mixed (Wooded) landscape and the South Pennines were Upland in character. The Dunsmore & Feldon and Upper Thames Clay Vales NCAs were relatively close to one another and both within the Western Mixed Agricultural Landscape Type.

Figure 3.11: HLS survey 2011 of 6 National Character Areas (62 holdings): Numbers of holdings in HLS Target Areas and in SSSIs



In contrast to the sites within the baseline survey where more than half the agreements included land designated as SSSI, only 10 agreements in **Module 3** (16%) contained SSSI land (Figure 3.11). Unsurprisingly, given that the areas were not sampled randomly, the relationship with HLS Target Areas was also different, with 47.6% of the agreements being outside a Target Area (compared to *ca* 35.6% in the baseline dataset). The correspondence with HLS Target Areas differed between NCAs, with all the Dorset Downs & Cranborne Chase NCA sites being within the Target Area of the same name, and most of the sites in the High Weald and South Pennines NCA also located in the equivalent Target Area. Very few agreements in the Fens or Dunsmore & Feldon NCAs, and only a third of agreements in the Upper Thames Clay Vales NCA were in a Target Area.

3c Content of the project databases

The survey data from all three years have been stored in an Oracle 10g relational database, which is described in some detail in Appendix 1 of this report. A fuller description of the database including data flow from collection to import and detailed metadata for each table is available in an additional document which accompanies the database as provided to *Natural England*.

As transferred to *Natural England*, the project database has the following major components:

- Original documentation for each agreement upon which the survey was based
- HLS options (codes), FEP codes and capital works recorded during the survey
- Survey maps depicting Broad and Priority Habitats, FEP features and both linear and point features
- Vegetation quadrats
- Assessments of FEP feature condition
- Assessments of designated feature condition (CSM results)
- Indicators of Success and RAG assessments
- Digital photographs together with documentation on their location, subject and view
- Pre-appraisal Forms (PAFs) as prepared for the appraisal Panels.

As described in Appendix 1, the data are labelled with a combination of agreement number, RLR parcel number, date and surveyor, and also where relevant with the survey protocol sued and habitat assessed. A number of controls have been added to the tables to prevent errors, such as unique constraints on identifying data to prevent duplicates and to prevent deletion of identifying data to decrease the risk of orphaned data.

The spatial data (shape files *etc*) are supplied as a geo-referenced database, allowing *Natural England* to reconstruct and manipulate the habitat maps and related information gathered during the surveys.

4 Analysis of mapped data: habitats under Higher Level Stewardship

The relationship between habitats and management options

Methodology

The Geographical Information System (GIS) created during the survey included attribute fields for Broad Habitat, Priority Habitat, FEP code as recorded by the surveyors, and two fields allowing collection of additional information on species present and management type. The HLS option codes have subsequently been added to the GIS by determining the options within a polygon, through a process of inspection of the HLS agreement maps by eye. Any polygon can have up to 6 different options within it. The total area of the polygon was then assigned to each option not shared amongst them. This is in part because land may be managed under combinations of options and supplements, but also in some cases units might be divided between areas managed under more than one option. In addition, as agreement maps do not contain definitive information on the location of rotational arable options, these have not been included in any analysis.

In the baseline survey, a total of 9266 polygons (including those where no option was known) were mapped, comprising 5838 in 2009, 2293 in 2010 and 1037 in 2011. These totals represented survey coverage of 7000 ha in 2009, 8100 ha in 2010 and 1510 ha in 2011. The following tables aggregate data from all three years. Much of the land (58%) was considered to be non-priority habitat. Thirty separate Priority Habitats were identified but most of these were found in very small amounts. The exception was Upland Heathland, which was found in 20% of all the land surveyed. No other habitat accounted for more than 2.5% of the area surveyed.

Three Priority Habitats are based on their landscape setting rather than the vegetation that is found on the ground. The surveyors were instructed to record the habitats based on vegetation. As a result a *post-hoc* reassessment of habitats that could be Coastal Floodplain and Grazing Marsh (**HK9, HK10, HK11, HK12, HK13** and **HK14**), Traditional Orchards (**HC18, HC19** and **HC20**) or Wood Pasture and Parkland (**HC12, HC13** and **HC14**) was carried out by assessing Ordnance Survey maps and surveyed FEP codes. Polygons were reassigned as these Priority Habitats if the landscape features met the criteria in the HAP definitions.

The spatial data collected in the field can be used to understand the nature and quality of habitats under management in each of the options surveyed. In particular, it can tell us about the effectiveness of targeting at option level; for instance, whether agreements are targeting appropriate habitats, and whether maintenance and restoration options are being used effectively. The analyses in this chapter provide feedback on the proportion of HLS options addressing Priority Habitats as mapped by the surveyors.

Some comparisons have also been made between the habitats mapped by the surveyors and habitats mapped by Land Cover Map 2007, which for the first time has provided national information on land cover at a field-parcel scale. The dominant LCM broad habitat for each polygon was also added to the GIS layer created by the surveyors.

The results presented here are from the Baseline (**Module 1**) survey only and do not include the NCA or Ecosystem Services surveys (**Modules 2** and **3**).

Degree of Intervention

The design of HLS is such that Priority Habitats in good condition (condition A, *per* the FEP system) should be placed into options for the maintenance of high-value features, whilst Priority Habitat not in good condition (condition B and C, *per* the FEP system) or non-Priority Habitat, with high potential for restoration or creation, should be placed into options for the restoration or creation of high value features. To investigate this further, the options found in the surveyed sample have been divided into five classes for analysis of the habitats surveyed: Maintenance; Restoration; Creation; Supplements; and Priority Habitats not relevant or measurable. The Arable options were added to this last category because they were both difficult to measure and are ephemeral in nature. It should be remembered that all following statements concerning the proportions of Maintenance, Restoration and Creation options do **not** include the Arable options.

It would be expected that a high proportion of maintenance options would be classified as Priority Habitat. Indeed, 67% of the land under maintenance options was identified as Priority Habitat, whereas under restoration options 47% was identified as Priority Habitat. A much lower proportion (15%) of land under habitat creation options was identified as Priority Habitat.

Occurrence of FEP features in particular HLS options

There should be a clear association between the HLS options implemented and the FEP features present on the ground. This relationship is fundamental to the choice of option and to the targeting of agri-environmental management. Comparisons were therefore made between the HLS option applied and the FEP feature codes allocated during the habitat mapping that formed a central part of the baseline survey. These comparisons focussed especially on options for grassland, upland and lowland heathland, and the results are presented in Tables 4.1-4.3. In these tables, the total area surveyed under each option is subdivided into areas mapped by the survey as specific FEP habitat features. Numerous FEP codes were recorded during the baseline survey but where a particular habitat feature occupies less than 1.5% of the total area under that option, the FEP habitat feature is not itemised but instead included in a general category “Other FEP codes”.

Table 4.1 presents the results for grassland options and supplements. The most extensively surveyed options were those for the maintenance and restoration of species-rich, semi-natural grassland (**HK6** and **HK7** respectively) and management and restoration of grassland for target features (**HK15** and **HK16** respectively). On land being managed under **HK6** for maintenance of species-rich, semi-natural grassland just over 50% of the area was mapped as a BAP grassland type *i.e.* the main target features for this option. A further 22% was classified as semi-improved grassland and 2.5% as improved grassland. Most of the remaining area was mapped as a range of non-grassland habitats and generally represented small areas of woody, wetland and tall herb vegetation present within the same parcel as the target grassland. The results for **HK7** are broadly similar but, as would be expected for this restoration management, the area under BAP grassland types is slightly lower (37%) and that under semi-improved grassland correspondingly greater (42%).

Table 4.1: FEP Codes recorded during the baseline survey of HLS Grassland options

	Total Area (ha)	G01 Improved grassland	G02 Semi-improved grassland	G04 Lowland Calcareous Grassland	G05 Lowland Dry Acid Grassland	G06 Lowland Meadows	G07 Purple Moor Grass and Rush Pastures	G08 Upland Calcareous Grassland	M01 Grass moorland and rough grazing	M04 Upland Heathland	W04 Fens	Other FEP codes
HK2 - Permanent grassland with low inputs	29	14	13								1	1
HK3 - Permanent grassland with very low inputs	97	57	20									20
HK6 - Maintenance of species-rich, semi-natural grassland	578	15	127	122	123	45	1	2	12	0	3	129
HK7 - Restoration of species-rich, semi-natural grassland	648	26	270	158	20	34	23	7	0		16	95
HK8 - Creation of species-rich, semi-natural grassland	20		3	10								7
HK9 - Maintenance of wet grassland for breeding waders	103	38	18			9	9				20	9
HK10 - Maintenance of wet grassland for wintering waders and wildfowl	56	42	3				2				1	8
HK11 - Restoration of wet grassland for breeding waders	49	29	14			1					3	1
HK13 - Creation of wet grassland for breeding waders	10		10									0
HK14 - Creation of wet grassland for wintering waders and wildfowl	2		2									1
HK15 - Maintenance of grassland for target features	793	113	221		11	0		0	63	292	9	85
HK16 - Restoration of grassland for target features	476	41	43	127		6	6	183	10		0	60
HK17 - Creation of grassland for target features	46		5			28						12
HK18 - Hay making supplement	128	9	72	1		6			17		11	12
HK19 - Raised water levels supplement	27	13	1				11					2
Total Area (ha)	3063	398	822	418	153	130	52	191	103	292	65	442
% of Total Area		13	27	14	5	4	2	6	3	10	2	14

The **HK15** and **HK16** options might be expected to have lower proportions of Priority Habitat as the range of target features eligible for management under these options do not all require management of Priority Habitat. However, analysis of the **HK15** option (maintenance of grassland for target features) revealed that a considerable proportion (37%) was actually upland heathland, with most of the remaining area either improved (14%) or semi-improved grassland (28%). The analysis of land under option **HK16** providing for restoration of grassland for target features showed a strong association with calcareous grassland, both lowland (27% of the option area) and upland (38.5%), suggesting that this option is being employed to manage species linked to such grasslands.

Amongst the less extensively used grassland options, the ELS "more of the same" options **HK2** and **HK3** can be used in HLS where their application provides support to HLS objectives, and are appropriate on improved and semi-improved swards where reduction of inputs might bring such benefits. 20 ha of **HK3** were mapped under less frequent FEP features including 4.0 ha of H01 below-ground historic features, 10.0 ha of T03 wood pasture and parkland and 3.0 ha under various woodland and tall-herb habitats.

The majority of the area under options used to provide habitat for wet grassland birds (*i.e.* **HK10, HK11, HK13** and **HK14**) was applied to grasslands that were either improved or semi-improved. In these cases, sward structure for feeding and nesting is often more important than botanical composition. Very little land under grassland options was mapped as arable, although that might have been expected where ley grassland was present. In total only 23 ha of land was mapped as A01 within the fifteen grassland options and supplements.

Table 4.2 provides a corresponding summary for **HL** options *i.e.* those targeted at areas of moorland and upland rough grazing. The most extensively applied options within this group are those intended to maintain or restore moorland habitats to benefit upland wildlife (**HL9** and **HL10**). Most land under **HL9** providing for maintenance of moorland (79.4%) was mapped as upland heathland during the baseline survey and much of the remaining 20.6% was allocated to other associated habitats *i.e.* M01 grass moorland and rough grazing, M02 fragmented heath, M06 blanket bog and M08 upland flushes *etc*. The only non-moorland habitats mapped at all frequently within **HL9** parcels were native semi-natural woodland (4.6%) and bracken (3.6%), both of which are appropriate elements of the natural upland habitat mosaic. For land being managed to restore moorland (**HL10**), the habitats present were more mixed with only 18% assessed as upland heathland and 30% as grass moorland and rough grazing. Blanket bog appeared far more extensive under **HL10** than under **HL9,** and this may reflect regional and local targets to restore degraded blanket bog (and other habitats on deep peat soils) to reduce carbon losses. The creation of upland heathland (**HL11**) was being attempted overwhelmingly on land mapped as M01 grass moorland and rough grazing.

Options for the maintenance and restoration of rough grazing for birds (**HL7** and **HL8**) were clearly associated with M01 grass moorland and rough grazing and with improved and semi-improved grassland. It was notable that the proportion of M01 grass moorland and rough grazing was higher under the restoration option (**HL8**) than that for maintenance (**HL7**), for which 29% was mapped as improved or semi-improved grassland. Bracken covered 13% of the land area under **HL7**. As with its lowland equivalent **HK3**, the option for permanent grassland with very low inputs in the uplands (**HL3**) was almost entirely applied to improved and semi-improved swards. Unenclosed moorland rough grazing (option **HL6**) was only assessed over 32 ha but, of this, almost 60% was under bracken.

Table 4.2: FEP Codes recorded during the baseline survey of HLS Upland options

		G01	G02	G08	M01	M02	M04	M06	M08	T08	V02	
	Total Area (ha)	Improved grassland	Semi-improved grassland	Upland Calcareous Grassland	Grass moorland and rough grazing	Fragmented heath	Upland Heathland	Blanket Bog	Upland Flushes, Fens and Swamps	Native semi-natural woodland	Bracken	Other FEP codes
HL2 - Permanent grassland with low inputs	5	3										2
HL3 - Permanent grassland with very low inputs	36	13	16		5					1	0	1
HL5 - Enclosed rough grazing	12				1		7			3	0	1
HL6 - Unenclosed moorland rough grazing	32				12		0		0		19	0
HL7 - Maintenance of rough grazing for birds	340	60	38	1	175			9	9	0	44	4
HL8 - Restoration of upland grazing for birds	216	3	55		150			1	5			2
HL9 - Maintenance of moorland	2527	2	20		58	12	2007	75	104	115	90	42
HL10 - Restoration of moorland	4091	3	26	157	1226	229	743	1159	178	22	295	55
HL11 - Creation of upland heathland	271	3	5		206			9	6		43	0
Total Area (ha)	7530	88	161	157	1832	241	2757	1254	302	141	491	106
% of Total Area		1	2	2	24	3	37	17	4	2	7	1

The final option group studied in this way was **HO** (see Table 4.3) for management of heathlands, where FEP habitat feature M03 lowland heathland was the key target. In the maintenance option **HO1**, 61% of the area was mapped as BAP lowland heath, with a further important component of BAP lowland dry acid grassland. Small areas of non-native plantation and landmark woodland were also present within the heaths surveyed, whilst the significant figure for arable (39 ha – 12.6% of the total) was derived from a single agreement in the Breckland where fallow land is provided within the heath matrix. For the restoration of lowland heath option (**HO2**), only 50% of the area was mapped as heath and much of the remainder reflected a history of neglect, being mapped as various scrub and woodland types. Just 16 ha of land under **HO3** (restoration of forestry areas to lowland heath) was included within the baseline survey, most of which at this very early stage in the agreements remained mapped as non-native plantation or other woodland types. An even smaller area of **HO4** heath creation was assessed, which had similarly not yet developed into a habitat recognisable as heath.

Table 4.3: FEP Codes recorded during the baseline survey of HLS Lowland Heathland options

	Total Area (ha)	A01 Arable	G05 Lowland Dry Acid Grassland	M03 Lowland Heath	T05 Non-native plantation	T07 Landmark woodland	T08 Native semi-natural woodland	V04 Scrub	Other FEP codes
HO1 - Maintenance of lowland heathland	309	39	42	189	10	12	3	4	9
HO2 - Restoration of lowland heathland on neglected sites	147		11	73	5		15	14	27
HO3 - Restoration of forestry areas to lowland heathland	16		1		12		2	1	1
HO4 - Creation of lowland heathland from arable or improved grassland	4			0				1	3
Total Area (ha)	476	39	54	263	28	12	20	20	37
% of Total Area		8	11	55	6	3	4	4	7

Occurrence of Priority Habitats under HLS Option Groups

The following eleven sections explore the results of the mapping component of the baseline survey in confirming the presence of the Priority Habitats that are a central target of HLS. The description is broken down by HLS option group, beginning with **HC** for woodland and scrub and proceeding systematically to HR for **HLS** supplements. The summaries state the area surveyed under each option, followed by the proportions (%) either allocated to each and any Priority Habitat or to no such habitat at all.

1) Woodland Trees and Scrub

Most of the options in this category were represented in the sample to some extent with the exceptions of **HC5** and **HC6.** In total 576 ha were surveyed that were attributed to one of the **HC** options using the HLS agreement maps. 40% of the land in the **HC** options was designated as priority habitat by the surveyors (Table 4.4) with 15 different priority habitats identified.

2) Historic Environment

There were examples of eight of the nine options related to the historic environment within the sample, but no examples of **HD11** (Restoration of traditional water meadows). In total 308 hectares were surveyed that could be attributed to one of the **HD** options from the HLS agreement maps. Only 1% of the area of **HD** options was mapped as Priority Habitat by the surveyors. Such a low percentage is not surprising as these options are not targeted at high value habitats and when such historic features are present under high value habitats, there should be sufficient flexibility within the core option to manage them effectively. The only Priority Habitats mapped were very small areas of Lowland Calcareous Grassland, Lowland Fen and Arable Field Margins (Table 4.5).

Table 4.4: Percentage of the area of each of the Woodland Trees and Scrub Options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Lowland Mixed Deciduous Woodland	Traditional Orchards	Upland Birchwoods	Upland Calcareous Grassland	Upland Heathland	Upland Mixed Ashwoods	Upland Oakwood	Wet Woodland	Wood Pasture and Parkland	No Priority Habitat
HC7 - Maintenance of woodland	103	5				16		1	41		47
HC8 - Restoration of woodland	176	8		1	1		1	6	4		74
HC9 - Creation of woodland in SDA of the LFA	53					3					97
HC10 - Creation of woodland outside the LFA SDA and the Moorland Line	2	32							15		53
HC12 - Maintenance of wood pasture and parkland	12						1			62	37
HC13 - Restoration of wood pasture and parkland	60	18								34	48
HC14 - Creation of wood pasture	3										100
HC15 - Maintenance of successional areas and scrub	45								51		49
HC16 - Restoration of successional areas and scrub	51			8	6		1		4		82
HC17 - Creation of successional areas and scrub	7										100
HC18 - Maintenance of high value traditional orchards	4		100								0
HC19 - Restoration of traditional orchards	5		100								0
HC20 - Maintenance of traditional orchards in production	9		94								7
HC21 - Creation of traditional orchards	5										100
Total Area (ha)	576										
% of Total Area		5	3	1	1	1	0	2	13	5	59

Table 4.5: The percentage of the area of each of the Historic Environment Options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Lowland Calcareous Grassland	Lowland Fen	Arable Field Margins	Ponds	No Priority Habitat
HD2 - Take out of cultivation	38					100
HD3 - Non-inversion cultivation	104			2		98
HD6 - Crop establishment by direct drilling	26					100
HD7 - Arable reversion by natural regeneration	8					100
HD4 - Management of scrub on archaeological features	3					100
HD5 - Management of archaeological features on grassland	127	0	0		0	99
HD9 - Maintenance of designed/ engineered waterbodies	2					100
HD10 - Maintenance of traditional water meadows	2					100
Total Area (ha)	310					

Table 4.6: The percentage of the area of each of the Arable Options (**HE**) of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Arable Field Margins	Blanket Bog	Lowland Calcareous Grassland	Lowland Fens	Ponds	Wet Woodland	No Priority Habitat
HE1 - 2m buffer strips	45	5				0		95
HE2 - 4m buffer strips	221	5	1					95
HE3 - 6m buffer strips	370	6			0	0	0	94
HE10 - Floristically enhanced grass margin (non-rotational)	198	4				0	0	96
HE5 - 4m buffer strips on intensive grassland	7			0				100
HE6 - 6m buffer strips on intensive grassland	13							100
Total Area (ha)	853							
% of Total Area		5	0	0	0	0	0	95

3) Arable

In total 853 ha of surveyed **HE** options and 764 ha of **HF** options were identified from HLS agreement maps in the sample. The sample of mapped agreements included three HLS options (**HE10, HF12NR** and **HF20NR**) that contained priority habitat. In addition nine ELS "more of the same" options were included within the HLS agreements surveyed (**HE1, HE2, HE3, HE5, HE6, HF1, HF4, HF7** and **HF11**). Only 5% of **HE** options and also **HF** options were designated as Priority Habitat by the surveyors and no habitat apart from Arable Field Margins covered more than 1% of the land (Tables 4.6 and 4.7). It should be noted that it was not possible to assess rotational options such as **HF13, HF14** and **HF15** within this analysis, as they are not included on agreement maps.

4) Resource Protection

There were examples of four of the resource protection options in the sample (**HJ3, HJ4, HJ5** and **HJ6**) but there were no examples of **HJ7** or **HJ8**. In total 161 ha were surveyed that were attributed to **HJ** options on HLS agreement maps. The surveyors identified 31% of the **HJ** area as Priority Habitat (Table 4.8), nearly all (29%) of which was Coastal Floodplain and Grazing Marsh being managed under option **HJ6** (Preventing erosion or run-off from intensively managed improved grassland).

5) Grassland

There were examples of all the core HLS grassland (**HK**) options in the survey with only **HK4** of the ELS ("more of the same") options not surveyed. In total 3105 ha were surveyed that could be attributed to **HK** options on HLS agreement maps. The surveyors mapped 52% of the land surveyed as Priority Habitat, with 16 separate habitats being identified (Table 4.9). When core HLS options for maintenance (**HK6, HK9, HK10** and **HK15**), restoration (**HK7, HK11, HK12** and **HK16**) and creation (**HK8, HK13, HK14** and **HK17**) are looked at separately, the area of surveyed land falls to 2814 ha. Of this, the maintenance options account for 54%, the restoration options 43% and the creation options 3%.

Options **HK6, HK7** and **HK8** (for species-rich semi-natural grassland) are clearly the most relevant for managing species-rich grassland Priority Habitats. These three options had a surveyed area of 579 ha, 664 ha and 20 ha respectively (Table 4.9). The maintenance option (**HK6**) was comprised of 69% of land mapped as Priority Habitats and 31% of non-Priority Habitat. The restoration option **HK7** was comprised of 43% Priority Habitats and 57% of non-Priority Habitat whereas the creation option **HK8** comprised 85% priority habitats and 15% non-priority habitat.

When a comparison is made between the total areas of grassland option on the agreements surveyed and the Broad Habitats mapped on these areas in Land Cover Map 2007, 39% of the land is identified as Improved Grassland and a further 23% as Arable and Horticulture (Table 4.10). Acid Grassland (9%), Calcareous Grassland (4%), Neutral Grassland (2%) and Rough Low Productivity Grassland (8%) make up another 23%. A large part of the remainder (7%) was identified by Land Cover Map 2007 as Dwarf Shrub Heath and this was almost all under the **HK15** option (Maintenance of grassland for target features).

Much of the land identified as Arable and Horticulture is under restoration or creation options but there are quite large areas under options where grassland should already exist (**HK2, HK3, HK5, HK6, HK9, HK15** and **HK18**). It is likely that these differences are a result of misclassification within the production of LCM2007.

Table 4.7: The percentage of the area of each of the Arable Options (**HF**) of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Arable Field Margins	Blanket Bog	Lowland Calcareous Grassland	Lowland Fen	Ponds	Wet Woodland	No Priority Habitat
HF1 - Management of field corners	172	5			0	0	0	95
HF4 - Nectar flower mixture	96	5				0		95
HF7 - Beetle banks	64	6					1	93
HF11 - Uncropped, cultivated margins for rare plants on arable land	7							100
HF12 - Non-rotational wild bird seed mix plots	398	5	0	0			0	95
HF20 - Non-rotational cultivated fallow plots or margins for arable plants	26	8						92
Total Area (ha)	764							
% of Total Area		5	0	0	0	0	0	95

Table 4.8: Percentage of the area of each of the Resource Protection Options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Coastal Floodplain and Grazing Marsh	Lowland Fen	Lowland Mixed Deciduous Woodland	Ponds	Wet Woodland	No Priority Habitat
HJ3 - Arable reversion to unfertilised grassland to prevent erosion or run-off	32	0	0	0	0	0	100
HJ4 - Arable reversion to grassland with low fertiliser input to prevent erosion or run-off	19	0	0	1	0	0	99
HJ5 - In-field grass areas to prevent erosion or run-off	42	0	0	0	0	0	100
HJ6 - Preventing erosion or run-off from intensively managed, improved grassland	68	69	3	0	1	1	26
Total Area (ha)	161						
% of Total Area		29	1	0	0	1	69

Table 4.9: The percentage of the area of each of the Grassland Options of HLS that were identified as Priority Habitat by surveyors (Note: **HK3** has 10% cover of Wood Pasture and Parkland, and **HK11** has 5% Reedbed not shown in this table)

	Total Area (ha)	Arable Field Margins	Coastal and Floodplain Grazing Marsh	Inland Rock Outcrop and Scree	Lowland Calcareous Grassland	Lowland Dry Acid Grassland	Lowland Fen	Lowland Meadows	Lowland Mixed Deciduous Woodland	Ponds	Purple Moor Grass and Rush Pastures	Upland Calcareous Grassland	Upland Hay Meadows	Upland Heathland	Wet Woodland	No Priority Habitat
HK2 - Permanent grassland with low inputs	29															100
HK3 - Permanent grassland with very low inputs	97		0								0					89
HK6 - Maintenance of species-rich, semi-natural grassland	579	0	5		20	21	1	9	0	0	0	1	2		1	31
HK7 - Restoration of species-rich, semi-natural grassland	664	0	1		23	3	2	3	1	0	4	1	1		1	57
HK8 - Creation of species-rich, semi-natural grassland	20	12			51			20							2	15
HK9 - Maintenance of wet grassland for breeding waders	104		29				19	8		1	9				0	36
HK10 - Maintenance of wet grassland for wintering waders and wildfowl	56		75				2				4					19
HK11 - Restoration of wet grassland for breeding waders	52		59				7	3								26
HK12 - Restoration of wet grassland for wintering waders and wildfowl	5															100
HK13 - Creation of wet grassland for breeding waders	10															100
HK14 - Creation of wet grassland for wintering waders and wildfowl	2	30														70
HK15 - Maintenance of grassland for target features	795		5			1	1	0	0	0		0		35	0	54
HK16 - Restoration of grassland for target features	481	0		2	25		0	1	0		1	38	1		1	31
HK17 - Creation of grassland for target features	46				0		0	48								52
HK18 - Hay making supplement	138				1		8	4				0	7		0	79
HK19 - Raised water levels supplement	27										40					60
Total Area (ha)	3105	5	156	28	161	80	164	149	33		30	21	12	57	35	2127
% of Total Area		0	5	0	13	5	2	4	0	0	2	6	1	9	1	48

Table 4.10: The percentage of Grassland Options surveyed related to the *Land Cover Map 2007*

	HK1	HK2	HK3	HK5	HK6	HK7	HK8	HK9	HK10	HK11	HK12	HK13	HK14	HK15	HK16	HK17	HK18	HK19	Total
Acid Grassland		8		0	4	1								17	19		12		**9**
Arable and Horticulture		1	58	58	13	28	0	32	59	28	100	100	100	20	5	71	11	56	**23**
Broadleaved Mixed and Yew Woodland		9	0	7	5	5								3	6	11	5		**4**
Calcareous Grassland					0	2									25		1		**4**
Coniferous Woodland		0	0	0	1	1	2										1		**0**
Dwarf Shrub Heath			2	0	3	2								21	3		7		**7**
Freshwater					3	1	5			3				0	3		5		**1**
Improved Grassland	100	65	39	28	63	50	71	51	25	16				19	32	5	54	44	**39**
Littoral Sediment				5					13	12				1					**1**
Neutral Grassland			1		2	2	2	10						2	1		4		**2**
Rough Low Productivity Grassland		16	0	1	7	6		7	3	41				16	6	13	1		**8**
Total Area (ha)	**0**	**31**	**97**	**119**	**567**	**650**	**20**	**104**	**56**	**52**	**5**	**10**	**2**	**795**	**481**	**46**	**138**	**27**	**3211**

Table 4.11: The percentage of Moorland and Upland Grazing Options surveyed related to the *Land Cover Map 2007*

	HL2	HL3	HL5	HL6	HL7	HL8	HL9	HL10	HL11	Total
Acid Grassland		8	7	52	33	31	5	31	50	**23**
Arable and horticulture	41	12			0	1	1	0		**0**
Bog						5	17	22	11	**19**
Broadleaved Mixed and Yew Woodland		1			2		1	3		**2**
Calcareous Grassland								1		**0**
Coniferous woodland	32				4		2	0		**1**
Dwarf shrub heath	28	14	93	48	36	37	70	34	39	**46**
Freshwater						2				**0**
Improved Grassland		63			25	21	4	2		**4**
Inland Rock		2						0		**0**
Montane Habitats								7		**4**
Rough Low Productivity Grassland		1			0	3	0	1	0	**0**
Total Area (ha)	**5**	**36**	**12**	**32**	**340**	**216**	**2527**	**4091**	**271**	**7525**

Table 4.12: The percentage of the area of each of the moorland and Upland Grazing Options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Blanket Bog	Calaminarian Grassland	Inland Rock Outcrop and Scree	Limestone Pavements	Lowland Fen	Lowland Heathland	Lowland Meadows	Lowland Mixed Deciduous Woodland	Ponds	Purple Moor Grass and Rush Pastures	Upland Birchwoods	Upland Calcareous Grassland	Upland Flushes Fens and Swamps	Upland Heathland	Upland Oakwoods	Wet Woodland	No Priority Habitat
HL2 - Permanent grassland with low inputs	5						0	0	0	0							0	100
HL3 - Permanent grassland with very low inputs	36					1	0	0	0	0							0	99
HL5 - Enclosed rough grazing	12						0	0	0	0					59		0	41
HL6 - Unenclosed moorland rough grazing	32						0	0	0	0				1	1		0	98
HL7 - Maintenance of rough grazing for birds	340	3					0	0	0	0		0	0	4			0	93
HL8 - Restoration of upland grazing for birds	216						0	0	0	0				4			0	96
HL9 - Maintenance of moorland	2524	2		0			0	0	0	0		0		5	81	4	0	8
HL10 - Restoration of moorland	4091	9	0	0	0		0	0	0	0	0		4	5	28	0	0	53
HL11 - Creation of upland heathland	271	3					0	0	0	0				3			0	93
Total Area (ha)	7527																	
% of Total Area		6	0	0	0	0	0	0	0	0	0	0	2	5	42	0	0	43

Table 4.13: Comparison of the relationship between the *Land Cover Map* categories in the area surveyed and the Priority Habitats identified by surveyors for the Moorland and Upland Grazing Options - Approach 1: ***Figures are the percentage of the LCM category attributed by surveyors to a particular Priority Habitat***

	Acid Grassland	**Arable and Horticulture**	**Bog**	**Broadleaved Mixed and Yew Woodland**	**Calcareous Grassland**	**Coniferous Woodland**	**Dwarf Shrub Heath**	**Freshwater**	**Improved Grassland**	**Inland Rock**	**Montane Habitats**	**Rough non Productive Grassland**	**Total % surveyed**
Blanket Bog	3		2				4				74		**6**
Inland Rock Outcrops & Screes										26			**0**
Limestone Pavements	1									37			**0**
No Priority Habitat	72	99	37	40		37	30	100	70	28	23	66	**43**
Upland Birchwoods				4									**0**
Upland Calcareous Grassland	8				99						3		**2**
Upland Flushes Fens and Swamps	4		7			1	5		11			1	**5**
Upland Heathland	12	1	53	52		62	58		18	9		29	**42**
Upland Oakwood				1			3					1	**1**
Total area (ha)	**1726**	**35**	**1398**	**149**	**24**	**66**	**3491**	**4**	**322**	**3**	**278**	**35**	**7530**

Table 4.14: Comparison of the relationship between the Priority Habitats identified by surveyors and the *Land Cover Map* for the Moorland and Upland Grazing Options - Approach 2: ***Figures are the percentage of each Priority Habitat as identified by the surveyors in a particular Land Cover Map category***

	Acid Grassland	**Arable and Horticulture**	**Bog**	**Broadleaved Mixed and Yew Woodland**	**Calcareous Grassland**	**Coniferous Woodland**	**Dwarf Shrub Heath**	**Freshwater**	**Improved Grassland**	**Inland Rock**	**Montane Habitats**	**Rough non Productive Grassland**	**Total Area Identified**
Blanket Bog	12		8				31				49		**418**
Inland Rock Outcrops and Screes	15		5				65			15			**4**
Limestone Pavements	78				1		16			6			**17**
Lowland Mixed Deciduous Woodland				100									**3**
No Priority Habitat	39	1	16	2		1	32		7		2	1	**3241**
Upland Birchwoods	4			87			7					2	**7**
Upland Calcareous Grassland	78		2		13		2				5		**178**
Upland Flushes Fens and Swamps	16		26				48		10				**370**
Upland Heathland	7		23	2		1	64		2				**3183**
Upland Oakwood				1			99						**101**
Wet Woodland	2			19			28					51	**2**

6) Moorland and Upland Grazing

There were examples of all the HLS moorland and upland rough grazing options in the sample of mapped agreements where options could be assigned from the digitised agreement maps. Of the ELS ("more of the same") options included in HLS agreements, two, **HL1** (Take Field corners out of management) and **HL4** (Management of rush pastures), were not found in the sample. In total 7527 ha were surveyed that could be attributed to moorland and upland rough grazing options. Priority Habitat was mapped by the surveyors on 57% of the land and 43% of this was Upland Heathland (Table 4.12).

Much of the non-Priority Habitat surveyed was identified as the Acid Grassland Broad Habitat. This is supported by the comparison with LCM2007 data (Table 4.11). Using LCM2007, Acid Grassland was identified on 23% of the area surveyed and Rough Low Productivity Grassland (mostly acid grassland) on less than 1%. There is, however, a significant discrepancy between the areas identified as Blanket Bog by the surveyors (6%) and that identified by LCM (19%). This is investigated further below.

A comparison between the assignment of habitats by LCM2007 and by the surveyors can be undertaken for each polygon. This can be done in two ways: the percentage of each LCM2007 category assigned to a particular Priority Habitat by surveyors (Table 4.13); and the percentage of the Priority Habitats assigned by the surveyors in each of the LCM 2007 categories (Table 4.14). Most of the LCM2007 categories have a narrow range of Priority Habitats associated with them and nearly all of them are logical (Table 4.13). The major exception is Bog where the surveyors largely identified those polygons as Upland Heathland (53%) and No Priority Habitat (37%). Conversely, the areas mapped as Blanket Bog by the surveyors are not identified by LCM as Bog but as Upland Heathland and Montane Habitats (Table 4.14). The other Priority Habitats seem to be in logical LCM2007 categories, although the allocation of Upland Calcareous Grassland, mapped by surveyors to Acid Grassland in LCM2007, looks like a classification error.

7) Access

Only three of the Access options (**HN2, HN3** and **HN4**) under HLS were represented in the sample. In total 594 ha that could be assigned to access options from the HLS agreement maps in the sample were surveyed. Of this area 75% was considered not to be Priority Habitat, 12% was on Lowland Calcareous Grassland and 6% on Upland Heathland with nine other Priority habitats being represented in small amounts (Table 4.15).

8) Lowland Heathland

Four of the five Lowland Heathland options were assigned to land surveyed based on the digitised agreement maps. There were no examples of **HO5** (creation of lowland heathland on worked mineral sites. Of the total of 476 ha that were assigned to lowland heath options 55% was mapped as the Priority habitat Lowland Heathland, 11% as Lowland Dry Acid Grassland and most of the rest was not priority habitat (Table 4.16). It is worth noting that option **HO1** for maintenance of lowland heathland provides an appropriate framework for managing Lowland Dry Acid Grassland.

9) Inter-tidal and Coastal

Only a small area (58 ha) surveyed was assigned to inter-tidal and coastal options from the HLS agreement maps (Table 4.17).

Table 4.15: The percentage of the area of each of the Access options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Arable Field Margins	Lowland Calcareous Grassland	Lowland Fen	Lowland Meadows	Reedbeds	Traditional Orchards	Upland Heathland	Upland Mixed Ash Woodland	Wet Woodland	Wood Pasture and Parkland	No Priority Habitat
HN2 - Permissive open access	275	0	25					12		1	1	56
HN3 - permissive footpath access	175	1		1	3	1			2	2	2	88
HN4 - permissive bridleway/cycle path access	144	3					3			0		94
Total Area (ha)	594											
% of Total Area		1	12	0	1	0	1	6	1	1	1	75

Table 4.16: The percentage of the area of each of the Lowland Heathland options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Lowland Dry Acid Grassland	Lowland Fen	Lowland Heathland	Lowland Mixed Deciduous Woodland	Ponds	Wet Woodland	No Priority Habitat
HO1 - Maintenance of lowland heathland	309	14	0	61				25
HO2 - Restoration of lowland heathland on neglected sites	147	9	4	32	1	0	0	54
HO3 - Restoration of forestry areas to lowland heathland	16	4						96
HO4 - Creation of lowland heathland from arable or improved grassland	4			5		8		87
Total Area (ha)	476							
% of Total Area		11	1	55	0	0	2	30

Table 4.17: Percentage of the area of each of the Inter-tidal & Coastal options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Coastal Floodplain and Grazing Marsh	Coastal Saltmarshes	Coastal Sand Dunes	No Priority Habitat
HP2 - restoration of sand dunes	41	0	0	100	0
HP5 - Maintenance of coastal saltmarsh	12	0	73	0	27
HP8 - Cration of inter-tidal and saline habitat on grassland	5	0	0	0	100
Total Area (ha)	58				
% of Total Area		0	15	71	14

Table 4.18: The percentage of the area of each of the Wetland options of HLS that were identified as Priority Habitat by surveyors

	Total Area (ha)	Coastal Floodplain and Grazing Marsh	Lowland Dry Acid Grassland	Lowland Fen	Lowland Heathland	Lowland Meadows	Ponds	Purple Moor Grass and Rush Pastures	Reedbeds	Upland Flushes Fens and Swamps	Upland Heathland	Wet Woodland	No Priority Habitat
HQ1 - Maintenance of ponds of high wildlife value (less than $100m^2$)	208				1		0				67		32
HQ2 - Maintenance of ponds of high wildlife value (greater than $100m^2$)	3	0				0	76						24
HQ3 - Maintenance of reedbeds	47			0					90			4	6
HQ4 - Restoration of reedbeds	7			5			19		73			1	2
HQ5 - Creation of reedbeds	0												100
HQ6 - Maintenance of fen	12	2		35	2		1	1	6			32	21
HQ7 - Restoration of fen	59	1	6	16	0		3	1	3	0		61	10
HQ8 - Creation of fen	1												100
HQ10 - Restoration of lowland raised bog	21						2						98
Total Area (ha)	359												
% of Total Area		0	1	4	1	2	2	0	14	0	39	12	28

10) Wetland

Wetland options comprise a set of options for managing high-value ponds and maintenance and restoration of fens, reedbeds and lowland raised bog *i.e.* a diverse set of habitats. Eleven of the twelve Wetland options were surveyed in the sample, with the area totalling 458 ha (Table 4.18). There were no examples of **HQ9** (maintenance of lowland raised bog). A higher proportion of Wetland options was identified as Priority Habitat than for most other suites of options, with 30% of this being mapped as Upland Heathland.

Summary

The mapping of habitats by surveyors on the ground in 174 agreements (as FEP features and as Broad or Priority Habitats) has enabled us to explore the relationship between the management options used and the features to which they have been applied.

A comparison between the options used and the FEP habitat features mapped by the survey provides insight into the effectiveness of HLS option choice, especially with regard to the features stated as benefitting from management prescriptions. This analysis provided some interesting messages. For instance, whilst over half the land under **HK6** for maintenance of species-rich semi-natural grassland was mapped using codes corresponding to BAP quality grassland types, which would be appropriate, a significant proportion was mapped as semi-improved, improved or other habitats. In contrast, the equivalent restoration option (**HK7**) addressed both BAP grasslands and semi-improved swards, which would not be inappropriate, although in the case of the latter should be supported by evidence that the restoration potential has been taken into account. This latter factor could not be considered here but would be addressed via the appraisal process described in Chapter 5.

Options for management of target features on grassland can be associated with a range of habitats depending on the feature targeted. The analysis found an association with improved/semi-improved grassland (**HK15** maintenance) and BAP calcareous grasslands (**HK16** restoration). These would be appropriate but it is less clear whether the association identified between **HK15** and upland heath represents use of an optimal management option for this feature. Options to reduce inputs or to encourage wet grassland birds are most often implemented on improved and semi-improved grasslands (often within BAP coastal and floodplain grazing marsh), and this would broadly be appropriate.

In the uplands, **HL9** moorland maintenance appeared to have been well targeted on BAP upland heath and related habitats, whilst restoration (**HL10**) also appeared to have been targeted appropriately at grass moorland and degraded blanket bog. The survey evidence for land being managed as rough grazing for birds also indicates that the options (**HL7** and **HL8**) have been targeted at appropriate habitats. The corresponding lowland heath habitats also demonstrate largely effective targeting with **HO1** maintenance mainly on BAP quality heath whilst **HO2** restoration has been properly located where heathland has been neglected and woody growth has spread. It is important to remember that this analysis addresses option-level targeting; in most cases, successful delivery of restoration options might require active restoration management, and the appropriateness of restoration management would be considered more closely in the appraisal process.

Overall, 67% of maintenance options were identified as Priority Habitat and this shows that high quality habitat has indeed been targeted by these options. It is likely that some of the remaining 33% is of relatively high quality but does not meet the rigorous definitions for Priority Habitats. The majority (60%) of land under woodland options was mapped by surveyors as non-priority habitat woodland, which would not be unexpected as most patches of woodland managed through HLS are relatively small in area. Patches of Wet Woodland and Lowland Mixed Deciduous Woodland were identified under HLS management and the HLS options should provide an effective framework for their conservation or restoration. It was encouraging that the comparison with polygons mapped in LCM2007, only found 19 ha of coniferous woodland under woodland options in the sample. It is possible that this may have been mixed woodland not detected by LCM2007.

It was difficult to assess the quality of land under arable management for various reasons. Many arable options apply to field margins, and the focus of the survey on new agreements meant management might not have been either implemented fully at the time, and consequently may not have been identified or mapped separately by the surveyors. Furthermore, many other options (stubbles, fallow plots, bird covers), including “whole-field” options, are rotational, and are not marked on agreement maps as they follow crop rotations around the cropped area.

The targeting of priority habitats by resource protection options is largely a consequence of the Coastal Floodplain and Grazing Marsh Priority Habitat being defined as a landscape type rather than on the basis of the vegetation communities present. Hence, improved grassland, as here, is found on Coastal and Floodplain Grazing Marsh and is appropriately managed under option **HJ6**, preventing erosion or run-off to the incorporated network of watercourses.

This project provided an opportunity to investigate the application of maintenance and restoration options on grassland, to determine whether the options were being applied correctly. The design of HLS is such that maintenance options should only be applied to grassland of existing high nature value and that grassland of lower nature value should be placed into restoration options on the basis of an assessment of restoration potential. A larger proportion (69%) of the Grassland maintenance option **HK6** was mapped as Priority Habitat which was considerably higher than the proportion (43%) of land identified as Priority Habitat on land under the restoration option **HK7**. The creation of grassland option **HK8** had 85% of land mapped as Priority Habitat, but this was entirely due to a single large polygon of Lowland Calcareous Grassland.

The analysis of Moorland and Upland grazing options identified an unforeseen issue concerning the identification and mapping of Blanket Bog and Upland Heathland. There was an almost total mismatch between the areas of these habitats mapped by surveyors in the field and those mapped for LCM2007. These habitats often occur in close proximity and in habitat mosaics together with grass moorland. Because of this these two habitats have been combined for the purpose of discussion as there is no way to tell which, if either, estimate of habitat distribution is more accurate. Taken together, much of the upland area is made up of Upland Heathland and Blanket Bog Priority Habitats and it is not surprising that the percentage of HLS options identified as priority habitat (54%) is quite high. Maintenance, restoration and creation options have the expected distribution of priority habitats. In land surveyed with **HL9** (maintenance of moorland) 86% was mapped as Upland Heathland or Blanket Bog and only 8% was non-priority habitat. The corresponding figures for land with **HL10** (restoration of moorland) were 37% of Upland Heathland or Blanket Bog and 53% non-priority habitat, and the proportions for land under **HL11** (creation of moorland) had 3% of land as Upland Heathland or Blanket Bog and 93% as non-priority habitat.

Access options are not targeted directly for their habitat quality, hence it is not surprising that the percentage of the area surveyed identified as priority habitat (12%) was low.

The area of Lowland Heath options surveyed was relatively small (476 ha, Table 4.16), but broadly reflected expected distributions of priority habitat between options. A high percentage (75%) of **HO1** (Maintenance of lowland heathland) was identified as priority habitat, with both Lowland Heathland and Lowland Dry Grassland represented, indicating successful targeting of the option. A similarly high percentage (69%) of **HO2** (restoration of lowland heath on neglected sites) was identified as priority habitat, suggesting that restoration targets should be achievable for these areas. Option **HO3** (restoration of forestry areas to lowland heath) showed only 5% to be existing priority habitat, but perhaps this is not at all unexpected in the immediate period following the destructive process of felling.

The very small area of Inter-tidal and Coastal Habitats surveyed (58 ha) make it very difficult to interpret the results in a meaningful way.

Some significant patterns were evident among options for wetlands (Table 4.18). Options for creation of reedbed (**HQ5**) and fen (**HQ8**) and restoration of lowland raised bog (**HQ10**) had no priority habitat associated with them as yet. However, options for the maintenance of large ponds

(**HQ2**), maintenance of reedbeds (**HQ3**) and restoration of reedbeds (**HQ4**) had high percentages of Priority Habitat (in this case reedbed).

5 Analysis of the quantitative data

The baseline survey of 174 HLS agreements produced four types of assessment. Firstly, FEP features under option management were subject to a standard condition assessment, and secondly the likelihood of meeting the desired outcomes of each option was estimated through a RAG assessment (see Chapter 3 of this report). The results of these assessments are described and discussed below (Section 5a). Thirdly, the vegetation quadrats recorded as part of the option assessment in the baseline survey were compared with vegetation data for the same broad habitat and within the same Land Classes drawn from Countryside Survey, in order to gauge how, if at all, HLS land differs from the wider countryside. This approach and its results are outlined in section 5b. Finally the whole agreement and its components were subject to a rigorous, though qualitative, assessment by a panel of experts on agri-environment schemes and conservation management. The methods employed to develop and deliver this panel approach are also described in Chapter 3, with a summary of the results given in Chapter 6.

5a Field assessments of feature condition and Indicators of Success

Individual options: species richness and vegetation structure

The baseline survey examined 103 different HLS options, recording vegetation quadrats and making assessments of feature condition, as well as assessing Indicators of Success (IoS). Table 5.1 provides a summary of the 11 options that occurred in at least 10 agreements that were surveyed and assessed.

Table 5.1: HLS options assessed during the baseline survey in 10 or more agreements (excluding supplements), recording the number of RLR parcels (or habitat features in the uplands) surveyed and the mean species-richness of the survey quadrats. Results are arranged by frequency of assessment. Note that where a parcel contains more than one HLS option, each of which has been assessed, it will contribute to the totals for all assessed options. The quadrat size also varied depending upon habitat (see Box 3.1)

HLS Option Code	Number of Agreements	Number of Surveys (RLR parcels *etc*)	Mean Species Richness
HK7	65	200	12.00
HK6	50	113	13.21
HK15	33	107	9.03
HL10	31	70	9.68
HC8	29	47	16.78
HC7	26	38	12.39
HK16	21	42	11.20
HK3	11	19	8.79
HE3	10	19	6.24
HQ7	10	17	11.26
HO2	10	30	10.10

The most frequently assessed options addressed grassland management, especially for species-rich, semi-natural grassland (**HK6** and **HK7**), though management for target features (**HK15** and **HK16**) was also common in the surveyed agreements. Options for maintenance and restoration of woodland (**HC7** and **HC8**) were widely practised within the HLS agreements included in the baseline survey, whilst the special foci of the 2010 and 2011 campaigns ensured that **HL10** restoration of moorland, **HO2** heath restoration (neglected sites) and **HQ7** fen restoration were well represented in the survey.

Table 5.2: HLS options and the community types from the *National Vegetation Classification* (*NVC*) to which quadrats and groups of quadrats were most frequently allocated in the baseline survey

HLS Option Code	*NVC* Community(s) most often recorded	Other *NVC* types frequently recorded
HC7	**W21** (especially **W21a**)	Other woodland (**W**)
HC8	**W21** (especially **W21a**)	Other woodland (**W**)
HC10	**MG7, MG10** and **MG11**	
HC15	**W21** (especially **W21a**)	Other woodland (**W**)
HC16	**W21** (especially **W21a**)	
HD5	**MG7a** and **MG10a**	
HE3	**MG1** (especially **MG1b**)	**MG7b**
HE10	**MG7** (especially **MG7b**)	**OV** types
HF1	Various **MG** and **OV** types	
HF12	Various **MG** and **OV** types	
HK3	**MG6**	**MG7**
HK5	**MG6** (especially **MG6b**)	**MG7b**
HK6	**MG6** (especially **MG6b**), **MG9**, **MG10a** and **U4b**	Various semi-natural **MG** and **CG** types
HK7	**MG6** (especially **MG6b**), **MG10a** and **MG7** (especially **MG7d**)	Wide range of **CG, M, MG** and **U** types
HK9	**MG11a**	**MG10a**
HK10	**MG10a**	Other **MG** types
HK11	Various **MG** types	
HK15	**MG6** (especially **MG6b**), **MG7** (especially **MG7a**), **MG10** (especially **MG10a**) & **MG11** (especially **MG11a**)	
HK16	**MG10a**	**MG6** and **MG7**
HK17	Various **MG** and **OV** types	
HL2	**MG6** and **MG7**	
HL3	**MG6**	
HL7	**MG6b**	**U4b**
HL8	Various **M, MG** and **U** types	
HL10	Various **H, M** and **U** types	
HL15	Various **H, M** and **U** types	
HN2	Mainly **MG** types	
HO1	**U1**	Various **H** types
HO2	Various **H** and **W** types	**W16a**
HQ6	**S26** (especially **S26a**)	
HQ7	Various **M** and **S** types	
HQ12	Various **M, MG** and **S** types	

There was no clear trend in species richness when maintenance options are compared with equivalent restoration options, though woodland options were more species rich than grasslands (partly because of the larger quadrat size) and the most species-poor options were **HE3** 6m buffer strips and the **HK3** permanent grassland under very low inputs. Average species-richness in **HE3** can be compared with other field margin options (**HE10** floristically enhanced margins and **HF1** management of field corners), although these three options were each only surveyed on 8-10 occasions. **HE3** strips had only 6.24 species/m^2 whilst the enhanced **HE10** had 8.6 species/m^2; field corners managed under **HF1** were apparently richer still with 9.23 species/m^2.

Each quadrat (or group of quadrats) was classified within the types of the *National Vegetation Classification* (*NVC*: Rodwell 1991-2000) using the MAVIS software package. Table 5.2 provides a summary of these results indicating *NVC* communities to which the quadrats of the baseline survey were most frequently allocated. Where other *NVC* types were well-represented (though less frequently) these too are indicated. The table distinguishes cases where particular sub-communities or communities were especially associated with individual HLS options from those where several (or many) *NVC* types were represented within the quadrats of the baseline survey.

Quadrats under woodland HLS options were mainly referred to **W21** *Crataegus monogyna-Hedera helix* scrub, including those where the management focussed on woodland (**HC7** and **HC8**) rather than management of scrub and successional areas (**HC15** and **HC16**). Woodland creation options (*e.g.* **HC10**) had not yet progressed sufficiently to produce a woodland type, and the vegetation remained referable to coarser mesotrophic grassland.

Arable options applied to field margins and corners produced mesotrophic grassland, although some quadrats were better placed in more disturbed vegetation types (**OV**), perhaps reflecting an early stage of implementation. Buffer strips (**HE3**) were generally coarser and dominated by *Dactylis, Elytrigia repens, Arrhenatherum* and *Schedonorus arundinaceus* (**MG1** *Arrhenatherum elatius* grassland, especially **MG1b** *Urtica dioica* sub-community). Floristically enhanced margins (**HE10**) were closer to **MG7** *Lolium perenne* leys, especially **MG7b** *Lolium perenne-Poa trivialis* leys. Management of archaeological features on grassland (**HD5**) is also associated with the **MG7** community particularly the **MG7a** *Lolium perenne-Trifolium repens* leys, although **MG10a** *Holcus lanatus-Juncus effusus* rush-pasture also occurs. Quadrats in land with permissive open access (**HN2**) were mainly in mesotrophic grassland types.

HLS grassland options were not surprisingly associated with *NVC* grassland communities, often with variants of **MG6** *Lolium perenne-Cynosurus cristatus* grassland. Where the botanical quality was higher, the **MG6b** *Anthoxanthum odoratum* sub-community was prevalent, though **MG7** *Lolium perenne* grassland remained extensive despite 2-4 years of HLS management. Options for species-rich, semi-natural grassland (**HK6** and **HK7**) had quadrats under a very wide range of *NVC* types including calcicolous grasslands (**CG**), acid grasslands (**U**) and fen meadows (**M22-M24**). Grasslands managed for target features were also referable to a variety of *NVC* communities, though coarser types such as **MG10a** (typical *Holcus lanatus-Juncus effusus* rush-pasture) were especially common. Where the targets of HLS management were waders and wildfowl (*e.g*. options **HK9** and **HK10**), the grasslands were moister mesotrophic grassland *e.g.* **MG10a** and **MG11a** (the *Lolium perenne* sub-community of *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland).

Moorland and upland rough grazing options (**HL**) were classified in two groups. Rough grazing options were mainly associated with **MG6** *Lolium perenne-Cynosurus cristatus* grassland, whilst the moorland options themselves included a wide variety of heath, mire and acid grassland communities. Lowland heathland options (**HO**) had quadrats referable to a similar range of *NVC* types, together with woodland communities where heath was being restored on previously neglected sites (option **HO2**).

Wetland options (**HQ**) had vegetation quadrats referred to a variety of mire and swamp types, as well as wet mesotrophic grasslands. However HQ6 maintenance of fen appeared to be more specifically associated with **S26** *Phragmites australis-Urtica dioica* tall-herb fen (especially **S26a** *Filipendula ulmaria* sub-community).

In addition to species richness and community type, the field data may be summarised in terms of vegetation height and other structural aspects. In the particular case of unenclosed upland vegetation, such outline statistics allow for direct comparison of major HLS options as they are implemented in the uplands, specifically **HL9** moorland maintenance and **HL10** moorland restoration.

Table 5.3: HLS survey of unenclosed upland habitats under options **HL9** and **HL10** (mainly 2010): Summary data for vegetation structure

Survey Type	HLS Code	Mean Dwarf Shrub Cover (%)	Mean Heather Cover (%)	Mean Heather Height (cm)	Mean Sward Height (cm)	Number of Surveys
Dry Heath	**HL9**	69.54	47.69	34.81	8.39	9
	HL10	36.69	28.91	24.68	13.16	6
Dry/Wet Heath (Mosaic)	**HL9**	65.29	43.58	34.35	6.65	17
	HL10	40.49	24.47	25.28	14.20	17
Grass Moorland	**HL9**	3.58	2.55	12.50	7.84	4
	HL10	3.51	3.13	21.67	10.15	4
Mire/Wet Heath (Mosaic)	**HL10**	21.04	18.52	18.75	16.39	5
Mires	**HL9**	26.22	32.15	23.38	15.92	4
	HL10	14.88	8.91	18.63	39.37	4

Table 5.3 describes the differences in cover of total dwarf shrubs and specifically of heather (*Calluna vulgaris*) between **HL9** and **HL10**, together with information on the mean height of the heather and of any Graminoid sward present. The results are presented not only by HLS option but also by the survey type – itself dependent upon the main habitat present, but allowing for situations where a mosaic of habitats occurred. The protocols used for the five types (dry heath, mixed dry/wet heath, mixed mire/wet heath, mires and grass moorland) were similar (Mountford *et al.* 2011) and the recording methods for the structural variables included in Table 5.3 were identical. It should be borne in mind that the sample size for some upland survey protocols was quite small, but the overall trends are clear.

Dwarf shrub cover was consistently higher in **HL9** than in **HL10** for upland heath and mire, with the same pattern where *Calluna* cover alone is assessed. As would be expected, dwarf shrub cover is highest in heath vegetation and <5% on grass moorland regardless of option. Heather height shows a similar pattern in relation to HLS management with an average height of *ca* 31 cm on heath and mire under **HL9**, but only *ca* 23 cm where **HL10** is being applied. However, where *Calluna* does occur on grass moorland, the growth appeared to be taller under **HL10** than under **HL9**. Finally examination of the Graminoid sward height revealed that on all moorland types (dry heath, dry/wet heath, mire and grass moorland) the vegetation was considerably coarser under **HL10**. Where graminoids occurred within a dwarf shrub dominated heath or on grass moorland, the mean sward height was *ca* 7.6 cm under **HL9** and *ca 12.5* cm in land managed within **HL10**. Given that Graminoids, notably *Trichophorum, Eriophorum* and *Juncus* species, have higher cover and vigour on upland mires than on heaths, it is not surprising that sward heights are much higher, but the differential between **HL9** and **HL10** remains, with the maintenance option having a mean height of ca 16 cm, whilst mires under HL10 have a mean sward height of almost 40 cm.

Condition of FEP features

1200 distinct assessments of FEP features (mainly habitats, but also historic and landscape features) were conducted during the baseline survey. The survey approach was not amenable to an assessment of species features, although their presence was noted whenever they were encountered. The survey methodology focussed primarily on HLS options addressing the main habitats within the RLR parcels, rather than either the field boundaries (feature code F) or scrub, bracken and other tall vegetation (feature code V). Thus Table 5.4 summarises the condition assessments for those FEP features gauged on at least 10 occasions.

The condition assessment followed the standard approach described in the FEP features manual (Natural England 2010b), allocating condition to one of three possible assessment categories: A, B or C. Each condition assessment was based on a group of specific criteria (normally four) for each FEP habitat feature as set out in Section 2 of the Manual. Should the feature not fail or miss any of these criteria, the condition will be in category A. If one criterion is failed or missed, the feature condition is B and where 2 or more criteria are failed/missed, then the feature will be in category C. In most instances the feature condition could be readily allocated to category A, B or C, but those instances where the condition seemed intermediate are indicated in the table. In the description of the results, such intermediate situations are reallocated equally to the 3 main categories *e.g.* of the 9 A/B scores for feature G04, 4.5 each are allocated to A and to B.

Overall, 27.6% of FEP features were in condition A, 42.2% in condition B and the remaining 30.2% in condition C. Some feature types (especially amongst the most frequently assessed) had condition scores distributed fairly evenly over the categories *e.g.* A01 arable, G02 semi-improved grassland, G03 species-rich grassland, grasslands for breeding waders (G12 and G14), H01 above ground historic features and W04 fens. Rather few feature types were consistently in good condition, although certain BAP habitats (F02 hedge-banks, G08 upland calcareous grassland, G15 grazing marsh and W08 reedbeds) together with ponds (W07), native plantations (T04) and access were frequently scored as A. Amongst those feature types most often scored in condition B were G07 purple moor-grass and rush pastures, several moorland habitats (M04, M06 and M08) and T08 native semi-natural woodland, as well as T05 non-native plantations and T15 traditional orchards.

Although no features were predominantly in the poorest condition category (C), a number were quite frequently scored as such, especially in BAP grasslands where 43-55% of instances were judged to be in poor condition *e.g.* lowland calcareous grassland, lowland dry acid grassland, lowland meadows and upland hay meadows. The broader grassland categories of G02 semi-improved and G03 species-rich grassland also had high proportions (33% and 36%) of instances in condition C. Finally it was notable that over half the assessed BAP lowland heaths (M03) were in poor condition (C).

The condition assessments of the historic environment suggest that approximately the same proportion (*ca* 38%) of features were either in category A or failed/missed just one criterion (category B). The remaining 24% failed the condition assessment on at least 2 criteria (category C). Both within category B and C, the main reasons for poor condition were either erosion due to overgrazing and/or burrowing or colonisation of the feature by scrub.

Table 5.4: FEP features and their condition as assessed by the HLS baseline survey of 2009-11. Notes: Results are presented for those features assessed on 10 or more occasions; and features assessed >1 in an agreement (*i.e.* in separate parcels *etc*) are counted as distinct occasions)

FEP Features	**Sample size**	**FEP feature condition (%)**				
		A	**A/B**	**B**	**B/C**	**C**
Access	*10*	90	10			
A01 – Arable	*14*	6		36		28
F02 – BAP Hedgerow	*23*	7		39		4
G01 – Improved grassland	*30*	10		73		17
G02 – Semi-improved grassland	*224*	21	1	44	2	32
G03 – Species-rich grassland	*40*	21		42	3	34
G04 – Lowland Calcareous (BAP)	*54*	20	17	17	6	41
G05 – Lowland Acid (BAP)	*34*	12		41		47
G06 – Lowland meadow (BAP)	*63*	21		32	3	44
G07 – Purple moor-grass & rush (BAP)	*56*	21	2	48	4	25
G08 – Upland calcareous (BAP)	*21*	38	19	24	9.5	9.5
G09 – Upland hay meadow (BAP)	*19*	11		32	11	47
G12 – Lowland wader habitat	*10*	20		50		30
G14 – Upland wader habitat	*16*	31		31		38
G15 – BAP grazing marsh	*32*	47		41		2
H01 – Above ground historic feature	*72*	39	4	32		25
H02 – Below ground historic feature	*12*	25		33	17	25
H05 – Relic boundary	*11*	45		45		10
H06 – Historic water meadow	*22*	9	2	14	45	
M01 – Grass moorland & rough grazing	*6*	18	8	18		45
M03 – BAP lowland heath	*29*	14		21	7	52
M04 – BAP upland heath	*37*	24	5	46	8	16
M06 – BAP blanket bog	*21*	5	10	43	19	24
M08 – BAP upland flushes *etc*	*18*	33	6	44		17
T03 – BAP wood pasture & parkland	*14*		14	36		50
T04 – Native plantation	*17*	53		35		12
T05 – Non-native plantation	*14*	14		71		14
T08 – Native semi-natural woodland	*52*	27	6	42	10	15
T15 – Traditional orchards	*19*	21	5	63		11
W04 – BAP Fens	*43*	26		33	5	37
W07 – Ponds	*17*	41	6	47		6
W08 – BAP Reedbeds	*22*	64	5	18		14
ALL FEATURES	**Total**	**278**	**44**	**413**	**45**	**295**
	%	**26**	**4**	**38**	**4**	**27**

Red Amber Green (RAG) assessment

For all HLS options that were surveyed and assessed, measurable Indicators of Success (IoS) were given a "RAG assessment". This was based upon data and observations collected during the field survey, with indicators assessed separately for individual RLR parcels. The three assessment categories were defined as follows:

- **G** = **Green**. The IoS has already been achieved or it is (almost) certain that it will be achieved within the duration of the HLS agreement. There is no (or minimal) risk that the desired outcomes will not be met.
- **A** = **Amber**. There is some doubt that the IoS will be achieved and a moderate risk that the desired outcomes will not be met. The management prescriptions may appear appropriate but they may be ambitious or require rigorous implementation.
- **R** = **Red**. There is a high risk that the IoS will not be achieved within the duration of the agreement. Site conditions may be such that the IoS is impossible to meet practically or the HLS management prescriptions require complete revision to meet the desired outcomes.

Table 5.5: RAG assessments of Indicators of Success (IoS) for HLS options made during the HLS baseline survey of 2009-2011 (Results are presented for those individual HLS options assessed in 10 or more agreements – results for other options are summarised at the level of the HLS option group). See Box 5.1 for explanation of how agreement-option combinations were allocated

HLS option		**Results of RAG assessment of measurable IoS**		
		Passed all	**Failed one**	**Failed >1**
HB options		14	1	
HC less frequent options		49	4	5
HC7		14	9	4
HC8		19	7	2
HD less frequent options		7	2	2
HD5		10	3	1
HE options		13	7	3
HF options		13	3	
HJ options		10	4	
HK less frequent options		33	7	4
HK6		24	14	16
HK7		33	16	18
HK9		5	3	2
HK15		15	7	10
HK16		15	7	1
HL less frequent options		17	2	6
HL8		8	1	2
HL10		40	13	18
HL15		9		1
HN less frequent options		2	1	2
HN2		8	1	3
HN3		10	1	1
HO less frequent options			3	3
HO2		4	2	5
HP options		1	2	
HQ less frequent options		20	12	8
HQ7		2	5	3
Organic options		5		
ALL OPTIONS	**Total**	**400**	**137**	**120**
	%	**60.9%**	**20.8%**	**18.3%**

Most options have several IoS and in many cases the indicator sets are applied to multiple RLR parcels under a particular option. As a result, several thousand RAG assessments were made of individual indicators, allowing for 714 assessments of distinct agreement-option combinations. Within each individual option in each agreement, a range of RAG scores might be given, varying between IoS and between RLR parcels. Table 5.5 summarises the results of these assessments placing outcomes by option-parcel combination into one of three categories.

A set of decision rules were adopted in order to guide the allocation of each agreement-option combination and these rules are briefly set out below in Box 5.1. Where individual options were assessed less frequently, the results are pooled by option group *e.g.* options **HC7** and **HC8** were assessed in 27 and 28 agreements respectively, but the results for the remaining 16 **HC** options that were surveyed are combined as "**HC** less frequent options".

Box 5.1: Decision rules employed in allocating agreement-option combinations to one of 3 categories: a) *Passed all IoS*; b) *Failed one IoS*; and c) *Failed >1 IoS* (see Figure 5.4)

1. Tally all the RAG assessments made for a particular HLS option at an agreement

2. Where <u>all</u> assessments for all RLR parcels under an option had been achieved or were judged very likely to be achieved within the duration of the agreement, allocate the agreement-option combination to the ***Passed all IoS*** category

3. Where <u>most</u> assessments for all RLR parcels under an option had been achieved or were judged very likely to be achieved within the duration of the agreement, and none of the remaining IoS were given a Red assessment, allocate the agreement-option combination to the ***Passed all IoS*** category (but only if the indicator was not judged as fundamental to the success of the option)

4. Where one indicator (in at least 1 parcel) had failed (Red assessment) or where there was a moderate risk of failure (Amber assessment) in at least 3 distinct indicators or 3 separate parcels, allocate the agreement-option combination to the ***Failed one IoS*** category

5. Where two or more indicators had failed (Red assessment) or where one indicator had failed and the majority of other indicators had a moderate risk of failure (Amber assessment), allocate the agreement-option combination to the ***Failed >1 IoS*** category

It should be noted that not all indicators are necessarily of equal importance – some may be fundamental to delivering the desired outcomes for an HLS option (*e.g.* the number of indicator species present in grassland under restoration management), others may reflect the general quality of delivery whilst being less critical to the option goals. Some indicators were not measurable during the surveys for this project, often because their success could not be measured until the option had been implemented for 2, 5 or 10 years. In a few cases, the indicator was poorly designed and not amenable to measurement at any time; this criticism of agreement building is further discussed in Chapter 6.

However, generally rates of success should be indicative of overall progress with HLS agreements and their component options. The results in Table 5.5 suggest that 62.3% of options had achieved all their IoS by the time of survey *or* were judged by the field teams as certain to achieve these indicators within the span of the agreement. For a further 20.1% of options, one indicator had been given a Red (very likely or certain to fail) assessment. In 17.6% of options, more than one IoS received a Red assessment.

The pattern of RAG assessment results varied between different HLS options, with three rough categories of HLS options and option groups discernible when compared with trends in the entire survey dataset:

I. Options/groups that pass all their IoS more frequently than is typical *e.g*. **HB** options, less frequently surveyed **HC** options, **HC8**, **HD5**, **HF** options, **HJ** options and organic options;

II. Options/groups that fail one IoS more frequently than is the norm in the survey *e.g*. **HC7**, **HE** options, **HK9**, **HK16** and **HQ** options including **HQ7**; and

III. Options/groups where the rate of apparent failure (>1 Red RAG score per option) is higher than typical for surveyed agreements *e.g.* **HK6**, **HK7**, **HK16**, **HL10** and **HO** options.

The use of capital works

The baseline survey included an assessment of the capital works that underpinned the annual HLS management options, recording progress with installation and, as described in Chapter 6, making a judgement about their suitability both for the particular agreement and the HLS scheme as a whole. Appendix 2 summarises the capital works used in the 174 agreements of the baseline survey, detailing the total extent of such works in these agreements, the number of agreements where each type of capital works had been used and their mean extent within those specific agreements. For most types of works, the extent and mean usage can be quantified in terms of length or area, or the quantity of capital works items on the agreement (Table A1). However, for certain types of works, each item may be unique to the particular agreement or tailored to the local requirements *e.g*. seed mixtures, historic features and, in particular, special projects (works code OES). Such types of activity may be effectively quantified only in terms of their cost (see Table A2). Most agreements had an active capital works programme, though 10 had none.

The most commonly used capital works items deal with securing field boundaries, allowing effective stock control for grazing management. New sheep fencing (works code FSB and FSH) was installed in nearly 60% of surveyed agreements, with 23% of agreements receiving the supplement for difficult sites (FDS). Activity on hedges was also important with restoration works in 37% of agreements and new hedges being planted in 20.7% of surveyed holdings. Stone walls were more localised in England but restoration works (WR) were planned in 21.8% of agreements, often accompanied by various supplements. Functional field boundaries are usually associated with good gates and wooden field/river gates (GF) were part of the HLS agreement in almost 55% of holdings.

Tree planting (codes TSP, STT and MT) may accompany hedgerow management or be used to support **HC** woodland options. The TSP works were part of 19% of agreements, usually accompanied by tree tubes and stakes (works code TT). Control of scrub and bracken was especially common in support of grassland, heathland and moorland options, with >30% of agreements having a scrub-control plan (SS combined with SA, SB and/or SC) and 17% of agreements taking action to reduce the extent of bracken, usually through chemical means (works code BCB/BCA) though occasionally mechanically (BMB/BMB).

Creation and restoration of water bodies and provision of water supply are less frequent though locally important in HLS agreements, with works on ponds (PC/PCP and PR/PRP) and scrapes (SCP and SCR) in *ca* 7% of agreements. New water troughs (WT) were in 16.7% of agreements, generally linked to new water-supplies (WS).

Protection of historic and archaeological features (HAP) was part of 18% of agreements, though the nature and scale of the works was not always clear. Special projects varied greatly in type and in size from a few hundreds of pounds to in excess of £100,000, and were included in about a fifth of agreements, in some of which the project was the core of the HLS activity *e.g*. to provide access and facilities for disabled visitors.

About 10% of agreements used native seed mixes (works code GS) to aid the reversion of heathland and grassland. In many of the 17 agreements where the GS works were applied, the documentation describes the source and composition of the seed mixture. Native seed was used especially to restore hay-meadows managed under option **HK7** (more rarely under **HK8** and **HK16**) and the practice was frequent in the Pennine Dales, linked especially to the *Hay Time* project of the Yorkshire Dales Millennium Trust where donor fields for seed gathering and recipient fields may be on the same holding or closely adjacent. A similar approach occurs in flood meadows in the Thames basin. Other grassland restoration and creation schemes use designed seed mixtures tailored to the relict flora present on the holding, or adjusted for particular fields where the objectives differ *e.g.* complex mixes to create BAP grassland types and more generic mixes where provision of pollen and nectar sources is the goal. Native seed application is also an adjunct to moorland restoration and creation (HLS options **HL10** and **HL11**) where *Calluna* seed is harvested from nearby moors for use in agreements, often augmented with *Erica tetralix*. The standard guidance for the GS supplement given in Part 5 of an agreement should safeguard against inappropriate seed mixtures but the best examples expand upon this guidance to provide an implementation or management plan that takes account of the soil conditions and local flora.

Overall some 87 different types of capital works were employed to support the annual HLS management options practised in the agreements of the baseline survey (Appendix 2). The complexity of some HLS agreements and options, together with integration of all the elements of an agreement, led to a need for expert advice and 19% of agreements had some professional help with management planning (PAH).

5b Comparison of HLS quadrats with the *Countryside Survey*

Introduction

To explore further the effectiveness of targeting of HLS a comparison was undertaken between the species composition and richness of parcels being managed under HLS with examples from the wider English countryside. Here the wider countryside was represented by vegetation samples drawn from the *Countryside Survey* (CS) database for the survey carried out in 2007 (Carey *et al.* 2008). The challenge in conducting such a comparison is in deriving ecologically equivalent samples such that the same kinds of vegetation are compared but not so similar that differences are unlikely to be detected. In this analysis species-compositional equivalence was ensured by using the Broad Habitat assignment for each plot as the common unit. In addition only data for English ITE Land Classes (Bunce *et al.* 1996; Carey *et al.* 2008) represented in both HLS and CS were analysed and adjustments made where necessary to ensure an even representation of upland and lowland locations in both datasets. The names and locations of the land classes are defined within Appendix 3A (Table A8 and Figure A3).

A more detailed account of the analytical methods used in this project is also included in Appendix 3B. The overall approach is derived and adapted from that used by Carey *et al.* (2002) to compare the ecological quality of land in Countryside Stewardship Scheme (CSS) with that in the wider countryside and also builds on the methods applied to the last Countryside Survey (Carey *et al.* 2008). Fundamentally the present assessment of Higher Level Stewardship (HLS) tests the following hypothesis:

- ✪ *Land selected for the implementation of HLS is of a higher environmental quality than otherwise ecologically equivalent land (habitats and vegetation) in the wider countryside*.

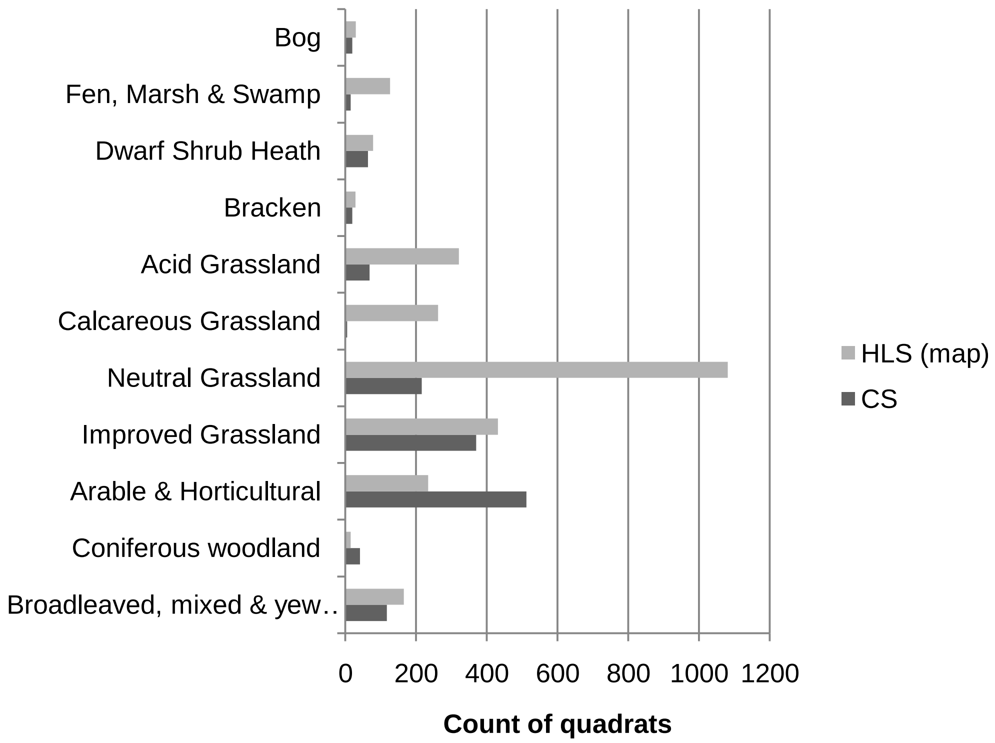
The results presented below make a rigorous comparison of a range of response variables derived from the vegetation composition of quadrats gathered during the HLS baseline survey, with the same variables obtained from quadrats collected during the fieldwork for Countryside Survey 2007.

Methods

Countryside Survey quadrat data and land-class adjustments

Species presence and cover data were extracted for **X** and **M** plots from *Countryside Survey* (see Appendix 3B of this report for information on these plots). During the 2007 *Countryside Survey* a 1 x 1m nest was censused at the centre of each **X** plot to enable comparison with data from agri-environment monitoring schemes.

Figure 5.1: Counts of quadrats assigned to Broad Habitats in HLS monitoring and Countryside Survey datasets



These CS data can be directly compared with grassland and arable margin quadrats gathered as part of the HLS survey. In the case of woodlands, the present project employed 10 x 10m plots, and thus comparison was made with the 10 x 10m X plot nest from the CS woodland data. Certain other less frequent broad habitats (Fen, Marsh & Swamp, Dwarf Shrub Heath and Bog) required further processing of CS data because the HLS monitoring deployed a 4 x 4m quadrat in these habitats but in CS **X** plots the nearest nest sizes were 2 x 2m and then 5 x 5m (see Appendix 3B).

In total 1479 plots were available that occurred in the same land classes and broad habitats as the HLS plots (Figure 5.1 & Appendix 3C). Few CS plots were available for comparisons of Fen, Marsh & Swamp (15 plots) and Bog (20 plots) and the results for these habitats below must be treated with more caution than those for other Broad Habitats. Too few CS samples were available for meaningful comparison of calcareous grassland (7) or supra-littoral sediment (19).

Even though vegetation samples may share a common Broad Habitat assignment, differences in response variables could be expected between upland and lowland or eastern and western examples. To ensure appropriate like-with-like comparisons the land class distributions of plots for Fen, Marsh & Swamp, Dwarf Shrub Heath, Bog and Acid Grassland were examined and any major upland versus lowland imbalances between HLS and CS samples were addressed by removing or adjusting the proportions of land classes represented in the CS (see Appendix 3B for fuller description).

HLS quadrat data

6446 plots were present in the HLS survey database, of which 100 plots had no land class and 93 plots had no Broad Habitat assignment, of which 1 plot occurred in both datasets. This left 6254 plots that could be compared with CS data (see Appendix 3C). Of the quadrats from the HLS survey broad habitats 13 (standing open water and canals), 14 (rivers and streams) and 21 (littoral sediment) were represented by 6, 3 and 2 plots respectively and could not be analysed. 46% of HLS plots were assigned to unique Broad Habitats in the field. The remaining 54% were assigned probabilistically using the profile of *NVC* units to which each plot was classified by running the MAVIS software on groups of plots (see Appendix 3B for more detail).

Response variables and analytical methods

Species lists and taxonomic treatments were made consistent by a prior inspection and allocation of problematic species. Such difficulties mainly referred either to instances where the field teams were unable to separate two (or more) taxa and used a generalised category or where the species was absent from the CS data altogether, as was the case for many nationally rare or alien species. In particular bryophyte species are not comprehensively recorded in CS and so these, together with rarities and aliens, were excluded from all analyses for the purposes of the CS versus HLS comparison. Having unified the treatment of taxa between schemes, fifteen response variables were calculated for each plot (see Table 5.6 for their names and description). The methods of statistical analysis used in this project are described in Appendix 3B together with the derivation of the response variables.

Table 5.6: Response variables calculated from the species presence and cover in each HLS and CS plot. Values for Grime indices were extracted from Grime *et al.* (1995) and Ellenberg values from Hill *et al.* (1999) and see Hill *et al.* (2000).

Response variable	**Description**
Grass:forb ratio	Ln (proportion of grass cover+0.5 / proportion of forb cover+0.5). High values equate with high cover of grasses versus cover of forbs. Where no grass or forb cover was present the plot did not contribute. Where either grass or forb was present only then the cover of the absent growth form was arbitrarily assigned to 0.5
Ericoid cover	Sum of cover of *Calluna vulgaris, Erica cinerea* and *E. tetralix*. Analyses were only carried out for quadrats located in the Bog or Dwarf Shrub Heath broad habitats.
C	Mean Grime Competitor score – see Carey *et al.* (2008)
S	Mean Grime Stress-tolerator score – see Carey *et al.* (2008)
R	Mean Grime Ruderal score – see Carey *et al.* (2008)
cC	Mean Grime cover-weighted Competitor score – see Carey *et al.* (2008)
cS	Mean Grime cover-weighted Stress-tolerator score – see Carey *et al.* (2008)
cR	Mean Grime cover-weighted Ruderal score – see Carey *et al.*(2008)
Ellenberg N	Mean Ellenberg fertility score
Ellenberg R	Mean Ellenberg substrate pH score
Ellenberg F	Mean Ellenberg wetness score
Ellenberg cN	Mean cover-weighted Ellenberg fertility score
Ellenberg cR	Mean cover-weighted Ellenberg substrate pH score
Ellenberg cF	Mean cover-weighted Ellenberg wetness score
Species richness	Species richness excluding bryophytes and lichens

Results

The results of the comparison between quadrats from the present survey of HLS land and those from the *Countryside Survey* are reported in two parts, depending on the CS plot type used: a) **M** plots for arable margins; and **X** plots for all other habitats. For each broad habitat the results tables list a) the response variables, b) the number of plots in the analysis, c) the F statistic, d) probability P and e) whether the difference between the CS plots and HLS plots was significant, and if so whether the value for the CS plots was lower or higher. The tables of results are complemented by a series of bar-charts (Figures A4-A13) showing the percentage of plots in each Broad Habitat (numbered) from the HLS survey and CS X plots. Both tables and bar charts are included within Appendix 3D.

Comparison of HLS plots against CS M plots

Only Broad Habitat 4 (Arable & Horticultural) had enough CS field margin plots to allow a feasible analysis. Table A9 summarises the occurrence of **M** plots in CS and of plots in the HLS survey conducted using the “Arable Margins, Buffer Strips and Field Corners” protocol (plots grouped by Broad Habitat). Comparison between surveys showed that the wider countryside sample (CS) had a higher proportion of competitor and ruderal species (*sensu* Grime *et al* 1995) and higher cover of species suited to conditions that are more fertile as well as moister and with a generally higher pH (mean Ellenberg N, R and F).

Comparison of HLS plots against CS X plots

Broadleaved Mixed & Yew woodland

Broadleaved woodlands sampled in HLS were on average less species rich and had a higher proportional contribution of Grime stress-tolerant species than samples from the wider English countryside. Both presence and cover-weighted mean Ellenberg fertility (N) were higher in the CS sample indicating lower richness and abundance of species of more fertile conditions in the HLS sample (Table A10 and Figure A4). The contrasting results for presence-only and cover-weighted mean Ellenberg wetness scores must reflect a lower relative richness but a higher proportional cover of more moisture-loving species in the wider countryside sample.

Coniferous woodland

Only 15 plots were assigned to this Broad Habitat in the HLS sample. Comparison with the 42 plots from CS show targeting of HLS onto woodland with a lower mean Ellenberg fertility than conifer woodland in the wider English countryside (Table A10 and Figure A5). Since mean Ellenberg substrate pH (R) is positively correlated with mean Ellenberg fertility except on the more calcareous substrates, it is not surprising that mean Ellenberg substrate pH mirrors the result for mean Ellenberg fertility. Plots in the HLS survey had a higher proportion of grass in the woodland floor than those in the wider countryside.

Arable & Horticultural

Comparison of cultivated land in the wider countryside sample versus HLS highlighted a number of significant and consistent differences. HLS land had a higher proportional contribution from the more stress-tolerant species but also a higher contribution from the more competitive species than the wider countryside. Both presence-only and cover-weighted mean Ellenberg fertility scores were significantly higher in the wider countryside CS sample than in HLS. Species richness was also higher in the HLS data (Table A11 and Figure A6).

Improved grassland

Results show quite unequivocally that, compared to the wider English countryside, HLS targeted improved grasslands with higher relative cover of forbs to grasses, a higher relative contribution of stress-tolerant species and lower contribution of ruderals and more competitive plants (*sensu* Grime *et al.* (1995). In addition mean Ellenberg fertility was lower in the HLS sample and species richness higher (Table A12 and Figure A7).

Neutral grassland

The same pattern of differences was seen in the Neutral grassland as in the Improved grassland indicating effective targeting of vegetation. Thus the HLS sample had lower mean Ellenberg fertility scores, both presence-only and cover-weighted, and a higher contribution from more stress-tolerant species (Table A13 and Figure A8). The profile of differences between HLS and CS samples was largely the same irrespective of whether HLS plots were assigned to the broad habitat in the field or probabilistically based on *NVC* matching. The only major difference was that species richness was not significantly different between CS and those HLS plots assigned probabilistically to Neutral grassland (Table A14).

Acid grassland

Acid grasslands in the wider countryside sample had a significantly higher relative contribution from stress-tolerant species and lower contributions from weedy and more competitive species (*sensu* Grime *et al.* 1995) than the HLS sample. Mean Ellenberg fertility score was also lower in the wider countryside (CS) sample (Table A15 and Figure A9).

Bracken

Areas of Bracken targeted in HLS had a significantly lower cover-weighted contribution from more competitive species (*sensu* Grime *et al.* 1995) and a lower mean cover-weighted Ellenberg fertility score than the wider CS sample (Table A15 and Figure A10). This may reflect deliberate targeting of the densest Bracken stands in CS consistent with definition of the broad habitat.

Dwarf Shrub Heath

The pattern of differences in response variable does not clearly discriminate between the wider English countryside and HLS samples. The wider countryside had a significantly lower relative contribution from more competitive species (*sensu* Grime *et al.* 1995) when based on presence only yet a higher contribution when cover-weighted (Table A16 and Figure A11). However all three cover-weighted Grime indices were higher in CS than HLS, presumably reflecting greater recording of vegetation layers in CS.

Fen, Marsh & Swamp

The CS sample was only based on 15 plots compared with 181 in HLS. Results should therefore be treated cautiously because the range of variation in the HLS sample is unlikely to be effectively represented in the CS sample. Comparison suggests that the HLS sample was characterised by a lower relative cover-weighted contribution from stress-tolerant species than the wider countryside sample and a higher contribution from species suited to more fertile conditions (lower mean Ellenberg fertility. All other scores including species richness and grass:forb ratio were not significantly different (Table A17 and Figure A12).

Bog

Like Fen, Marsh & Swamp, this comparison was based on relatively few CS plots (n=20). Since the HLS sample numbered only 30 plots the analysis is at least more balanced (see Appendix 3C). Results suggested that the HLS sample had a lower cover-weighted contribution from species of more fertile substrates than the CS sample yet the cover-weighted contribution from more moisture-loving species was also lower in the HLS sample (Table A18 and Figure A13). Higher cover-weighted means for all three Grime scores must reflect greater recording of vegetation layering in the CS sample.

Summary

Condition and quality of habitats under HLS

The baseline survey assessed 103 different HLS options, the most widely represented being **HK6, HK7**, **HK15** and **HK16**, with woodland options and those for moorland and lowland heathland of secondary importance. There was no clear trend in species richness when maintenance options are compared with equivalent restoration options.

The quadrats from the baseline survey were classified into the *National Vegetation Classification.* Samples from **HC** maintenance and restoration options were mainly referred to **W21** *Crataegus monogyna-Hedera helix* scrub, whilst creation options had not yet progressed sufficiently to produce a woodland type. Field margins and corners under **HE** and **HF** options supported coarse mesotrophic grassland or leys, although some quadrats contained disturbed vegetation types (**OV**).

Grassland options (**HK**) were the most frequent group within the baseline survey and were clearly associated with *NVC* grassland communities. Variants of **MG6** *Lolium perenne-Cynosurus cristatus* grassland were common under many options, though those for species-rich, semi-natural grassland possessed a much wider range of *NVC* types including calcicolous (**CG**), acid (**U**) and fen meadow (**M**) communities. Grasslands managed for target features tended to have coarser types such as **MG10a** (typical *Holcus lanatus-Juncus effusus* rush-pasture) whilst wader and wildfowl options had moister mesotrophic grassland (*e.g.* **MG10a** and **MG11a**).

Moorland and upland rough grazing options (**HL**) were classified either as **MG6** grassland where rough grazing predominated or as a wide variety of heath, mire and acid grassland communities on moorland. Wetland options (**HQ**) contained various types of mire and swamp, as well as wet mesotrophic grasslands, though **HQ6** fen maintenance was more associated with **S26** *Phragmites australis-Urtica dioica* tall-herb fen.

Moorland was also examined in terms of the vegetation structure and height under maintenance (**HL9**) and restoration (**HL10**) options. Upland heath managed by **HL9** had a greater cover of dwarf shrubs, taller and more extensive *Calluna* and a shorter grass sward within the mosaic. Mires showed much the same pattern between **HL9** and **HL10** except that the cover and height of Graminoids was markedly greater in both options. Even grass moorland, though clearly not dominated by Ericoids, revealed the same differential between maintenance and restoration options for dwarf shrubs and for sward height.

FEP feature condition was assessed on 1200 occasions, mainly for habitat features, with 27.6% in condition A, 42.2% in condition B and 30.2% in condition C. Certain habitats scored consistently well (*i.e.* very rarely failed to meet a condition criterion) including BAP hedge-banks, upland calcareous grassland, grazing marsh and reedbeds. Several examples of purple moor-grass and rush pastures, moorland habitats (M04, M06 and M08) and native semi-natural woodland failed to meet one condition criterion. Although none of the habitat features were predominantly in the poorest condition category (C), some habitats had frequent cases failing two or more condition criteria, notably BAP grasslands and BAP lowland heaths.

Indicators of Success (IoS) were given a RAG assessment for HLS options, including 714 distinct agreement-option combinations. The observed rates of success reflected overall progress with HLS agreements and options, with 62.3% of options having achieved all their IoS or highly likely to do so during the agreement. However in *ca* 20% of options, one indicator had been given a Red assessment and a further 17.6% had more than one IoS receiving a Red assessment. Options where Red assessments were most often allocated (*i.e.* where the risk was highest that the desired outcomes would not be met) included those for species-rich, semi-natural grasslands (**HK6** and **HK7**), grassland for target features (**HK16**), moorland restoration (**HL10**) and options for lowland heath.

Comparison of HLS quadrats with the *Countryside Survey*

The vegetation data gathered during the HLS survey were compared with ecologically equivalent samples derived from Countryside Survey (CS) to assess the evidence that HLS land was of higher environmental quality than the wider countryside *i.e.* testing both whether HLS is effectively targeted and whether progress toward desired outcomes can be demonstrated. The results of the comparison between HLS quadrats and those from the *Countryside Survey* were reported mainly through a series of response variables derived from vegetation composition and the ecological attributes of the individual species.

Within woodland broad habitats, the HLS samples in broadleaved, mixed and yew woodland were less species rich and with greater cover of stress-tolerant species than samples from the wider countryside. Woodland samples from the wider countryside had a vegetation composition reflecting higher fertility. Within conifer woodland, the flora of HLS samples also indicated lower fertility than in the wider English countryside. HLS plots in conifer woods had a higher proportion of grass in the woodland floor than those from the CS survey.

Quadrats from the HLS survey were compared with those from CS2007 within 3 grassland habitats: Improved, Neutral and Acid. Improved grassland in the HLS survey had a markedly higher cover of forbs relative to grasses, as well as greater abundance of stress-tolerators and lower contribution of ruderals and more competitive plants. The HLS sample also reflected lower fertility and greater species richness. The patterns for neutral grassland were very similar except that species richness was not significantly different between the two datasets. In marked contrast, the samples of acid grassland from the wider countryside had a significantly higher abundance of stress-tolerant species, lower contributions from ruderal and competitive species and evidence of lower fertility than the HLS quadrats. In this respect, acid grasslands stood apart from most broad habitats, showing some evidence that the HLS sample was of poorer environmental quality than typical of the wider countryside.

Two other broad habitats of acid soils were assessed. Areas of bracken under HLS had a significantly lower contribution from competitors and also indicated less fertile conditions than the CS2007 sample. However, the response variables for dwarf shrub heath did not clearly discriminate between the broad English countryside and HLS land, and the results for competitive species were equivocal.

Analyses of wetland habitats were based upon a small sample size, especially restricted from CS2007, and the results are somewhat unexpected with a) HLS Fen, Marsh and Swamp apparently having a lower cover of stress-tolerant species and a greater contribution from species typical of higher fertility; and b) HLS bog samples also having more fertility indicators and with a lower cover of moisture-loving species.

Finally, comparison of samples from Arable and Horticultural land showed that in the wider countryside this habitat had a higher proportion of both competitor and ruderal species than HLS land, and also higher covers of indicators for fertile, moist and less acid sites. HLS arable land had a greater abundance than the general countryside not only of stress-tolerators but also of competitors. Species richness was significantly higher under HLS.

Taken as a whole, these comparisons of HLS vegetation data and corresponding data from the wider countryside reveal certain general patterns. Most habitats under HLS tend to be more species-rich, to have fewer ruderals and indicators of fertile conditions as well as a greater contribution from stress-tolerant species. Habitats with such attributes include woodland, improved and neutral grassland, bracken and arable land, and one could broadly define these attributes as typifying land of higher environmental quality. However, three habitats (acid grassland, bog and fen/marsh/swamp) appear to show the opposite pattern, with HLS vegetation reflecting more fertile situations where competitors and ruderals have high cover.

6 Results of the panel appraisal

Appraisal panel outputs

The approaches taken by the Appraisal Panel are described in Chapter 3. Each panel member scored every criterion individually with the meeting arriving at an agreed panel score that was recorded with any explanatory information and comments. In the description within this chapter, the results for criteria that were scored at the agreement level are given in their entirety, whilst for those criteria scored at the option level (prescriptions, indicators of success or option outcomes), results are only presented for options that were assessed on at least 10 occasions. The criterion for Feature-scale Outcomes was only assessed in unenclosed moorland in 2010 and all such results are included here. Results for agreement-scale are presented as histograms depicting the total numbers of agreements in each score category. Option-scale and feature-scale criteria are presented as bar-charts showing, for each option or feature, the proportions allocated by the panel to different score-categories.

Most criteria were scored on a scale from 1 to 4, when a score of 3 might be considered broadly acceptable for more generic agreements, and for the overall agreement score, 3 was seen as the threshold of a generally effective agreement. Where there are a number of agreements scoring below such a broadly effective level, these are indicated and explained, as are cases where the distribution of panel scores includes many at the highest level.

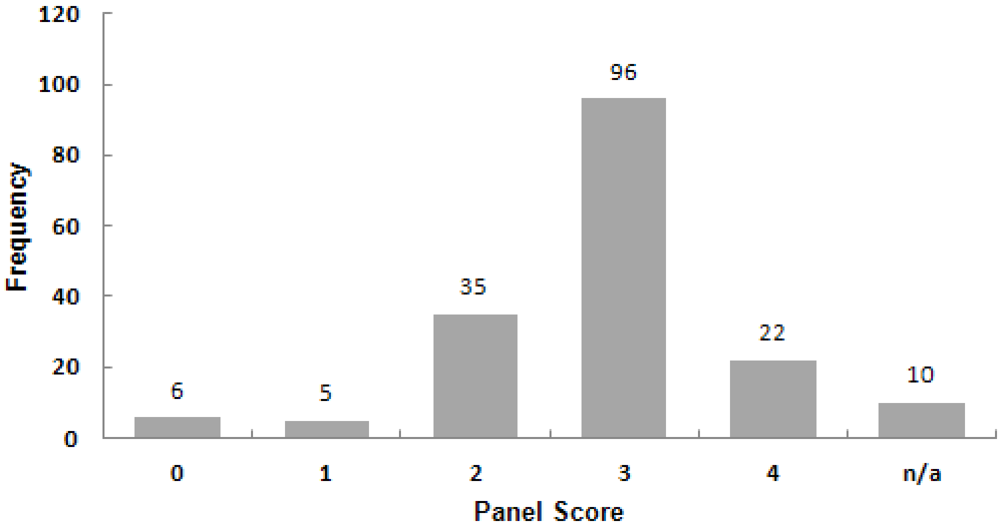
Results are presented for each criterion in turn, beginning with those that reflect the agreement building process and concluding with assessment of the likely outcomes at an option, feature and agreement level. The field survey results measuring feature condition and the RAG assessment of Indicators of Success are described in Chapter 5.

Accuracy of the Farm Environment Plan (FEP)

The pooled results for the Appraisal Panels from 2009-2011 are summarised in Figure 6.1. In over 55% of agreements, the FEPs were scored at 3 *i.e.* "*minor discrepancies were identified within the FEP that would not substantially affect the likelihood of the agreement delivering the desired outcomes*". FEPs in a further 22 agreements (12.6%) were judged as providing a fully accurate representation of all key features on the agreement. Significant discrepancies were identified within the FEPs in 35 agreements (20%) that would affect the likelihood of the agreement delivering the desired outcomes. In just five cases the FEP had major discrepancies that would probably prejudice delivery of the desired outcomes.

The most frequently encountered problem with the FEP was the absence of the Environmental Features Data-sheet, detailing the features and their condition. This was especially frequent for the upland agreements targeted in the 2010 survey when two-thirds of the sample had FEPs without a data-sheet. Another major factor leading to lower panel scores was when there was evidence of misidentification of habitat features in the FEPs – in almost all cases recording a habitat in the FEP that was of higher quality than that actually present ("habitat inflation"). Thus features were recorded in the FEP as BAP grasslands or G03 species-rich grassland when the survey found the sward to be G02 semi-improved or even G01 improved grassland, or where upland heath and grass moorland was classified as BAP blanket bog. The interpretation of some FEPs was made slightly more difficult by the use of grassland categories designated as habitats for birds (*e.g.* G12 and G13) rather than those based upon botanical composition. However, in most cases a botanically-based habitat feature was also listed or could be inferred with confidence, making comparison with the present survey straightforward.

Figure 6.1: ***Farm Environment Plan (FEP).*** Summary of panel scores (1 to 4) for the 174 HLS agreements assessed as part of the baseline survey. Notes: n/a indicates that the panel could not assess this criterion for these particular agreements whilst 0 indicates there was no FEP document.



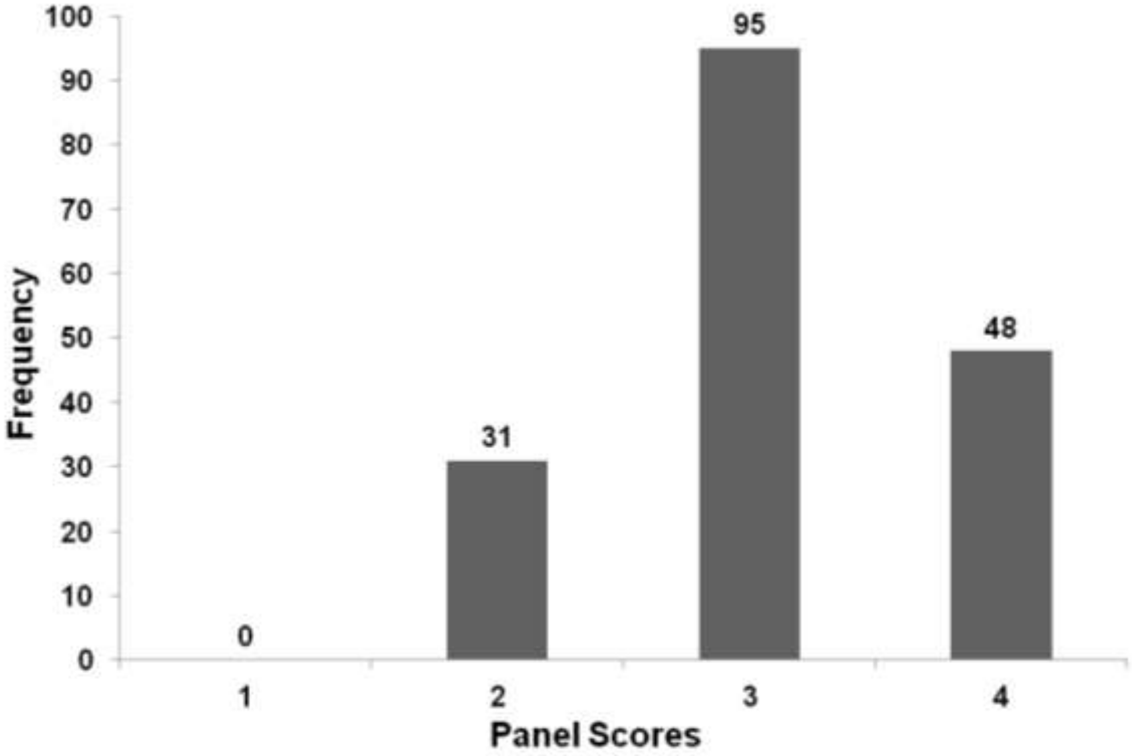
Habitat quality inflation (and inaccuracies in the FEP map) can lead to the wrong options being selected, potentially at a higher cost, and with sub-optimal prescriptions, and most significantly Indicators of Success that cannot be attained. The absence of feature condition information (from the data-sheet) means that progress toward the desired outcomes may not be assessed with confidence as there is no baseline in the FEP. Some FEPs did not take sufficient regard to the context of the holding (*e.g.* landscape and/or habitats adjacent to the holding), potentially resulting in inappropriate management on the agreement land that could damage adjacent high-quality habitat. In one case, for example, an HLS agreement lay directly adjacent to a mesotrophic lake of regional importance, yet the agreement largely ignored this feature, and the surrounding land did not employ **HJ** resource protection, or other, options which might enhance the water-body.

Overall the quality of the FEPs in the agreements surveyed could be characterised as adequate to good. Most FEPs appeared comprehensive and detailed, and there was relatively little evidence from the field survey of omissions that resulted in missed opportunities. There was some regional variation in the approach to FEPs, partly influenced by the level of contribution of local Biological Records Centres or by the style and quality of the Historic Environment Record (HER), although it was recognised that the indexing of some of this supporting material within the EDRM of Genesis was inconsistent and that some material could have been missed when constructing dossiers. The very best FEPs were those where there was clear evidence that the *Natural England* advisers had used the detail of the FEP to adapt prescriptions within the agreement and where a full range of supporting documentation to the FEP was both alluded to in the core agreement and present in the dossier. Overall, the panels felt that their appraisals confirmed the value of the FEP process as a building block for developing effective HLS agreements.

Appropriateness of Agreement Targeting

The Panel was asked to provide a judgement of the fit between the agreement and the Phase 2 Target Area or Regional Theme Statements for the area where the agreement was located. The results of these judgements are summarised in Figure 6.2. Over half the agreements (95) were assessed as making some contribution to the relevant Target/Theme priorities, with the additional management justified, offering reasonable value for money and with few missed opportunities identified (Panel score 3). A further 48 agreements (27.6%) were seen as making a substantial contribution to relevant priorities with additional management fully justified and no evidence of missed opportunities. Only 31 agreements (17.8%) were scored at 2 *i.e.* the panel felt that although they still made some contribution to local targets, the management was dominated by poorly justified approaches offering questionable benefit and with some opportunities clearly missed. No agreements showed a really poor fit.

Figure 6.2: ***Appropriateness of Agreement Targeting.*** Summary of panel scores (1 to 4) for the 174 HLS agreements assessed as part of the baseline survey



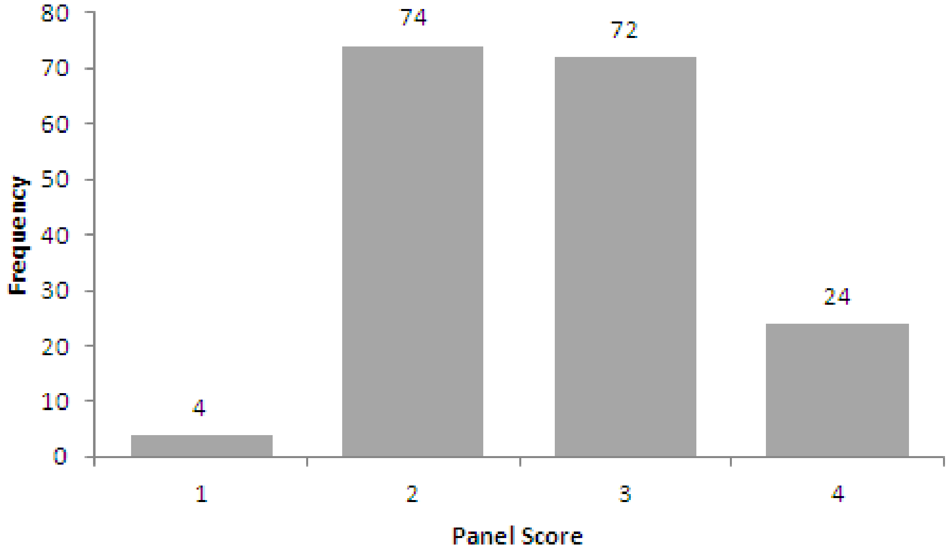
The quality of targeting was judged somewhat better in upland agreements than in those from the lowlands, especially where a high proportion of the agreement focussed on management of extensive semi-natural habitats. The panels found some evidence that agreements delivered against Regional Theme Statements had less focused objectives and were less well tailored to local conservation needs. Panels also felt that contribution to landscape objectives were poorly defined and/or hard to assess within the targeting framework.

Overall, the panel concluded that although there may be some room for improvement in maximising coverage of the range of local/regional targets, most agreements met some of the HLS targets for that area or region. Where agreements scored lower marks for targeting, the panel did recognise that it in some circumstances it was unrealistic to expect too much from a single agreement, especially if it was of limited extent or covered a narrow range of features, but that in such circumstances, those targets that were being addressed should be of high value.

Choice and use of HLS options

The panel made a judgement on the appropriateness of option choice in relation to the features identified in the FEP, assessing whether these options represented reasonable aspirations and/or goals for the features concerned. Twenty-four agreements (13.8%) were scored as of the highest quality with all features under management in appropriate options and, if appropriate, arable and resource protection options well chosen, sufficient and well positioned. A further 72 agreements (41.4%) showed slightly poorer design, but with no major discrepancies between features and options and with any arable and resource protection options well placed and with potential to deliver expected benefits. However, in a similar number of agreements (74 *i.e.* 42.5%) the panel identified at least one mismatch between feature and option that might adversely affect the environmental outcomes (score 2). Only four agreements were assessed at the lowest level (score 1) reflecting serious mismatches between features and options that were likely to result in adverse environmental outcomes, and with any arable and resource protection options poorly sited with little potential to produce benefits.

Figure 6.3: ***Use of Options.*** Summary of panel scores (1 to 4) for the 174 HLS agreements assessed as part of the baseline survey



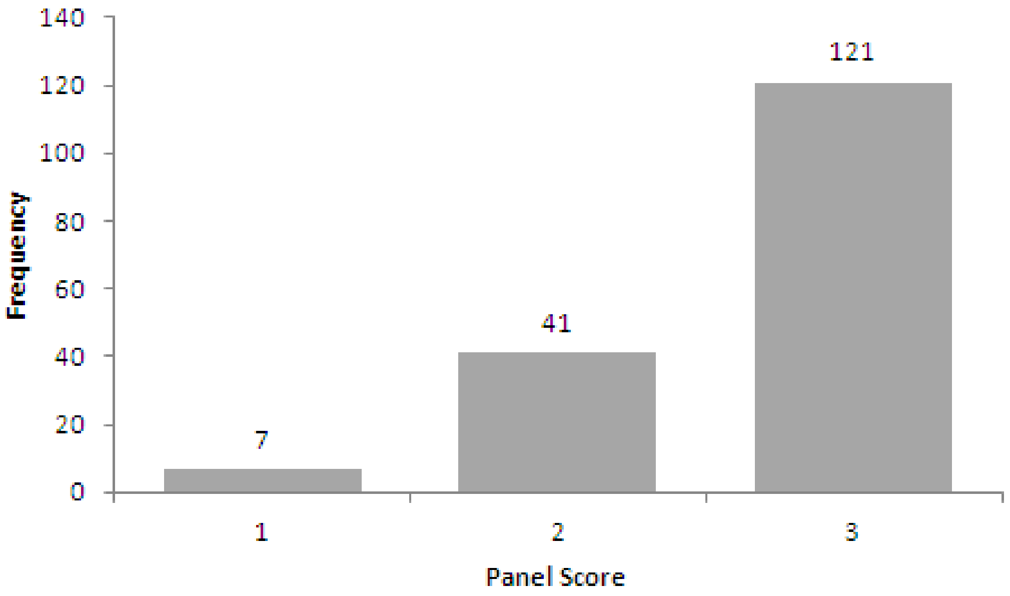
The mismatches between features and options appeared to arise for several reasons. The 'habitat quality inflation' observed in the FEPs led to some features being placed in maintenance options when restoration or creation would have been more appropriate. This was particularly an issue for the use of **HK6** and **HK7**, where **HK6** was used on semi-improved swards, instead of **HK7** or indeed where the latter was used on such swards with no clarity over how restoration would be brought about. Panels felt that in cases where habitat restoration options were chosen, the agreement should always specify how the restoration objective would be achieved. Some options were often targeted on features where the potential to deliver seemed somewhat aspirational and where the panel felt equivalent benefits could potentially be realised at lower cost by the use of either ELS options or other HLS options *e.g.* the objectives of options for managing grassland for target features (**HK15/HK16**) were sometimes vague and there were instances when the panel felt that the use of rough grassland options (**HL**) could have delivered the same benefits. A few agreements included options (often supplements) that were felt to be less well justified or even added arbitrarily. Whilst these can add value to the agreement, to elicit cooperation over a priority target, the panel felt that sometimes options were being added arbitrarily, possibly to facilitate a transition between the value of a previous "classic" scheme agreement and HLS. In a few instances, the panels questioned the value of large agreements that appeared complex with a huge array of options but at closer inspection, were dominated by low-value 'more of the same' type management with relatively little additionality or contribution from key HLS options. Very rarely, an option suitable for managing one feature of interest was identified as potentially damaging to a second feature. Thus, in the example of the mesotrophic lake alluded to above in discussing the FEP, the agreement had implemented **HC9** by the shore with consequent risk of negative impacts on the water-body through shade and through nutrient inputs through leaf-fall.

Taken as a whole, the panel were more concerned about this aspect of agreement building than the FEP and targeting criteria. The observed frequency of mismatches between features and options was important in that it could result in poor or suboptimal delivery of environmental outcomes. The panel recommended including a justification for option choice within the agreement documentation, as a way of improving overall agreement design.

Accuracy of the Agreement Map

Assessment of the agreement map was a simpler procedure and the panel were asked to recognise any errors that had led to inappropriate management and incorrect use of options, scoring the agreements over a 3-point scale (Figure 6.4).

Figure 6.4: ***Accuracy of Agreement Map.*** Summary of panel scores (1 to 4) for the 174 HLS agreements assessed as part of the baseline survey. Five agreements could not be assessed due to absence of the agreement map



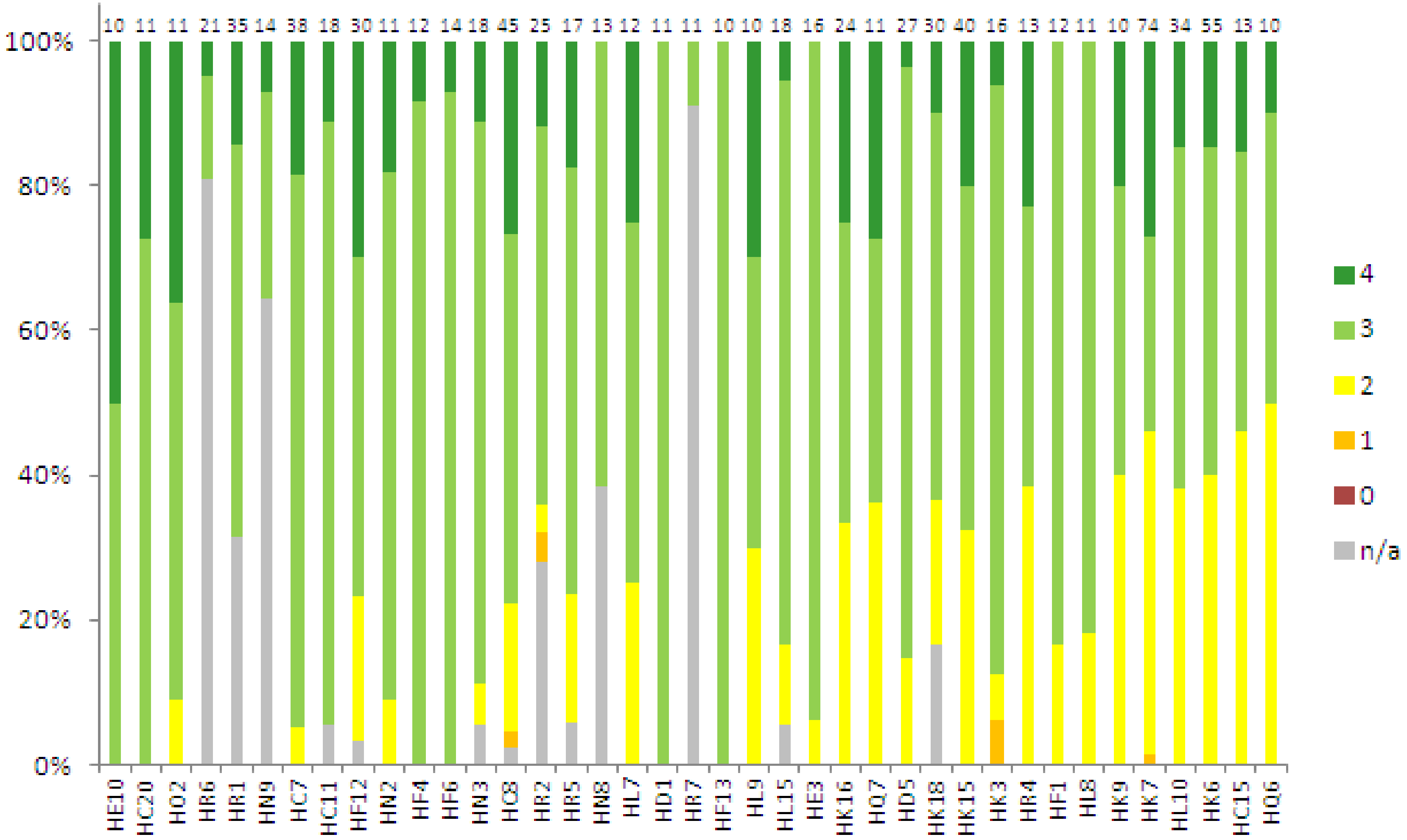
The great majority of agreement maps (69.5%) were accurate showing good correspondence on the ground between all features and management. Most of the remaining agreements (41 *i.e.* 23.6%) were scored as 2, with at least one case where the feature occupied only part of the area under management and where the panel felt this mismatch could not be justified on pragmatic grounds. Just 7 instances (4%) had one or more clear mismatches between features and management options resulting in either under- or overpayment, with the risk of breaching the agreement.

Those few problems that were reported with the agreement maps included no marking of capital works on the maps or no detail on the location of where burning was to be applied. Very occasionally potential errors arose due simply to the small size of the RLR parcels, where the scale of the map did not allow the agreement holder to identify which parts of the parcel were under particular options. A few arable options for plots were shown applying to a whole field. Agreement maps also suffered from the renumbering of RLS parcels, resulting in apparent discrepancies between the FEP and agreement maps.

Management Prescriptions: Comprehensiveness and Appropriateness

The panel reviewed the prescriptions for each option, assessing them for both comprehensiveness and appropriateness. Results are presented for those options that were assessed on ten or more occasions in the baseline survey (Figure 6.5) with options arranged from those where most cases were scored highly (left) to those where half the assessments were 2 or lower (right).

Figure 6.5: ***Prescriptions.*** Summary of panel scores (1 to 4) for options assessed on 10 or more occasions during the baseline survey. The bars show the relative proportions (percentages) in each scoring category and numbers above the bars give the actual number of times the particular HLS option was assessed



The highest score (4) was given where the prescriptions were tailored to the site where necessary and effectively delimited acceptable management whilst leaving room for any necessary adaptation to address the Indicators of Success. Options scoring 3 had mainly generic prescriptions but these showed no internal conflict and provided an appropriate framework for management of the feature. Scores of 2 were given when there were risks of internal conflicts with the prescriptions or where some were inappropriate or had missing elements that could affect successful management of the feature. The few options given the lowest score (1) had key elements inappropriate, missing or in conflict within the prescriptions, making mismanagement of the feature likely.

The 39 HLS options that were assessed on 10 or more occasions may be broadly dealt with in four categories:

I. Options where at least 65% of examples scored 3 or 4 for their prescriptions:
   a. *Woodland, trees and scrub*: **HC7** Maintenance of woodland, **HC8** Restoration of woodland; **HC11** Woodland livestock exclusion supplement; and **HC20** Restoration of traditional orchards
   b. *Archaeology*: **HD5** Management of archaeological features on grassland
   c. *Arable and margins*: **HE10** Floristically enhanced grass margin (non-rotational); **HF4** Nectar flower mixture; **HF6** Overwintered stubbles; and **HF12** Enhanced wild bird seed mix plots
   d. *Grassland*: **HK3** Permanent grassland with very low inputs outside the Severely Disadvantaged Area (SDA) of the Less Favoured Area (LFA) and the Moorland Line
   e. *Moorland & upland rough grazing*: **HL7** Maintenance of rough grazing for birds; **HL9** Maintenance of moorland; and **HL15** Seasonal livestock exclusion supplement
   f. *Access*: **HN2** Permissive open access; **HN3** Permissive footpath access; and **HN8** Educational access (base payment)
   g. *Lowland heathland*: **HO2** Restoration of lowland heathland on neglected sites
   h. *Supplements*: **HR5** Bracken control supplement

II. Options where no examples were scored 4, though >65% scored 3:
   a. *Archaeology*: **HD1** Maintenance of weatherproof traditional farm buildings
   b. *Arable and margins*: **HE3** 6 m buffer strips on cultivated land; **HF1** Management of field corners; and **HF13** Fallow plots for ground-nesting birds
   c. *Moorland & upland rough grazing*: **HL8** Restoration of rough grazing for birds

III. Options where the majority of examples could not be assessed (usually due to absence of any prescriptions):
   a. *Access*: **HN9** Educational access (payment per visit)
   b. *Supplements*: **HR1** Cattle grazing supplement; **HR6** Supplement for small fields; and **HR7** Supplement for difficult sites

IV. Options where more than 35% of examples scored 2 or below:
   a. *Woodland, trees and scrub*: **HC15** Maintenance of successional areas and scrub
   b. *Grassland*: **HK6** Maintenance of species-rich, semi-natural grassland; **HK7** Restoration of species-rich, semi-natural grassland; **HK9** Maintenance of wet grassland for breeding waders; **HK15** Maintenance of grassland for target species; **HK16** Restoration of grassland for target species; and **HK18** Hay-making supplement
   c. *Moorland & upland rough grazing*: **HL10** Restoration of moorland
   d. *Wetland*: **HQ6** Maintenance of fen; and **HQ7** Restoration of fen
   e. *Supplements*: **HR2** Native breeds at risk grazing supplement; and **HR4** Supplement for control of invasive species

The composition of these categories shows a clear trend toward poorer prescriptions for grassland options and, to a lesser extent, wetlands such as fens. All options in arable land and for field margins appeared to have adequate prescriptions. Options without prescriptions were supplements where the management is defined within the prescriptions for the core option the supplement overlays.

The main issues identified with use of management prescriptions tended to be linked to poor drafting, imprecision and/or omission and lack of clarity about the availability of or relationship with supporting management plans. Either the option introduction or the poor and imprecise prescriptions themselves frequently used highly standardised generic text to describe objectives, features and management techniques, and indeed a small but significant minority of prescription sets were confused, vague, repetitive and inconsistent. Generally, tailoring prescriptions to an agreement improved the guidance and meant the desired outcomes were more likely to be achieved though there were risks of unintended consequences; for instance, in a frequently encountered example, the tailoring of grassland prescriptions by removing the generic prescription that allowed the use of manures with no insertion of a replacement resulted in no apparent on fertiliser application.. However, it should also be stressed that in many cases, generic prescriptions will provide an acceptable regime for the feature being managed on any particular agreement.

Generic prescriptions are especially unsuitable where complex or innovative management is required, where there the management needs to address multiple features and/or where there is real risk that the desired outcomes may not be met. For more complex sites, management plans often provide a necessary framework for adding vital clarity over how outcomes will be delivered (*e.g*. in grassland restoration, moorland management and woodland management) enabling the relationship and dependencies between capital and annual management to be defined.

Other less frequent but nonetheless important issues with the management prescriptions in some HLS options included:

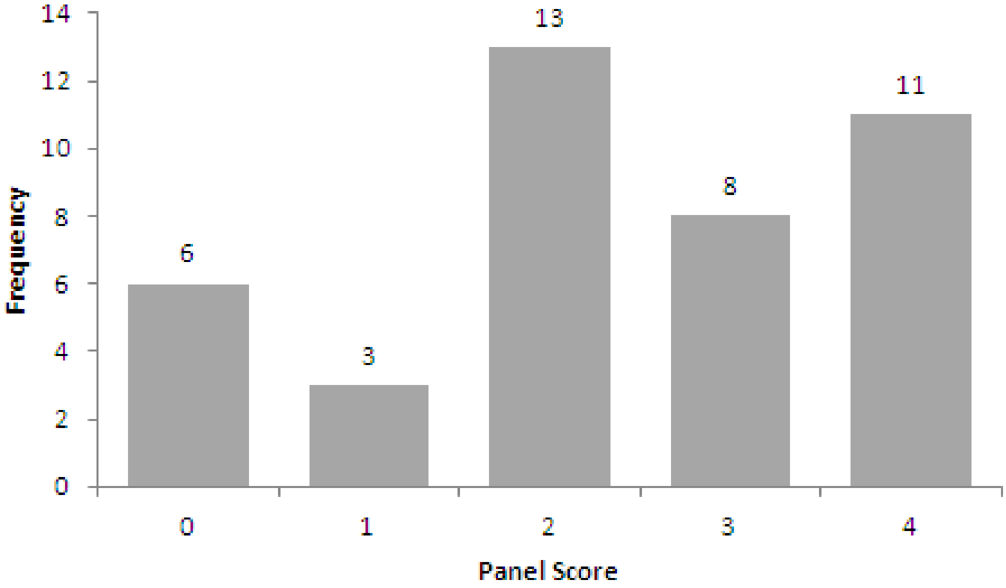
- Prescription sets for woodland options were often sparse and lacking detail.
- Grassland options for target features occasionally omitted to specify the feature or to adapt the prescriptions to meet the needs of the feature.
- There were examples of grassland options that lacked information on stocking rates or periods; for instance appearing to prescribe a continuous grazing season when a period to allow flowering, fruiting and seed-setting was vital for option success.
- Certain management practices (*e.g.* burning) had locally been incorporated into prescriptions when it is questionable whether they were appropriate for conservation of the feature present (e.g. blanket bog).
- Some stated seed-mixes (*e.g*. for **HE10, HK7** and **HK8**) appeared to be potentially unsuitable for the receptor site.
- Guidance on eradication of invasive species was typically poor with ambiguous wording that might not provide clarity to the agreement holder.

Taken as a whole, however, the panel found that the prescription sets for most HLS options were capable of delivering the intended outcomes and were adequately written. The panel did feel that the context of prescriptions within the agreement could be better described, advocating a more structured approach to Part 3 of the agreement, especially in large or complex sites. This should include an explanatory preamble to the prescriptions, justifying why the approach was being taken (with target features explicitly stated), and that when used, management and implementation plans should be attached to the agreement dossier or integrated within the main text. Finally, the panel concluded that more advice was needed for NE advisers on how and when to modify or augment generic prescriptions.

Stocking calendar

Stocking calendars should be a key element of management guidance in some HLS agreements, and are mandatory on holdings with open extensive moorland. This criterion was only assessed in 2010 due to its importance in upland agreements. A summary of the panel results is given in Figure 6.6 for 41 of the 50 agreements surveyed in 2010; the remaining 9 agreements had no open moorland and thus a calendar was not mandatory.

Figure 6.6: ***Stocking Calendar.*** Summary of panel scores (0 to 4) for HLS upland agreements assessed in 2010 (score of 0 indicates no stocking calendar was present despite being necessary).

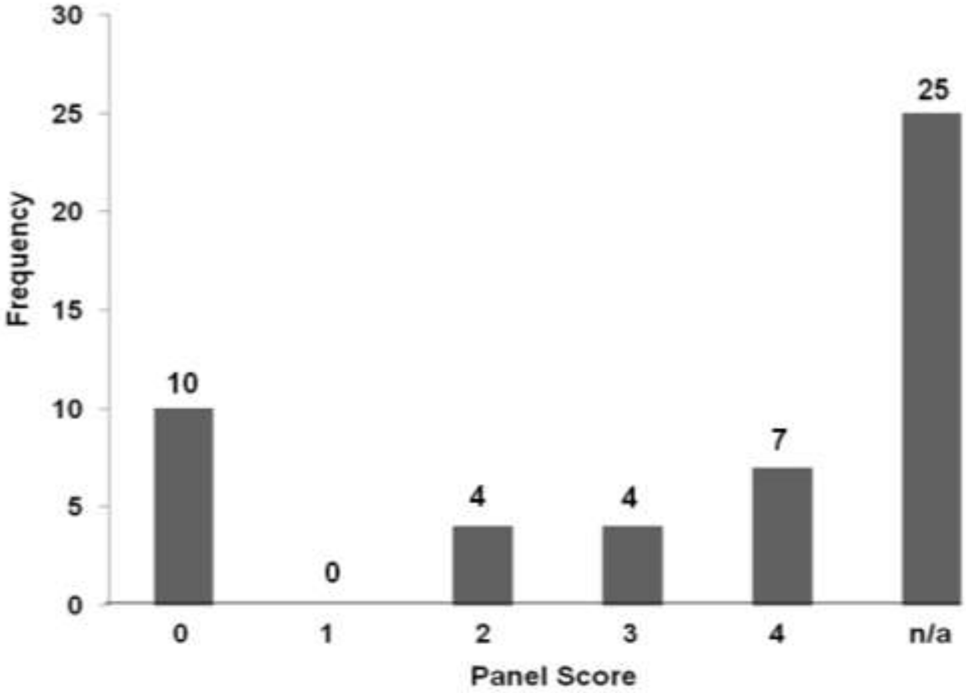


Six agreements that should have had a stocking calendar did not appear to have one, and were consequently marked at 0. Three agreements had a calendar which had key elements missing, which could make successful delivery of HLS goals unlikely. The remaining 32 agreements were distributed fairly evenly between panel-scores 2, 3 and 4, with lower scoring holdings having aspects that could limit successful delivery and the highest score (4) reflecting calendars that were specific to the site and defining management that appeared likely to deliver desired outcomes. Some of the lower scoring calendars appeared to have had grazing levels set too high for effective restoration. Many generic issues related to stocking calendars were identified (see below) but the commonest cause of difficulties was abandonment of the original template. Instead of tailoring the calendar to the holding, such diversion from the template resulted in insufficient detail on rates (maximum and minimum) and both when and where these rates should be applied. The panel also noted the difficulty of setting and indeed assessing the appropriateness of stocking rates over varied landscapes that might contain fragile habitats (*e.g.* upland flushes and blanket bog) that could be vulnerable to overgrazing.

Burning plan

Many HLS agreements on unenclosed open moorland require a burning plan to provide guidance on what, where and when to burn without damaging vulnerable features. As with the stocking calendar, the panel only assessed the quality of burning plans in 2010, when upland agreements were the focus of the survey. Of the 50 agreements surveyed, only half were judged as requiring such a plan with the remainder scored as “n/a” (Figure 6.7). However of the 25 agreements where a burning plan was thought to be necessary, a further 10 (40%) appeared to lack the necessary documentation and were consequently scored as 0. The remaining 15 agreements did possess the required plan.

Figure 6.7: ***Burning Plan.*** Summary of panel scores (0 to 4) for the 50 HLS upland agreements assessed in 2010. Notes: a) score of 0 indicates no burning plan present despite being necessary; and b) n/a indicates agreements where no such plan was mandatory



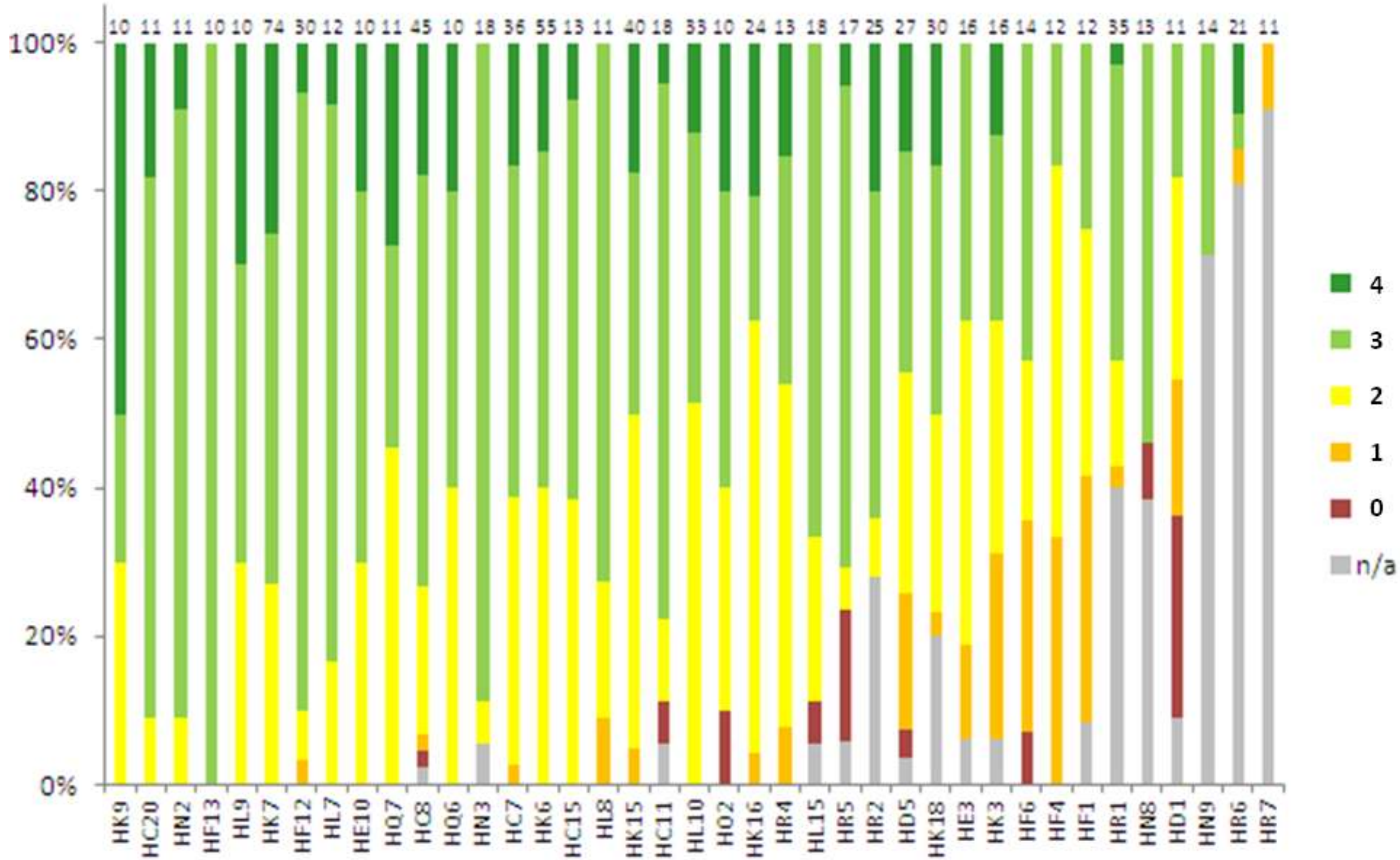
Of the 15 plans assessed, seven were specific to that holding and properly delimited acceptable burning to deliver GLS objectives (score 4). The remaining eight agreements showed some potential weaknesses in the plan, with half possessing a generic plan that might nonetheless be suitable (score 3) and the other four agreements being judged to have some inappropriate or missing elements that might affect successful delivery (score 2).

In the eight plans where the panel identified some weaknesses, the main problems were a rotation that the panel felt was badly designed and/or inadequate identification of sensitive areas, sometimes compounded by imprecise wording. The panels were concerned at the application of burning to blanket bog and wet heath features. Overall, the best plans showed tailoring, sensitive areas mapped and the burning adjusted to account for conservation features (*e.g.* merlin) as well as red grouse. In the case of agreements lacking a burning plan, it was identified that in some cases, at least, the plan was being produced during the first year of the agreement.

Indicators of Success: Comprehensiveness and Appropriateness

The panel reviewed the Indicators of Success (IoS) following a similar approach to that for management prescriptions, assessing them for comprehensiveness and appropriateness in the context of each option. The panel were also asked to judge whether the prescriptions and IoS were consistent with each other and focussed on the same outcome. As with the prescriptions, results are presented here for those options that were assessed on ten or more occasions throughout the three years of the baseline survey.

Figure 6.8: ***Indicators of Success (IoS)***. Summary of panel scores (1 to 4) for options assessed on 10 or more occasions during the baseline survey. Bars show relative proportions (percentages) in each scoring category and numbers above the bars give the actual number of times a particular HLS option was assessed. Note: Some options lacked IoS and are scored zero (0) where IoS are necessary or n/a where IoS are not essential (often supplements)



These options are arranged in Figure 6.8 from those where most cases were scored highly (left) to those where half the assessments were 2 or lower (right). Where the indicators provided a comprehensive picture of successful management, were specific to the site, measurable, achievable and clearly distinguished from prescriptions, the panel gave them a core of 4. A lower score (3) was given where the indicators were essentially generic but still generally comprehensive, appropriate, measurable and achievable. Those IoS that were less satisfactory were scored as 2 when there were risks of internal conflicts with the prescriptions or where some were inappropriate or had missing elements that could affect successful management of the feature. The few options given the lowest score (1) had key elements inappropriate, missing or in conflict within the prescriptions, making mismanagement of the feature likely. When no IoS were drafted for options where such indicators were necessary, the panel gave a score of zero.

Following approximately the outline used for the prescriptions, Figure 6.8 presents results for the 39 HLS options[1] that were assessed on at least 10 occasions by the panel. These can be roughly placed in four categories that differ slightly from those used above:

I. Options where at least 60% of examples scored 3 or 4 for their IoS:
   a. *Woodland, trees and scrub*: **HC8**, **HC11** and **HC20**
   b. *Arable and margins*: **HE10**, **HF12** and **HF13**
   c. *Grassland*: **HK7** and **HK9**
   d. *Moorland & upland rough grazing*: **HL7**, **HL8**, **HL9** and **HL15**
   e. *Access*: **HN2** and **HN3**
   f. *Supplements*: **HR2** and **HR5**

II. Options where 50-60% of examples scored 3 or 4 for their IoS:
   a. *Woodland, trees and scrub:* **HC7** and **HC15**
   b. *Archaeology*: **HD5**
   c. *Arable and margins*: **HF6**
   d. *Grassland:* **HK6**
   e. *Access*: **HN8**
   f. *Lowland heathland:* **HO2**
   g. *Wetland:* **HQ6** and **HQ7**

III. Options where most examples could not be assessed (due to absence of any IoS):
   a. *Access*: **HN9**
   b. *Supplements*: **HR6** and **HR7**

IV. Options where less than 50% of examples scored 3 or 4 for their IoS:
   a. *Archaeology:* **HD1**
   b. *Arable*: **HE3**, **HF1** and **HF4**
   c. *Grassland*: **HK3**, **HK15**, **HK16** and **HK18**
   d. *Moorland & upland rough grazing*: **HL10**
   e. *Supplements*: **HR1** and **HR4**

Comparison with the results from the appraisal of the prescriptions reveals that the panel consistently found problems with the Indicators of Success, which were sometimes inappropriate for the option and/or feature concerned. Also there was a less perceptible pattern in the option groups that had high or low quality IoS, with examples from most option groups in three of the categories – though again some options, and especially supplements, such as **HN9**, **HR6** and **HR7** were not amenable to assessment. Amongst the most frequently assessed options, the panels identified that generally the species-rich grassland options e.g. **HK7** had well-drafted IoS whilst the options with poorer quality IoS included options for managing grassland for target species, and also arable options, many of which were 'more of the same' options *e.g.* **HE3** and **HF4**, for which inclusion of IoS is not mandatory.

[1] Options are listed here only by their HLS codes. The full names of these options are given in the section describing appraisal panel results for management prescriptions.

A fundamental criticism levelled by the panel concerned the measurability of some Indicators of Success, and especially those related to species or to factors such as diffuse pollution. Indicators might not be measurable due to their being expressed in vague qualitative terms or requiring baseline information from which to measure change. For example, reference to 'maintaining' species populations would require accurate baseline information and regular, accurate monitoring that could be beyond the scope of the agreement. IoS were sometimes expressed in jargon that is clear to conservation professionals but which might need interpretation for a lay readership *e.g.* '*SSSI land should be in favourable or recovering condition*' or "undesirable/desirable species".

Some of the least effective IoS encountered had been drafted for "More of the Same" options and supplements. These were frequently omitted altogether (as they are not currently mandatory), and where included they typically comprised little more than general information about the management or the value of the holding. The panel felt that where ELS options are used within HLS agreements, IoS should be included, not least to provide justification for additional spend on ELS management within HLS, and similarly there may be opportunities to set IoS for those supplementary options that demand more than simply meeting IoS for the core HLS option they overlay. For example, the benefits expected from supplements such as **HK18** for haymaking and **HR4** for control of invasive weed supplements could be described explicitly. The panels also felt that IoS should also be more explicitly linked to the capital works programme where outcomes are dependent on delivery of capital items.

The panel recommended a clearer framework for assessing progress against indicators over time. The current approach is to have some indicators measurable at year 2, others at year 5 and others at the completion of agreement but typically with different indicators set for assessment at different timescales rather than the same indicators measured repeatedly. There are obvious differences in the way a suite of IoS might be described for restoration or maintenance management, but the panels saw merit in establishing a matrix for each indicator with a target set for key points in the agreement that described the trajectory towards a successful outcome. Some options appeared to have too few IoS to assess the success of the option (*e.g.* in woodlands) whilst a smaller number included a proliferation of indicators where a simpler framework with a few well-targeted IoS would have sufficed.

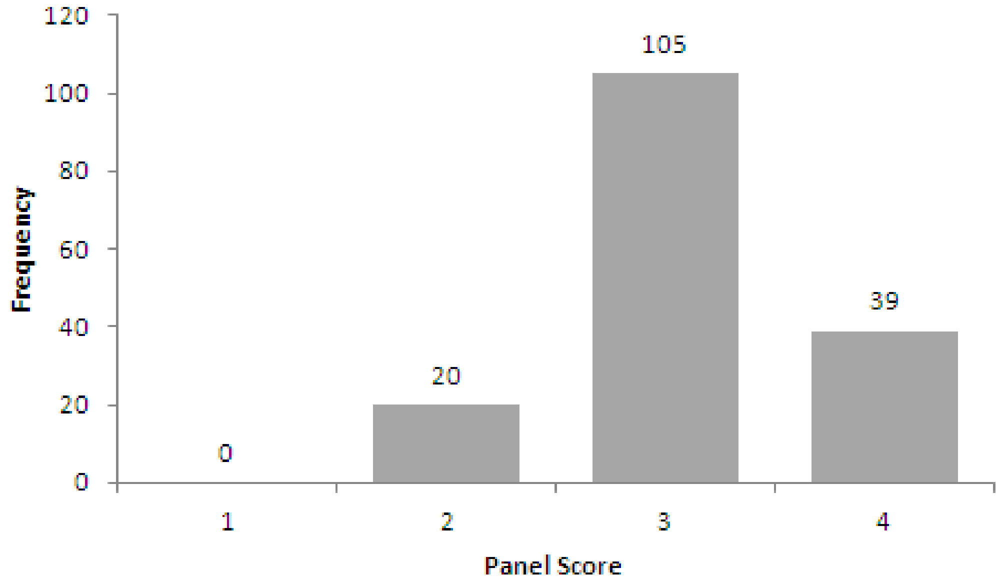
Most importantly the panel felt that the application of IoS was typically too generic, utilising standard indicators defined in Genesis, and not sufficiently tailored to the range or nature of target features present in individual situations. The panels felt that the linkages between prescriptions and IoS could be strengthened such that management approaches could be tested for their practicability – in effect, were the IoS actually achievable under the stated regime? The use of generic IoS meant that the threshold for success might sometimes be set either very low or improbably high given the present condition of the parcel. The panel also identified a need for greater tailoring of IoS with regard to particular parcels; individual options in some agreements are applied to a number of parcels, potentially representing different condition situations and requiring greater adaptation of both the prescriptions and the indicators. It was noted that some option groups (*e.g*. **HK6-8** for the maintenance, restoration or creation of species-rich semi-natural grassland) employed identical sets of indicators regardless of whether maintenance or restoration of the habitat were the aim.

Despite a general need for more tailored indicators, the panel acknowledged that given the importance of income forgone in underpinning management, audit of HLS (and agri-environment schemes generally) might appear more straightforward where generic prescriptions and IoS were used, rather than more adapted management. In commenting on the generic set of IoS, the panel did judge that most were comprehensive and/or potentially appropriate if suitably tailored. However a small number were intrinsically poor or difficult to measure *e.g.* IoS that expected a surveyor or the agreement holder to be able to measure the percentage of forbs flowering in grassland was considered essentially unmeasurable.

Suitability of capital works

The panel examined the capital works applied in the agreements on the basis of whether they enabled and supported the delivery of HLS. Appraisal focussed on the relationship between the capital works programme and the HLS options and prescriptions detailed in Parts 3 and 3 of the agreement documentation, and an assessment of whether the programme was suitably focused on key outcomes and of an appropriate scale, and whether delivery was timely. They also took into account the design and specification of the works as recorded in Part 5 of the agreements. Figure 6.9 presents the panel results for 164 of the 174 agreements assessed within the baseline survey. Ten of the agreements had no capital works programme and are thus omitted from the summary of results.

Figure 6.9: ***Capital Works*****.** Summary of panel scores (1 to 4) for the HLS agreements assessed as part of the baseline survey



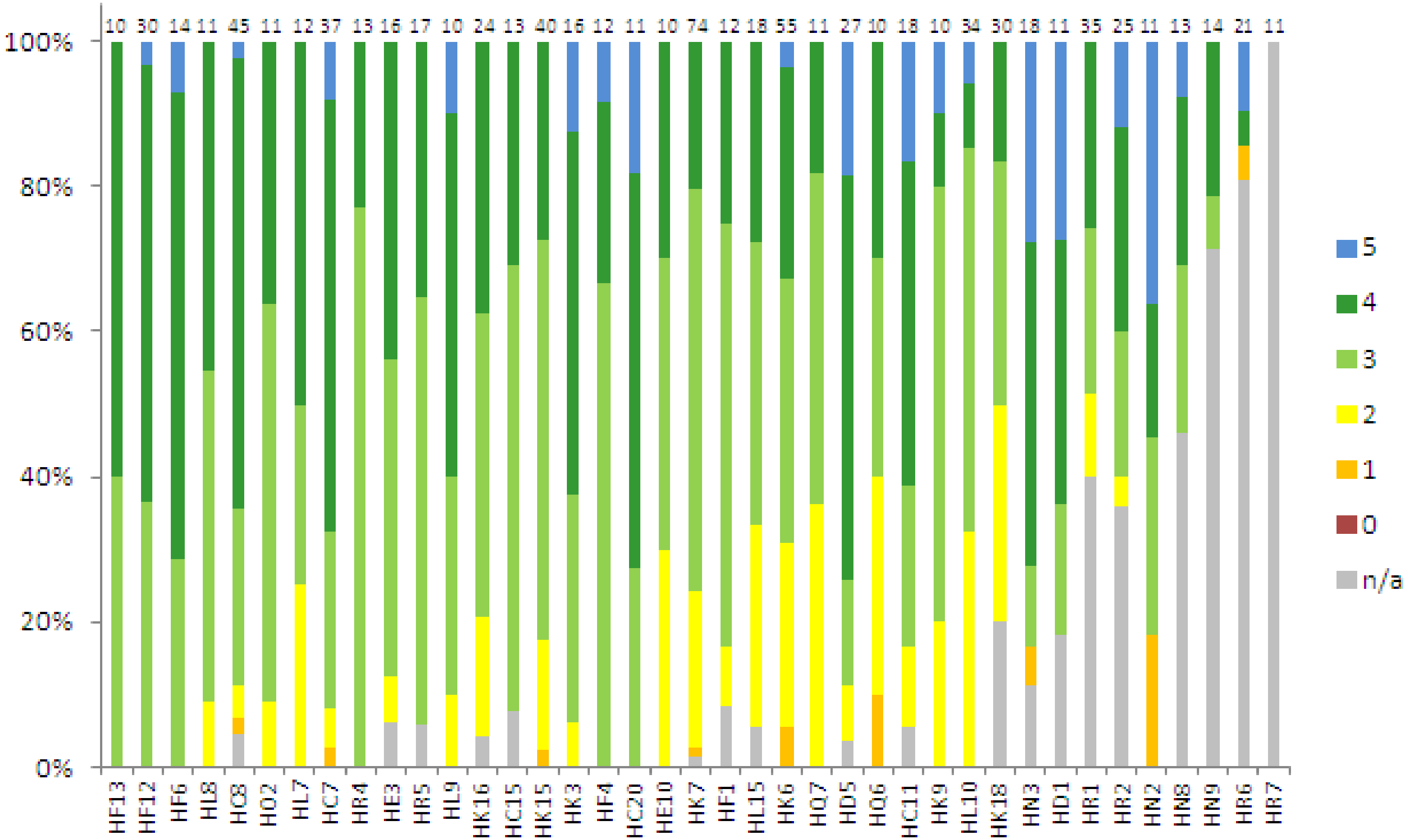
Most capital works programmes were assessed as essential to the functioning of annual management options and that any "free-standing works" were likely to add some value to the environmental outcomes (*i.e.* 88% of agreements scoring 3 or 4). Although many capital works were integrated with specific HLS options, some were focussed on the delivery of HLS objectives independent of an annual option *e.g.* improving the networks of stone walls or hedgerows, or using special projects to repair historically important buildings thereby reinforcing or enhancing landscape character. None of the agreements included in the baseline survey had a capital work programme judged as unlikely to provide the necessary support to the annual management options or to contribute to desirable environmental outcomes. However 20 agreements (12%) had a programme that provided only minimum support to annual management options, but with little evidence of any other added environmental value.

Given that the great majority of capital works programmes had been properly designed and supported the delivery of HLS, the few issues identified by the panel were relatively minor. There were occasional problems with a lack of detail and specification, as well as insufficient linkage to other objectives for the agreement, and in a few cases capital works were not properly entered on the agreement map. The panel did not directly score capital works specifications, but noted that these were typically submitted in generic form, and that sometimes a more tailored specification might have been desirable.

Achievement of desired option outcomes

For each individual option, the panel assessed the likelihood that the intended outcomes of the option would be achieved within the lifetime of the agreement. The panel used a 6-point scale assessing the likelihood that all/most/some desired outcomes would be achieved *i.e.* all (5), most (4), some though some uncertain (3), some unlikely (2), unlikely for all/most (1) or unable to determine (0). Results are presented in a similar way to those for management prescriptions and IoS, dealing with those 39 options assessed on ten or more occasions in the baseline survey of 2009-2011. These options are arranged in Figure 6.10 roughly from those where most cases were scored highly (left) to those where a large number were scored 2 or lower or could not be assessed (right).

Figure 6.10: ***Option Level Outcomes.*** Summary of panel scores (0 to 5) for options assessed on 10 or more occasions during the baseline survey. Bars show relative proportions (percentages) in each scoring category and numbers above the bars give the instances that a particular HLS option was assessed



Once again, following similar categories to those employed for description of the panel results for prescriptions and IoS, the 39 options may be placed in three groups:

I. Options where at least 70% of examples scored 3, 4 or 5 for their IoS:
   a. *Woodland, trees and scrub*: **HC7**, **HC8**, **HC11**, **HC15** and **HC20**
   b. *Archaeology:* **HD1** and **HD5**
   c. *Arable and margins*: **HE3**, **HF1**, **HF4**, **HF6**, **HF12** and **HF13**
   d. *Grassland*: **HK3**, **HK7**, **HK9**, **HK15** and **HK16**
   e. *Moorland & upland rough grazing*: **HL7**, **HL8** and **HL9**
   f. *Access*: **HN2** and **HN3**
   g. *Lowland Heathland:* **HO2**
   h. *Supplements*: **HR4** and **HR5**

II. Options where most examples could not be assessed:
   a. *Access*: **HN8** and **HN9**
   b. *Supplements*: **HR1**, **HR2**, **HR6** and **HR7**

III. Options where <70% of examples scored 3-5, with most of remainder scoring 0-2:
   a. *Arable and margins*: **HE10**
   b. *Grassland:* **HK6** and **HK18**
   c. *Moorland and upland rough grazing:* **HL10** and **HL15**
   d. *Wetland:* **HQ6** and **HQ7**

The groupings may be interpreted fairly easily. Most options (26 of the 39) were judged generally likely to meet all or most of their desired outcomes, though there was some doubt with a few outcomes. As with other criteria employed by the Appraisal Panel, many supplements and the options for educational access were often not amenable to scoring.

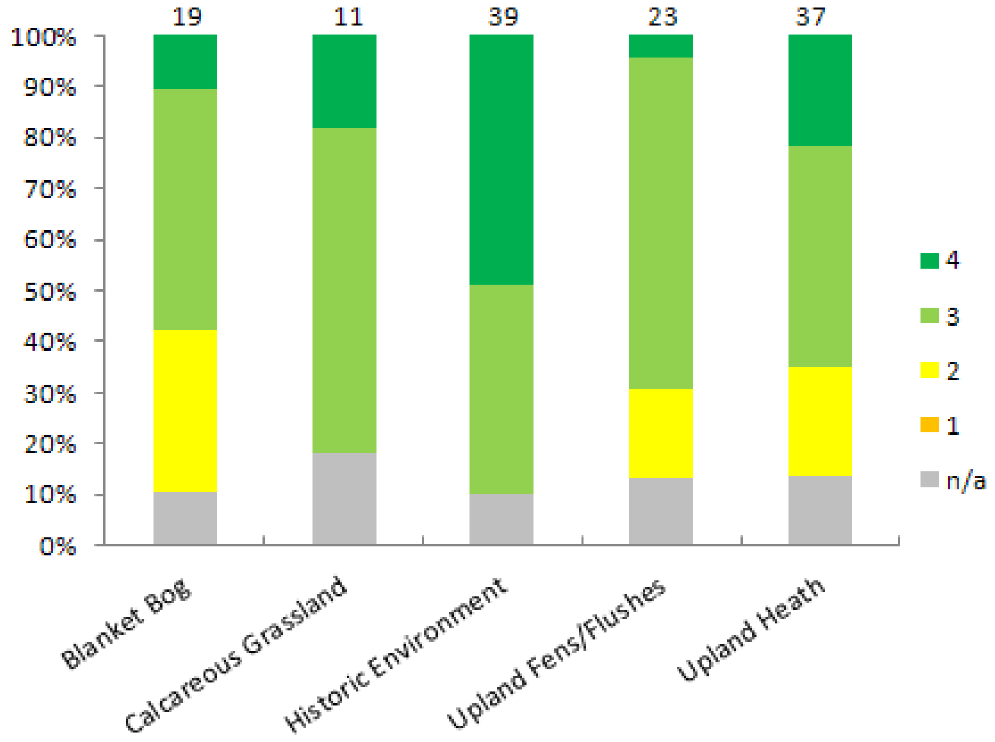
Those options where the panel more often found reason to doubt the achievement of the desired outcomes are usually those where habitat quality inflation or difficulties with management reduce the prospect of meeting the desired outcomes. Thus **HE10** floristically enhanced grass margins were affected by inappropriate seed mixtures and/or insufficient management during the establishment phase to reduce the dominance of competitive coarse tussock grasses. Where maintenance of species-rich, semi-natural grassland (**HK6**) was intended, a positive outcome was only possible if there was species-rich, semi-natural grassland present at the outset and, in the worst instances of targeting of this option , this was not the case. For moorland restoration (**HL10**), the panel found that a significant number of cases started with significant areas of vegetation that had poor dwarf shrub cover or indeed, where grass moorland was dominant. The prospect of restoring upland heath or blanket bog without substantive additional intervention in such situations was judged to be low. The maintenance and restoration of fen (**HQ6** and **HQ7**) were also options identified by the panel as having a greater likelihood of failure, sometimes due to the misclassification of the habitat and sometimes because the desired outcomes were assessed as too ambitious given constraints operating on the site and/or the scale of intervention to be applied. The options that were scored poorly were all high value habitats requiring active and/or often difficult restoration management. However, even for options that were generally scored as effective, the panel identified that some might take longer than the span of an agreement to deliver in full; for instance, woodland creation and complex moorland restorations involving core management and supplements.

Overall, the panel found that most agreements included options where at least some outcomes were likely to be achieved, though noted that some others remained uncertain at this early stage in the agreement. It is important to recognise that in making judgements about the likely effectiveness of management, the panels worked under the overriding assumption that the management planned would be delivered in a way that was compliant and of a reasonable standard over the span of the agreement. Because the desired outcomes of some options were not always clearly expressed, the panel recommended that rigorous review or QA was needed at the outset of an agreement to ensure that the desired outcomes were appropriate and realistic. The panel also felt that for more complex or larger/high value agreements full management or implementation plans should be produced and either contained within or linked explicitly to within Part 3 of the agreement. . Such plans provide a better framework for demonstrating that options and option combinations have been planned effectively to deliver desired outcomes in realistic timeframes.

Achievement of feature scale outcomes (upland agreements)

This criterion was only assessed by the panel for the upland element of the baseline survey in 2010 and then only within unenclosed moorland where very large parcels under the same option might contain, and hence management expected to deliver for, several features. In such cases, prescriptions need to be tailored to address all the key features and habitats present. The panel appraisals attempted to take into account the combination of options, supplements and capital works programmes (together with stocking calendars, burning and other management plans where applicable) applying to land areas to assess whether the agreement provided an effective framework for delivering outcomes for the range of moorland features believed to be present. Results of the appraisals for the five most frequently assessed features (blanket bog, calcareous grassland, historical features, upland fens/flushes and upland heath) are presented in Figure 6.11. The panel was usually not able to make judgements about targeted species features.

Figure 6.11: ***Feature Level Outcomes.*** Summary of panel scores (0 to 4) for the 50 HLS upland agreements assessed in 2010, describing the five most frequently assessed features on unenclosed uplands.



The most frequently cited reason for lower scores was that the management applied to protect or enhance the condition of one feature might potentially have less favourable impacts on others, resulting in management conflict. The panel stressed that implementation of HLS options, whether through prescriptions and management plans, needed to take account of all the important features in an area, and further emphasised the need for integrated planning at both the agreement scale and ideally between agreements in a contiguous area (*e.g*. a moorland block). The results are presented by main FEP feature:

1) *M06 (blanket bog BAP habitat)*: Most concern was expressed about this habitat, with plentiful cases identified where the management proposed appeared to have serious weaknesses that were likely to limit its effectiveness (score 2). Few examples were judged likely to deliver fully the desired outcomes (score 4). Winter grazing, whilst desirable for other features, was seen as

potentially damaging to bog. Many blanket bogs were badly degraded and successful production of sustainable high quality bog may be hard and protracted.

2) *M08 (upland fens, flushes and swamps BAP habitat)*: Results were broadly similar to blanket bog, though fewer samples had serious weaknesses and the panel judged that the feature could be effectively managed, though with some risk. Winter grazing was again identified as problematic for these fragile and localised habitats.

3) *M04 (upland heath BAP habitat)*: The pattern of scores was similar to M08, but with more cases where the likely outcomes were judged favourable. Serious weaknesses arose from misclassification of M01 grass moorland as though it were M04 upland heath, meaning that development of high quality heath under **HL10** was unlikely.

4) *G08 (upland calcareous grassland)*: This feature was only well-represented within the Pennine Dales, where the habitat was generally in good condition, and the panel concluded that usually all desired outcomes would be met.
5) *Historic Environment*: Features relating to archaeology, historic environment and landscape were the most frequently assessed during the appraisal process. They were also the features for which the panel gave consistently the highest scores, with no examples judged as having serious weaknesses (score 2) and in almost half the cases the panel believed that HLS would deliver the desired outcomes fully for these features.

Achievement of planned agreement outcomes

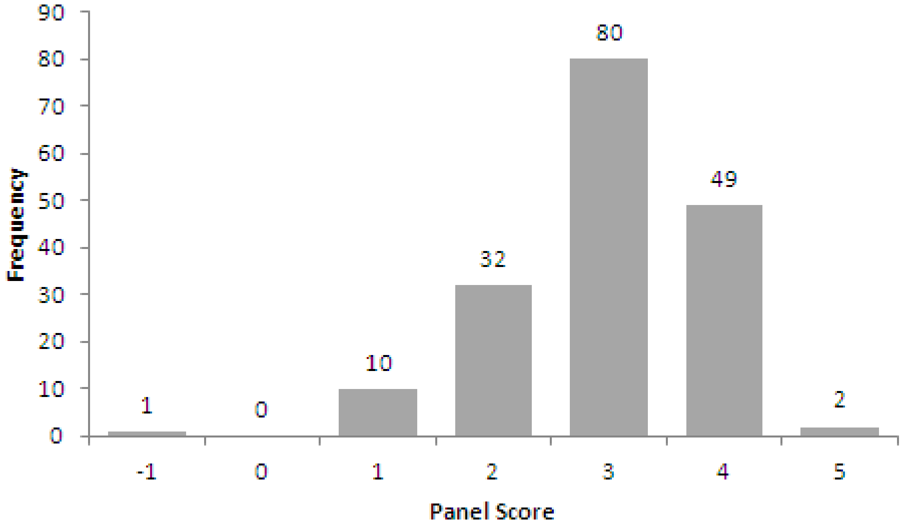
The last criterion scored by the panel integrated the results from the first 8 stages of the appraisal and endeavoured to forecast how likely it was that the whole agreement would be effective in delivering multiple objectives, combining to give synergy and additionality. The panel used a 7-point scale to assess the agreements:

5: Likely to be fully effective in achieving all possible scheme outcomes, maximising delivery against all objectives and providing additionality and good synergy between objectives
4: Likely to be fully effective for most outcomes but a few minor weaknesses; provides additionality and good synergy between objectives
3: Likely to be effective in achieving most outcomes but with some significant weaknesses; some additionality and/or synergy between objectives
2: Significant weaknesses but potentially effective in some areas; synergy between objectives and additionality are both limited
1: Serious weaknesses but will achieve some limited scheme outcomes, albeit with little additionality and/or synergy between objectives
0: Likely to be ineffective in achieving all scheme outcomes
-1: Likely to be detrimental to some or all scheme outcomes

Figure 6.12 summarises the results of the scores given by the Appraisal Panel to the 174 agreements within the baseline survey. Three-quarters of the agreements were scored from 3 to 5, indicating that the agreements would achieve all or most outcomes, but the preponderance of scores in category 3 indicates that in almost half the agreements assessed the panels had identified some significant weaknesses. A further 32 agreements were judged only effective in some areas, and 10 agreements had serious weaknesses.

Although the panel recognised that allotting these scores was a qualitative process and the distinction between agreements scored as 2 or 3 for overall agreement outcomes was vague, the threshold between these scores provides a good overall indication for the overall acceptability of the quality of the agreement. The panel also cautioned against the uncritical interpretation of the overall scores allotted, recognising that ambitious but risky agreements could score lower, but might have great potential value, particularly if well-designed and if the management was generally delivered effectively.

Figure 6.12: ***Agreement Level Outcomes.*** Summary of panel scores (-1 to +5) for the HLS agreements assessed as part of the baseline survey



The underlying causes for low agreement-level scores are of course derived from those cited within the appraisal of the agreement building process and the predictions of option/feature outcomes. Those that scored most poorly (1) were agreements where options appeared to be at risk of failing consistently or where the use of certain options threatened to damage adjacent priority habitats. However, the evidence from the appraisal process is that three out of four agreements were at least adequate in delivering their objectives and providing significant environmental benefits.

7 Ecosystem Services in High Level Stewardship

An approach to assessing ecosystem services on grasslands

Ecosystem services are defined as the resources and processes derived from ecosystems that benefit humankind. These include products, such as food, air and water, and services, such as the decomposition of wastes, pollination and control of pests (MEA, 2005). There is increasing concern that anthropogenic exploitation of many ecosystems is leading to the widespread degradation of the ecosystem goods and services they provide (CBD, 2010). Ecological restoration is seen as a key part of international initiatives to reverse biodiversity loss and enhance ecosystem service provision (CBD, 2010; EU, 2010).

Grassland is one of the most widespread ecosystems globally, covering around 3300 million hectares, with 230 million hectares in Europe alone (Carlier *et al*., 2009). Grasslands play an important role in delivering ecosystem services such as meat and forage production, carbon sequestration and pollination (Sala & Paruelo, 1997). There is also evidence that service delivery may be significantly enhanced by conservation and restoration of bio-diverse 'High Nature Value' grasslands (Pilgrim *et al*., 2010; Pywell *et al*., 2010; Watson *et al.,* 2011).

Agri-environment schemes are a key policy instrument for the planning and implementation of such large-scale conservation and restoration measures required to ensure the continued provision of ecosystem services. Grassland management to deliver biodiversity and ecosystem services is one of the dominant activities funded under such schemes (Anon., 2009): with over 400,000 ha currently managed as low input grassland under ELS, and a further 77,000 ha under HLS. There is an urgent policy need to understand and quantify the potential role of the schemes in delivering ecosystem services (Sutherland et al., 2010). Most attempts to achieve this have relied on expert opinion (Cole, 2009), and there remains a critical lack of quantified field data on the effects of conserving and restoring biodiversity on ecosystem services (Rey Benayas *et al*., 2009).

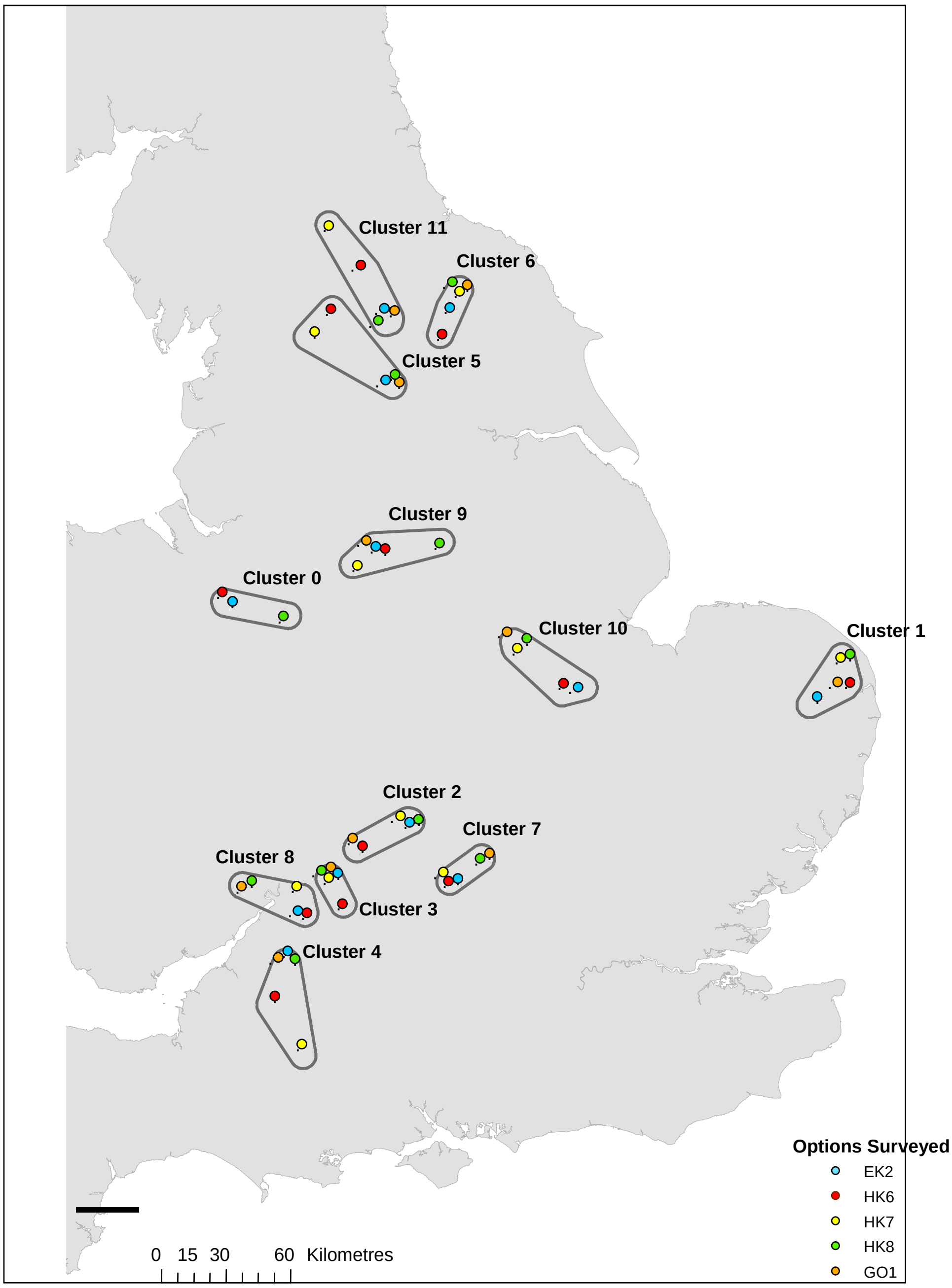
This chapter describes the results of a monitoring exercise designed to measure the effectiveness of grassland management prescriptions that have been widely adopted within HLS and ELS for both restoring biodiversity, and enhancing ecosystem function and associated ecosystem services. Measures of appropriate biodiversity and service delivery from existing diverse, semi-natural grassland conserved under the HLS were contrasted with those resulting from high intervention grassland restoration (*e.g.* re-introduction of grazing, scrub removal, Woodcock *et al.*, 2005) and habitat re-creation on ex-arable land (*e.g.* by addition of species-rich seed mixtures and green hay, Pywell *et al*., 2002; Edwards *et al.,* 2007). These measures were further contrasted with the biodiversity gains and ecosystem service delivery from grassland managed extensively with low inputs of fertiliser under the widespread Entry Level agri-environment scheme (Pywell *et al*., 2010). Finally, biodiversity and ecosystem service delivery from these widely differing AES management strategies were compared to those of adjacent grasslands managed outside of the AES.

Field methods

Site selection

The medium-term (5 year) effectiveness of HLS management prescriptions to conserve (**HK6**), restore (**HK7**) and re-create (**HK8**) botanical diversity in grassland and enhance ecosystem services (ES) was examined in 12 geographically separate clusters throughout England on a range of soil types (Figure 7.1).

Figure 7.1: Location of the grassland restoration sites



In addition, each cluster contained a grassland site managed extensively to promote biodiversity and ecosystem services through reduced inputs of fertiliser under the less demanding ELS (option **EK2**). All four sites within each cluster were compared to a grassland control site (G01 improved grassland habitat) managed intensively outside of agri-environment schemes, giving a total sample of 60 sites. The HLS grassland sites were selected as far as possible from a sample originally surveyed by *Just Ecology* in 2007 (Hewins *et al.*, 2008), enabling variation in the quality of semi-natural grassland sites and restored sites to be minimised.

Effectiveness and appropriateness of grassland management prescriptions

The effectiveness and appropriateness of each option was measured by repeating the survey undertaken by *Just Ecology* in 2007 during the summer of 2010 for the sub-sample of HLS **HK6-HK7** agreements. The *Just Ecology* work on **HK8** was a desk study alone, meaning that any vegetation comparison between 2007 and 2010 would be partial at best. The 2010 survey included: i) mapping the target grassland feature stand, ii) undertaking a condition assessment against the Indicators of Success for the options (**HK6-HK8**) using a combination of HLS and Common Standards Monitoring

(CSM) methods (Robertson and Jefferson, 2000), and iii) recording vegetation within five permanent quadrats. This enabled an assessment of change in the extent and type of mapped features. In addition, change in grassland condition and the composition of the permanent quadrats were measured. Similar quadrat recording was also undertaken in the ELS **EK2** grassland and the non-AES intensively managed grasslands for comparison.

Soil and biodiversity measurements

Standard measures of soil properties, vegetation composition and the associated invertebrate community were made from each site. For logistical reasons, the soil samples and measurements were undertaken later than the vegetation and invertebrate assessments.

Measures of soil nutrients and physical properties, and the biological activity of soil fauna were made from each site in spring 2011. Fifteen bulked soil cores were collected to a depth of 7.5 cm in a zigzag pattern across each site. These were analysed using standard procedures for texture and pH, Olsen extractable phosphorus (P), total phosphorus, potassium (K), magnesium (Mg), total nitrogen (N), total organic matter based on dry combustion (loss-on-ignition), and organic carbon based on a modified Walkley-Black assay (Allen *et al*., 1974; Defra , 2010). Soil bulk density was measured from a single precision core in the centre of each site for two depth fractions (0-7.5 cm & 7.6-15.0 cm) using the soil extraction method described by Robertson *et al*. (1999). Comparative measures of soil biological activity were made by burying 15 bait lamina strips (Terra-Protecta ©GmbH) at each site for a consistent period of 10 days (Kratz, 1998).

Vegetation composition and sward structure were recorded at each site from a structured walk-over survey and fixed quadrats in the summer of 2010. The presence of species was recorded at twenty stops on a 'W' walk across each site. Cover-abundance of each species was estimated using the Domin scale (Kershaw and Looney, 2005). In addition, the percentage cover of all vascular plant species was also recorded from five 2 × 2 m quadrats located in a cross pattern aligned N-S and E-W in the centre of each site. Quadrat spacing was adjusted for each site depending on parcel shape and size, and the need to avoid an edge buffer. Sward height was measured in each quadrat using a 30 cm diameter drop disk (Stewart *et al*., 2001).

The composition of the invertebrate community on each site was estimated using a combination of vacuum sampling and coloured water traps in the summer of 2010. Vacuum samples were taken using a Vortis Suction Sampler (Burkard, Rickmansworth, UK) along two 50 m transects separated by 30-40 m. A 10-second suck was taken every five metres giving a total sample area of 1.92 m^2. Sampling was conducted between 10.00 and 17.30 in suitable weather conditions (dry, without strong wind, when vegetation was dry). Each sample was transferred to a separate, labelled container and preserved in 70% industrial methylated spirit. In addition, the insect pollinator community present on each site or close by was sampled using coloured water traps (Westphal *et al*., 2008). This is a passive sampling technique that collects high numbers of species. It is largely unaffected by collector bias and is quantitatively similar to transect recording methods. It uses brightly coloured plastic dishes painted with UV-reflective paint (yellow, blue, white) that are intended to mimic flowers and attract pollinators. Three separate clusters comprising one of each coloured trap (nine per site) were part-filled with a killing solution of water and detergent and left open for 72 hours. The catch was filtered from the killing solution, placed in a labelled pot and preserved in 70% industrial methylated spirit.

Analysis and estimation of services

The range of physical and biological parameters measured at each grassland site were selected to provide either a direct or indirect estimate of ecosystem functions related to the provision of goods and services as described by the UK National Ecosystem Assessment (http://uknea.unep-wcmc.org/; Smart *et al*., 2010; Pywell *et al*., 2011) (Table 1.). Further considerations in the selection of field measurements were accuracy, repeatability and practicality given the constraint of visiting each site only twice.

Table 7.1: Field measurements and their relationship to ecosystem goods and services

Field measurement	Intermediate ecosystem function	Ecosystem service	Good(s)
Soil carbon / organic matter	C sequestration, GHG emissions	Climate regulation	Climate mitigation
Soil bulk density	Soil infiltration capacity	Water regulation	Flood protection
Bait lamina, soil nutrient analysis	Decomposition, nutrient cycling	Improved soil fertility, efficient nutrient cycling	Food, forage & fibre
Invertebrate pollinators (and their food plants), predators, detritivores	Pollination, pest control, decomposition, nutrient cycling	Crop production, pest regulation, improved soil fertility	Food, forage & fibre
Plant species richness, Natural England Grassland Positive / Negative Indicator Species	Native species diversity, quality and representativeness; landscape heterogeneity	Cultural services	Aesthetic value, environmental settings (e.g. tourism)

Below-ground measures of total carbon and inorganic matter provide an indirect measure of the ability of grasslands managed under different regimes to sequester carbon, to thus mitigate the effects of increased greenhouse gas emissions, and hence the role of grasslands in climate regulations service. It was not possible to undertake measures of above-ground biomass production as many of the sites were summer grazed and the maintenance of exclusion cages across such dispersed sites was not possible. Soil bulk density measurements enabled an accurate estimate of soil pore space and porosity which is closely correlated with the water infiltration capacity resulting from different grassland management strategies. These measures can be related to the water regulation service, and specifically the flood prevention potential provided by grassland ecosystems depending on their location in the landscape. The proportion of each bait lamina strip eaten by soil fauna provides a relative estimate of the decomposition and nutrient cycling capacity of the grassland soil at each site. This measure, together with soil macronutrient concentrations, indicates the capacity of the grassland to provide food, forage and fibre.

Above-ground we specifically focused on the agro-ecosystem services for production provided by functional groups, namely food web services and gene flow services (pollination) (after Moonen and Bàberi, 2008; Pywell *et al.,* 2011). Estimates of the potential of each grassland site to produce food and forage were based on the following plant traits or characteristics: UK Ellenberg soil fertility (N), light (L) and annuality (A; the relative association with disturbed vegetation) (Hill, Preston and Roy, 2004) and the 'CSR' competitiveness index (C) (Grime *et al*., 1988). For each site a percentage cover-weighted score was calculated for each trait. The abundance of pollinating insects from the vacuum samples and water traps, together with the temporally more robust measure of the diversity of pollinator forage plants, provide an indirect estimate of the potential value of grasslands in providing a beneficial pollination service to crops and natural ecosystems. Estimates of the abundance of pest species (*e.g.* poisonous grassland weeds) and potentially beneficial predatory invertebrates provide a measure of the food web services provided by different AES management prescriptions. Finally, the abundance of invertebrate detritivores was also used to provide a further indirect measure of nutrient cycling potential provided by the different grasslands.

Measurement of restoration success and habitat quality

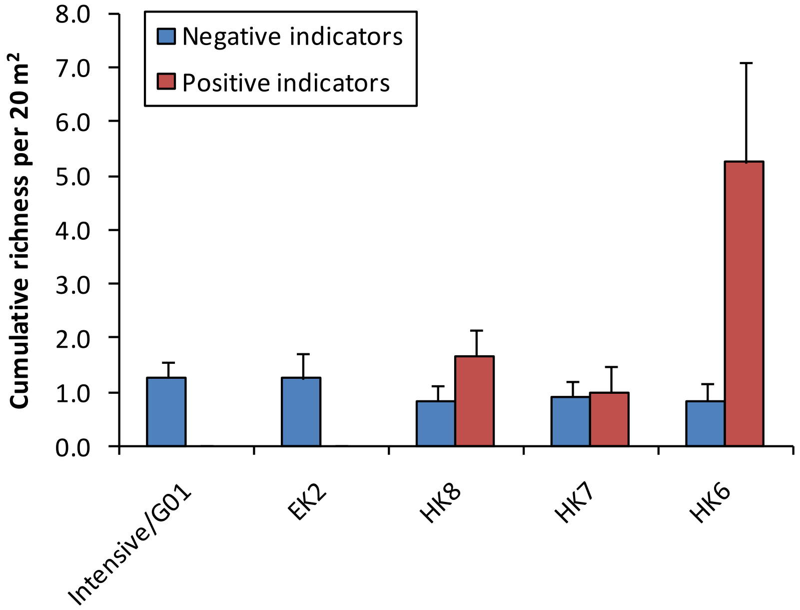
The trajectory of vegetation community re-assembly and restoration success was measured in three ways. Firstly, the mean number of Natural England Positive Grassland Indicator species was calculated for each site (Robertson & Jefferson, 2000). Secondly, for each cluster the Euclidian distance between the species-rich, semi-natural grassland maintained under **HK6** and each restoration treatment (**HK7**, **HK8**, **EK2**) and the non-AES control was calculated using the vegetation percentage cover data for each site (Krebs, 1999). Euclidean distance was defined as:

$$ED_{jk} = \sqrt{\sum_{i=1}^{n} \left(X_{ij} - X_{ik}\right)}^{2}$$

where ED_{jk} is the Euclidean distance between samples *j* and *k*; X_{ij} is the number of individuals of species *i* in sample *j*; X*ik* is the number of individuals of species *i* in sample *k*; *n* is the total number of species. There was an inverse relationship between the Euclidean distance and the similarity of samples in terms of their species composition and species relative abundance. Thirdly, the similarity of both the pristine and restored vegetation communities to those described by the British *National Vegetation Classification* (*NVC*: Rodwell, 1992) was calculated using the TABLEFIT software (Hill, 1996). The percentage fit to UK Biodiversity Action Plan (BAP; Anon. 2006) priority grassland communities was calculated for each site (Neutral grassland = **MG3**, **MG4**, **MG5**; Calcareous grassland = **CG1-9**; Acid grassland = **U1**, **U4**).

Species number (richness) and angular transformed cover values were calculated for each plant guild and functional grouping. In addition, cover-weighted values for functional traits were calculated for each quadrat and these were averaged for each site. Abundance (Log_e N+1) and number of invertebrate families or orders were calculated separately for the detritivores, herbivores, predatory and pollinator groupings from vacuum samples and water traps. The response of each of these parameters to agri-environment scheme management prescription (treatment) was tested using analysis of variance (ANOVA) models in Genstat 9.0 © statistical software. A covariate term of mean sward height (cm) was also applied to the ANOVA models for invertebrates to further explain variation. ANOVA contrasts were used to compare selected grassland management prescriptions with each other in order to test the survey hypotheses.

Figure 7.2: Cumulative number of Natural England positive and negative indicator species of grassland condition per 20 m^{-2} under the different grassland restoration prescriptions



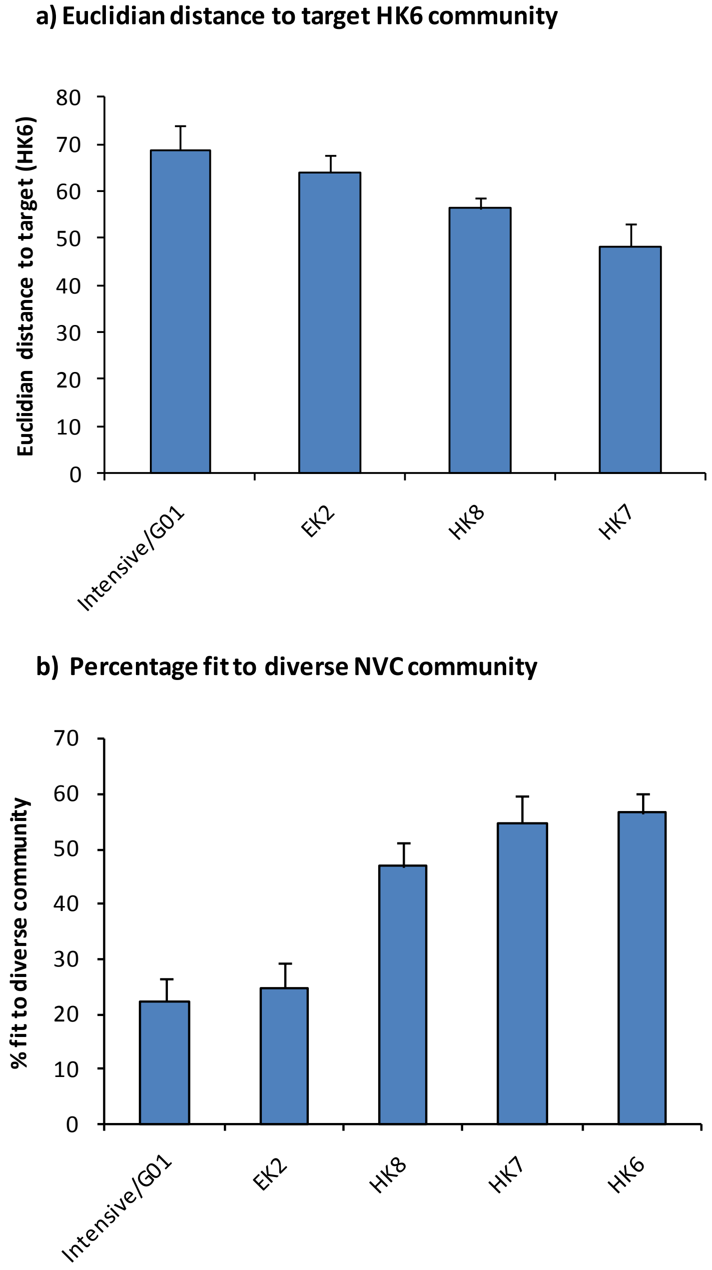
Effectiveness of grassland restoration

All 12 sites managed under the HLS prescription to maintain species-rich grassland (**HK6**) were classified using FEP methodology as either species-rich (G03) or BAP priority grassland. However, using the Condition Assessment only 30% of these sites passed (Condition A), with a further 30%

failing on a single assessment criteria (Condition B). Eight of the sites undergoing restoration management (**HK7**) were classified as either species-rich or BAP priority, but only 25% of these priority sites passed the Condition Assessment. Six of the sites undergoing re-creation to species-rich grassland (**HK8**) were classified as either species-rich or BAP priority habitat and, of these, only 8% passed the condition assessment. The majority of the HLS sites failed to achieve favourable condition due to insufficient cover of positive indicator species. None of the grassland managed in ELS or the non-scheme control grasslands were classified as either species-rich or a BAP priority habitat.

The cumulative number of Natural England Positive Indicator species in all five quadrats was significantly higher (ANOVA $F_{4,42}$ = 6.59***) under **HK6** management compared with all other treatments (Figure 7.2). Positive Indicator species were absent from the ELS and non-scheme grasslands. There was no significant difference in the number of Negative Indicator species between management treatments.

Figure 7.3: Restoration success as measured by the mean (±SE) a) Euclidian distance to diverse **HK6** target community, and b) Percentage fit to a diverse grassland community described by the *NVC* (Rodwell, 1992)



The mean Euclidian distance (similarity) to the species-rich **HK6** grassland community was significantly higher ($F_{3,33}$ = 5.12**) for the ELS (**EK2**) and non-AES grasslands compared with the HLS grassland undergoing restoration (**HK7**) (Figure 7.3a). The mean percentage goodness-of-fit to a species-rich *NVC* community associated with BAP priority grassland habitats was significantly higher ($F_{4,42}$ = 28.03***) in the sites managed by HLS prescriptions (**HK6-8**) compared with ELS (**EK2**) or non-AES sites (Figure 7.3b). There was no significant difference in goodness-of-fit to BAP habitats between ELS and non-AES grasslands.

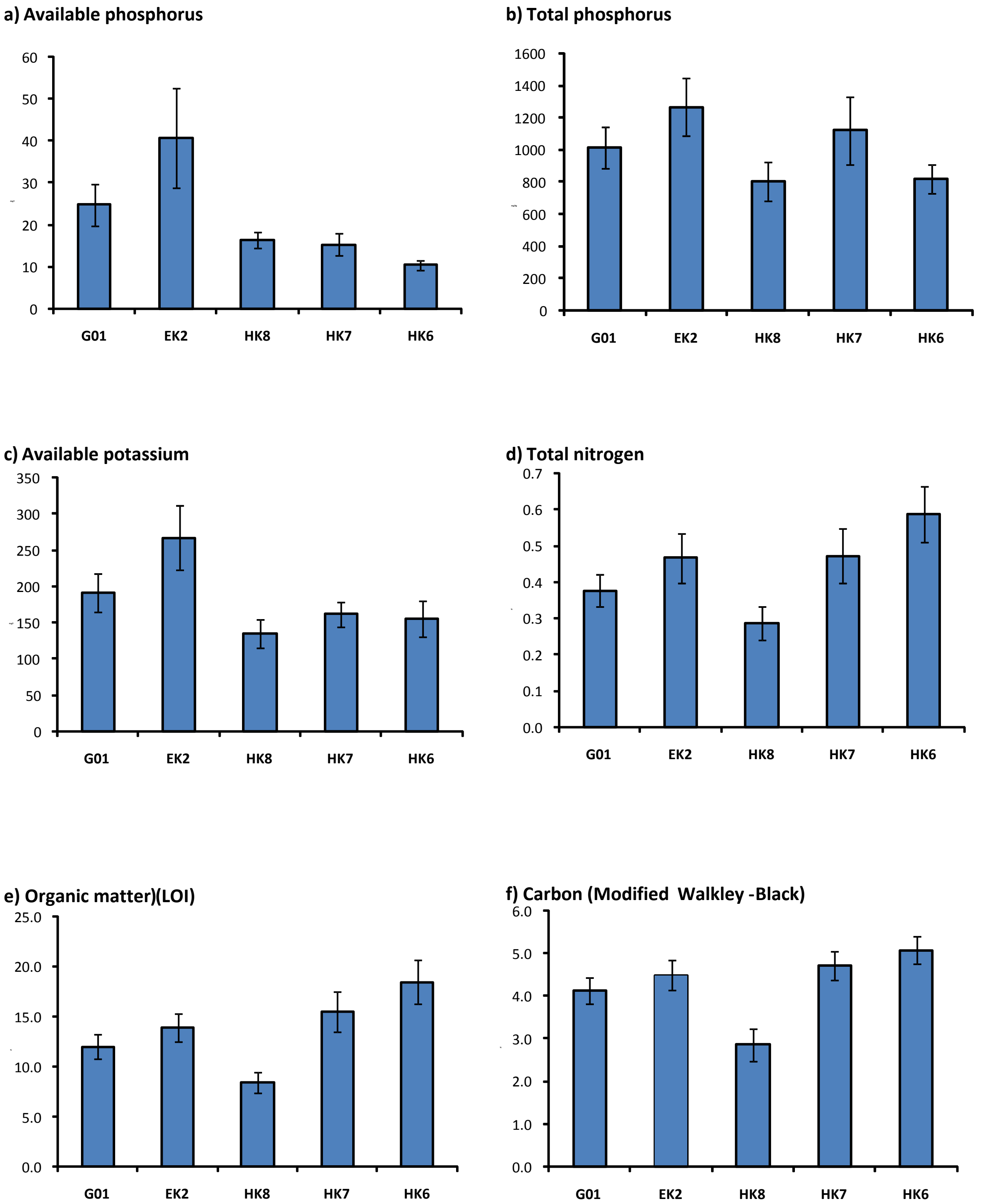
Soil ecosystem function and services

There were no significant differences in soil pH between grassland management treatments (Table 7.2). However, there were large, highly significant differences in soil fertility. Extractable phosphorus and potassium, and total phosphorus were all significantly higher in the **EK2** grasslands compared with the species-rich **HK6** and **HK7** (Figure 7.4a-c). Extractable phosphorus was also higher in the non-scheme grasslands than **HK6**. Total nitrogen and organic matter as estimated by loss on ignition were both significantly higher in the **HK6** grasslands compared with the agriculturally improved (G01) and ex-arable (**HK8**) grasslands (Figure 7.4d-e). Both measures were also significantly higher in the restored species-rich grassland (**HK7**) compared with the grassland created on ex-arable land (**HK8**). Finally, soil carbon content was significantly higher in permanent grassland types compared with the ex-arable sites (**HK8**). Carbon content of the species-rich grasslands (**HK6**) was significantly higher than the improved, non-scheme grasslands (G01) (Figure 7.4f).

Table 7.2: Differences in soil attributes between grassland types (Where: NS = not significant (p > 0.05); * = p < 0.05; ** = p < 0.01; *** = p < 0.001)

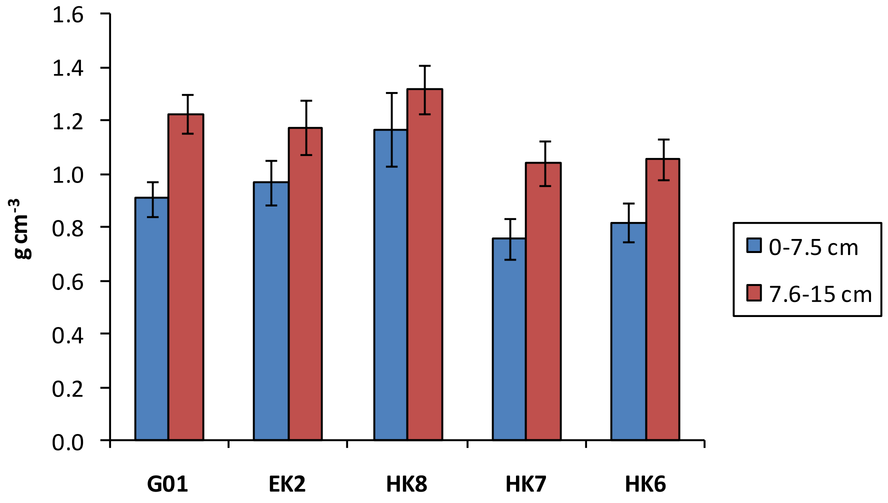
	Treatment (ANOVA $F_{4,42}$)	Significant (p<0.05) Tukey's pairwise tests
pH	1.58ns	
Olsen P	6.18***	EK2>HK7,HK6; G01>HK6
Total P	4.91**	EK2>HK6,HK8
K	4.37*	EK2>HK6,HK8
Mg	0.62ns	-
Total N	6.84***	HK6>G01,HK8 HK7>HK8
Organic matter%	9.37***	HK6>G01,HK8 HK7>HK8
Carbon%	12.52***	HK6,HK7,EK2,G01>HK8 HK6>G01
Texture:		
Sand%	5.89***	HK6>G01,EK2,HK8 HK7>HK8
Silt%	5.50***	G01,HK8,EK2>HK6
Clay%	5.18**	HK8>HK6,HK7
Bulk density 0-7.5cm	3.45*	HK8>HK7
Bulk density 7.6-15cm	2.57*	-
Soil biological activity:		
bait lamina (% eaten)	1.07ns	-

Figure 7.4: Differences in mean (±SE) **soil nutrient concentrations between grassland types**: a) Available phosphorus; b) Total phosphorus; c) Available potassium; d) Total nitrogen; e) Organic matter (LOI); f) Carbon (modified Walkley-Black



There were significant differences in soil physical variables between grassland types (Table 7.2). Sand content was significantly higher in the species-rich grasslands (**HK6**) compared with the non-scheme (G01), low input ELS (**EK2**) and ex-arable (**HK8**) grasslands. Sand content of the species-rich grassland undergoing restoration (**HK7**) was also higher than the ex-arable grasslands. The reverse trend was found for silt content. Clay content was significantly higher in the ex-arable compared with the species-rich grasslands (**HK6-7**). Bulk density was significantly higher in the ex-arable grassland compared with the species-rich restored sites (Figure 7.5). Finally, there were no significant differences in soil biological activity as estimated by bait lamina strips.

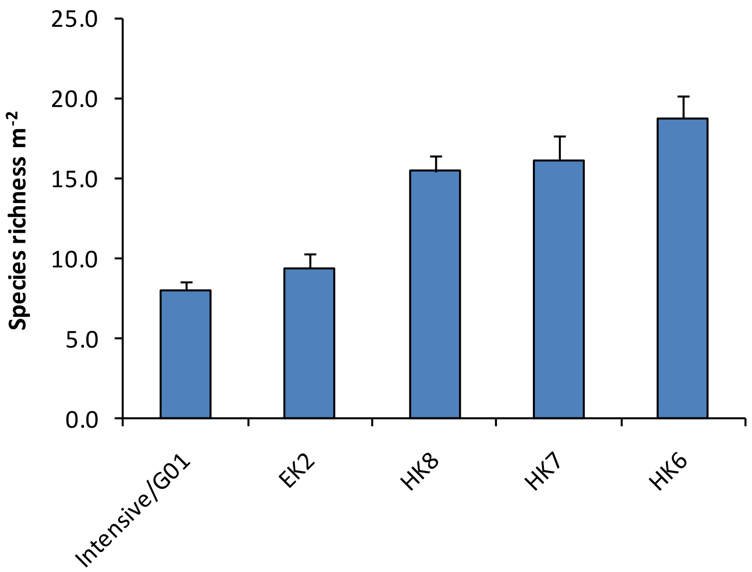
Figure 7.5: Differences in mean (±SE) soil bulk density between grassland types in the 0-7.5 cm and 7.6-15 cm depth



Grassland ecosystem diversity, function and services

There were also a large number of significant differences in above-ground ecosystem functions and associated services provided by grasslands under the different management regimes (Table 7.3). Total species richness (number) of native vascular plant species per m^2 was significantly higher in the grassland managed under HLS (**HK6**, **HK7**, **HK8**) compared with the ELS (**EK2**) and non-scheme grasslands (G01) (Table 7.3; Figure 7.6).

Figure 7.6: Species richness m^{-2} of native vascular plant species under the different grassland restoration prescriptions



Species richness of grasses was significantly higher in grasslands managed under **HK6** compared with **EK2** and G01 (Figure 7.7). Similarly, grass richness was significantly higher under **HK7** and **HK8** compared with G01. Species richness of legumes was significantly higher under HLS management compared with ELS and non-scheme grasslands. Richness of hemi-parasites was significantly higher under the restoration (**HK7**) and re-creation (**HK8**) prescriptions compared with the others. Diversity of other forbs was significantly higher in the **HK6** grasslands compared with **HK8**, **EK2** and G01. Similarly, forb diversity was higher in **HK7** than **EK2** and G01. There were no significant differences in the species richness of pernicious and poisonous weeds between management prescriptions. Finally, the richness of annual plants was significantly higher under re-creation (**HK8**) compared with all other grassland management types (Figure 7.8). Richness of perennials was highest under **HK6** compared with other grasslands.

Table 7.3: Differences in plant cover-abundance, species richness and cover-weighted functional traits scores between grassland types (Where: NS = not significant ($p > 0.05$); * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$)

	Treatment (ANOVA $F_{4,42}$)	**Significant (p<0.05) Tukey's pairwise tests**
Species richness		
Total richness	22.14***	HK6,HK7,HK8>EK2,G01
Grasses	6.71***	HK6>EK2,G01 HK7,HK8>G01
Legumes	10.64***	HK6,HK7,HK8>EK2,G01
Hemi-parasites	8.69***	HK8>HK6,EK2,G01 HK7>EK2,G01
Other forbs	11.71***	HK6>HK8,EK2,G01 HK7>EK2,G01
Weeds / undesirable species	0.56NS	-
Annuals	4.29**	HK8>HK6,EK2,G01
Perennials	24.46***	HK6,HK7,HK8>EK2,G01 HK6>HK8
NE Positive Indicator species	6.59***	HK6>HK7,HK8,EK2,G01
NE Negative Indicator species	0.46NS	-
Cover		
Grasses	4.27**	EK2,G01>HK8
Legumes	3.09*	HK8>HK6
Hemi-parasites	5.56***	HK8,HK7>EK2,G01
Other forbs	4.75**	HK6>EK2,G01
Weeds / undesirable species	0.79NS	-
Functional traits		
Ellenberg fertility	15.39***	G01>HK7,HK8,HK6 EK2>HK8,HK6 HK7,HK8>HK6
Ellenberg light	4.42**	G01>HK7,HK6
Annuality	23.07***	G01>HK8,HK7,HK6 EK2>HK7,HK6 HK8>HK6
Pollinator preference plants	5.46***	HK8>G01,EK2 HK7>EK2
Ruderal	13.02***	G01,EK2,HK7,HK8>HK6
Competitor	3.75*	G01>HK8
Stress-tolerator	15.74***	HK6>G01,EK2,HK7,HK8 HK8>G01

Figure 7.7: Differences in mean (±SE) species richness m^{-2} of broad plant functional types between grassland types

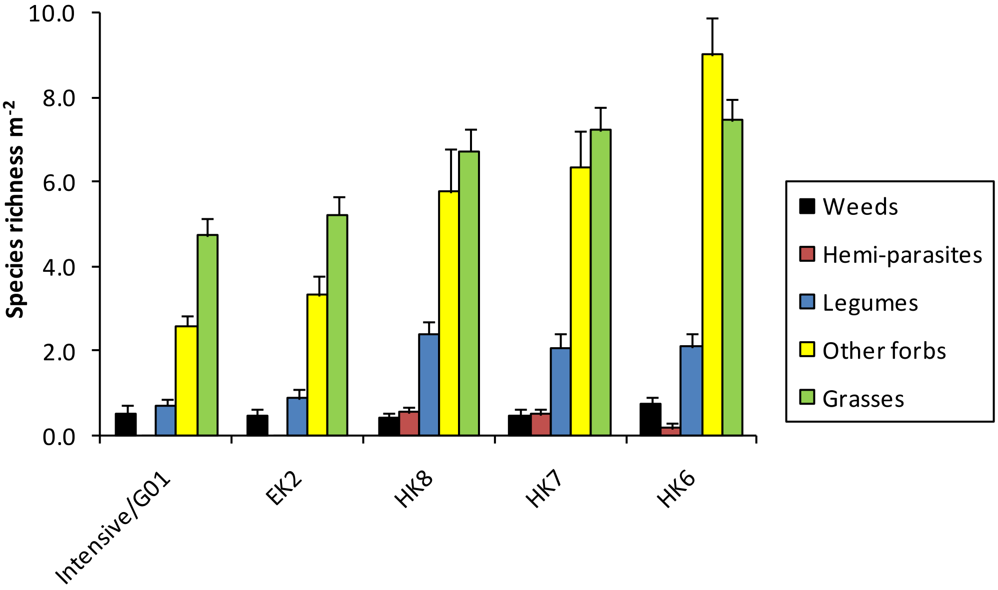
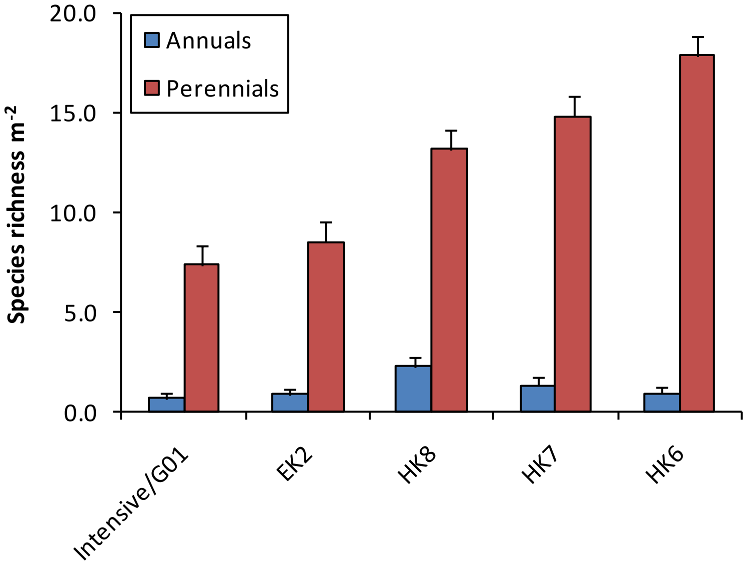


Figure 7.8: Differences in mean (±SE) species richness of a) annuals and perennial plants and b) Positive and negative Indicator species for the different grassland types



In contrast, the mean percentage cover of grasses was significantly higher in the grasslands managed under ELS (**EK2**) and the intensively managed non-scheme grasslands compared with the HLS grasslands (Figure 7.9). The cover of legume species was significantly higher in the re-created grasslands (**HK8**) compared with the species-rich grasslands maintained under option **HK6**. Cover of hemi-parasitic plants was significantly higher in the restored and re-created grasslands compared with the ELS and non-scheme grasslands. Cover of other forb species was significantly higher in the **HK6** grasslands compared with **EK2** and non-scheme grasslands. There were no significant differences in the cover of weed species between grassland types.

Figure 7.9: Differences in mean (±SE) percentage cover of plant functional groups between grassland types

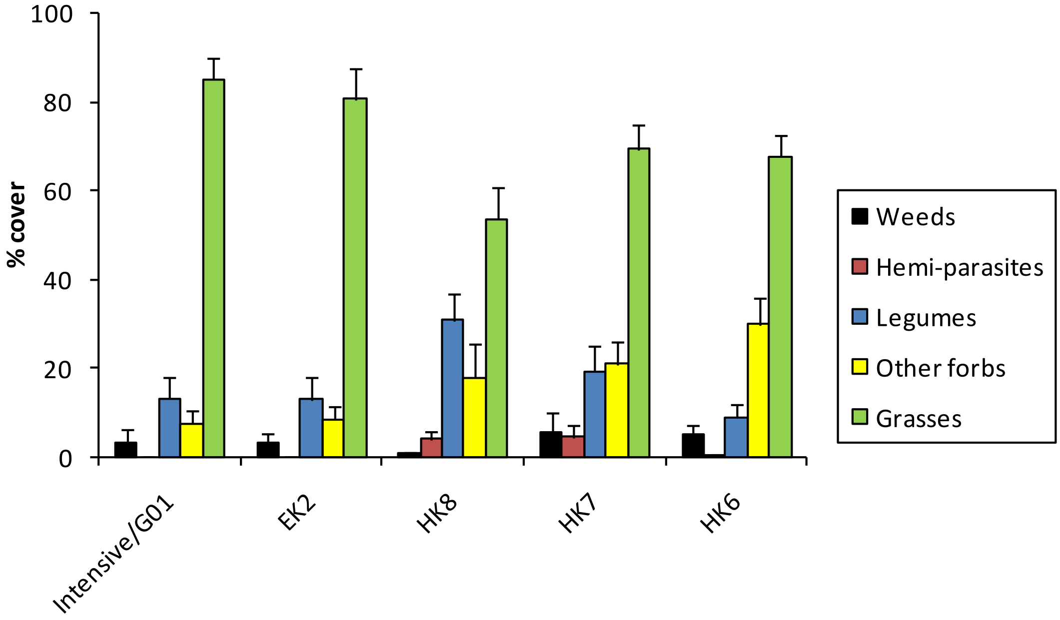
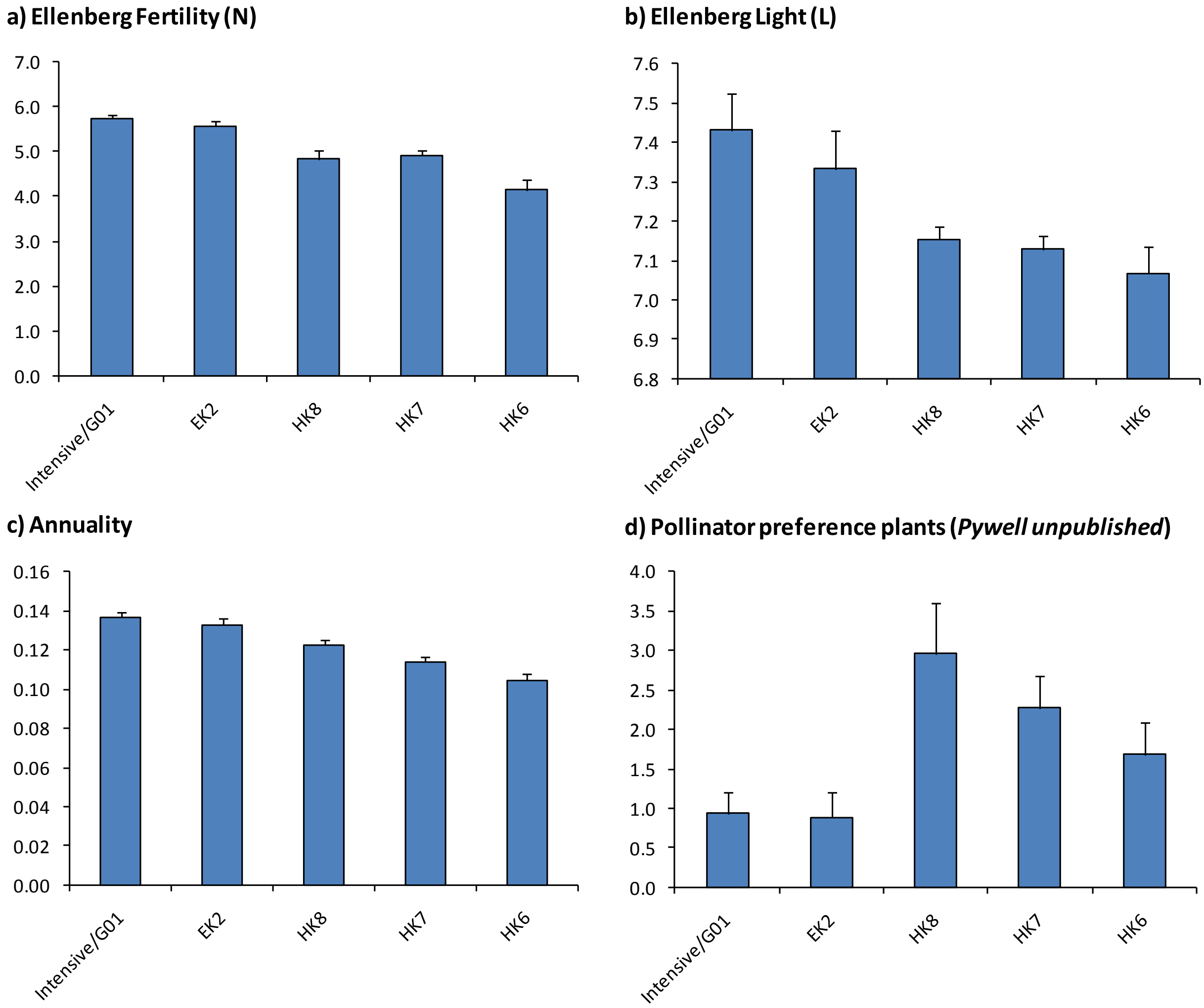


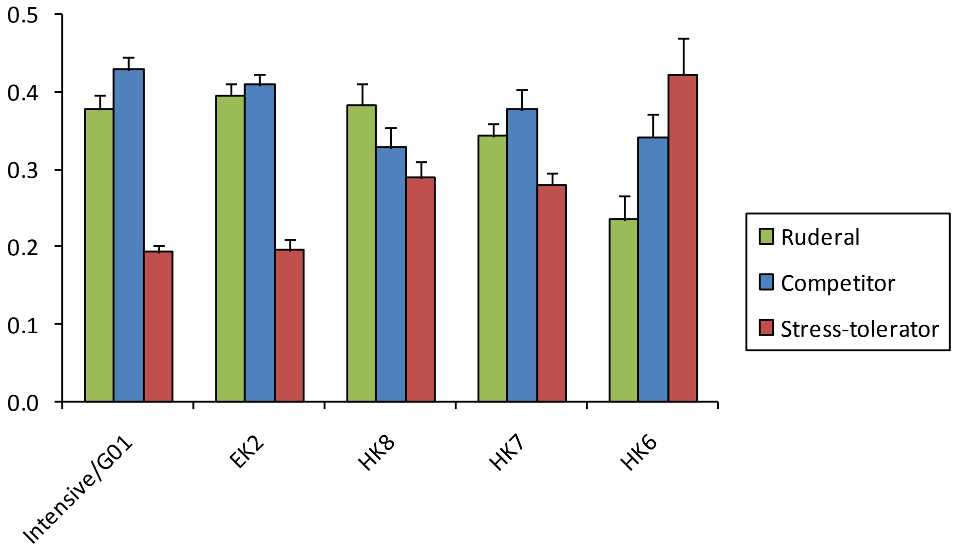
Figure 7.10: Differences in mean (±SE) cover-weighted functional plant traits between grassland types: a) Ellenberg fertility, b) Ellenberg light, c) Annuality, and d) Pollinator preference



Finally, cover-weighted Ellenberg fertility (N) scores were significantly higher in the intensively managed, non-scheme grassland compared with the HLS grasslands (**HK6-8**) (Table 7.3; Figure 7.10a). Fertility scores were also higher in the ELS grassland compared with the **HK6** and **HK8** grasslands. Finally, fertility scores were higher in the restored (**HK7**) and re-created (**HK8**) grassland compared with **HK6**. Ellenberg light (L) scores were significantly higher in the intensively managed, non-scheme grassland compared with the HLS grasslands managed under **HK6** and **HK7** (Figure 7.10b). The mean annuality score of the grassland community (the degree to which the plant community is associate with disturbance) was significantly higher in the non-scheme grassland compared with all HLS grasslands (Figure 7.10c). Similarly, the ELS grasslands had a significantly higher annuality than the **HK7** and **HK6** grasslands. Annuality was also significantly higher in the re-created grasslands (**HK8**) compared with **HK6**. Finally, the cover-weighted pollinator food plant score was significantly higher in the re-created grasslands (**HK8**) compared with the ELS and non-scheme grasslands. Restored grassland (**HK7**) also had a higher score than ELS grassland (Figure 7.10d).

The cover-weighted ruderality score was significantly lower in the maintained, diverse **HK6** grasslands compared to all others (Table 7.3; Figure 7.11). The competitor score was significantly higher in non-scheme grassland compared to re-created grassland (**HK8**). The stress-tolerator score was significantly higher in the **HK6** grassland compared with all others.

Figure 7.11: Differences in mean (±SE) cover-Grime life-history strategy (CSR) between grassland types



There were comparatively fewer significant effects of grassland management on invertebrate functional groups and the ecosystem services they provide (Table 7.4). This may reflect the greater sensitivity of invertebrates to local variation in weather conditions and management, such as grazing. The overall number of invertebrate taxa from vacuum sampling was significantly higher in the species-rich grassland maintained under HLS (**HK6**) compared with the ELS grassland (**EK2**) (Figure 7.12). Invertebrate samples from the intensively managed, non-scheme grassland tended to be very variable. Similarly, the number of herbivore and predator families was significantly higher in the **HK6** grassland compared with **EK2**. The abundance of invertebrates as a potential food source for other trophic levels was significantly higher in the **HK6** grasslands compared with **EK2** (Figure 7.13). Similarly, abundance of detritivores was significantly higher in **HK6** compared with all other grassland types. Finally, the abundance of herbivores was significantly higher in **HK6** compared with **EK2**. Sward height also had a significant effect on the diversity and abundance of invertebrate groupings. Total number of invertebrate families, and the number and abundance of detritivores and predators were all associated with taller swards.

Figure 7.12: Differences in mean (±SE) taxonomic richness (number families/orders) of invertebrates and main functional groups between grassland types: a) All families/groups, b) Decomposers, c) Herbivores, d) Predators, and e) Pollinators

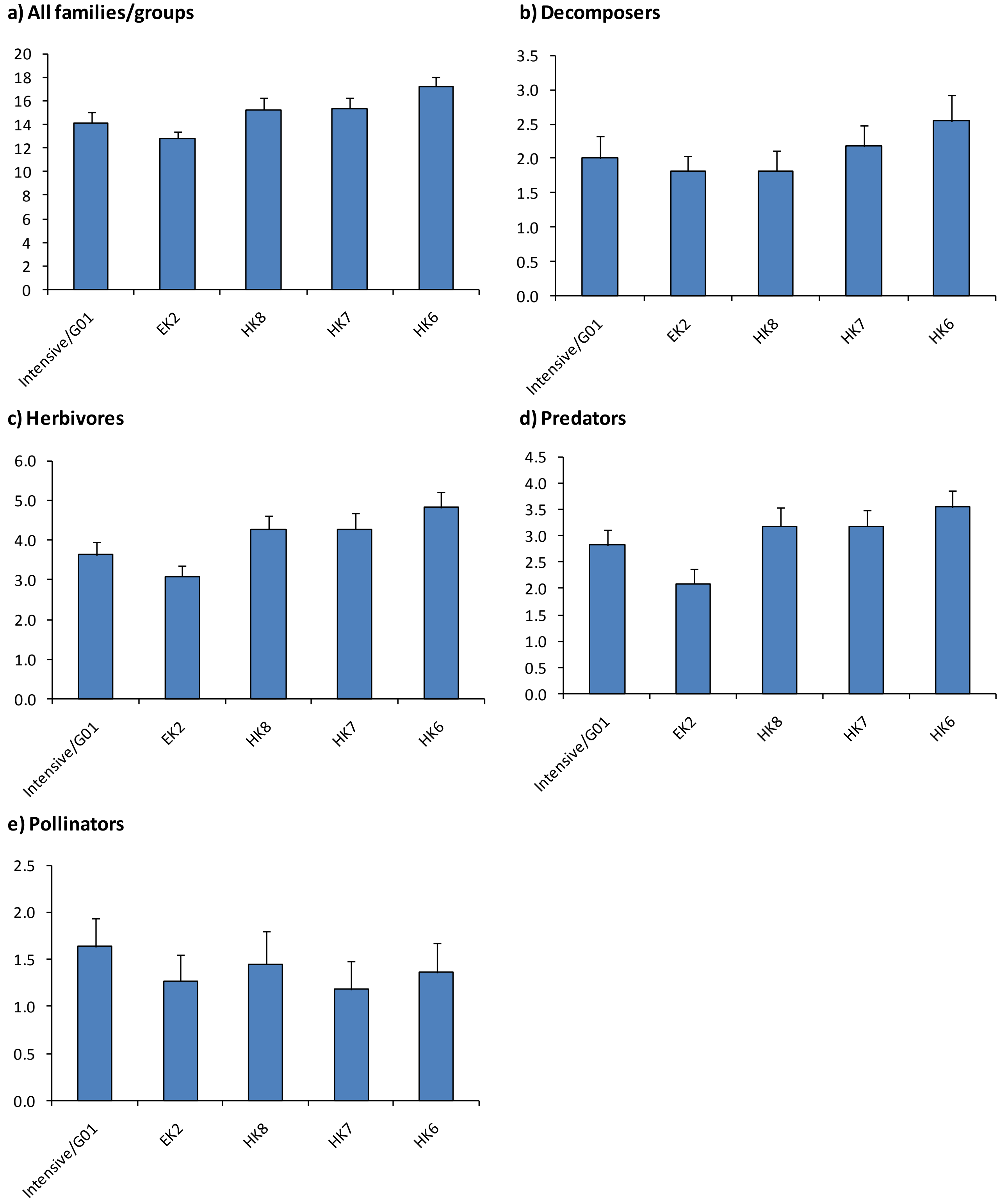


Figure 7.13: Differences in mean (±SE) abundance of invertebrates and main functional groups between grassland types: a) All families/groups, b) Decomposers, c) Herbivores, d) Predators, and e) Pollinators

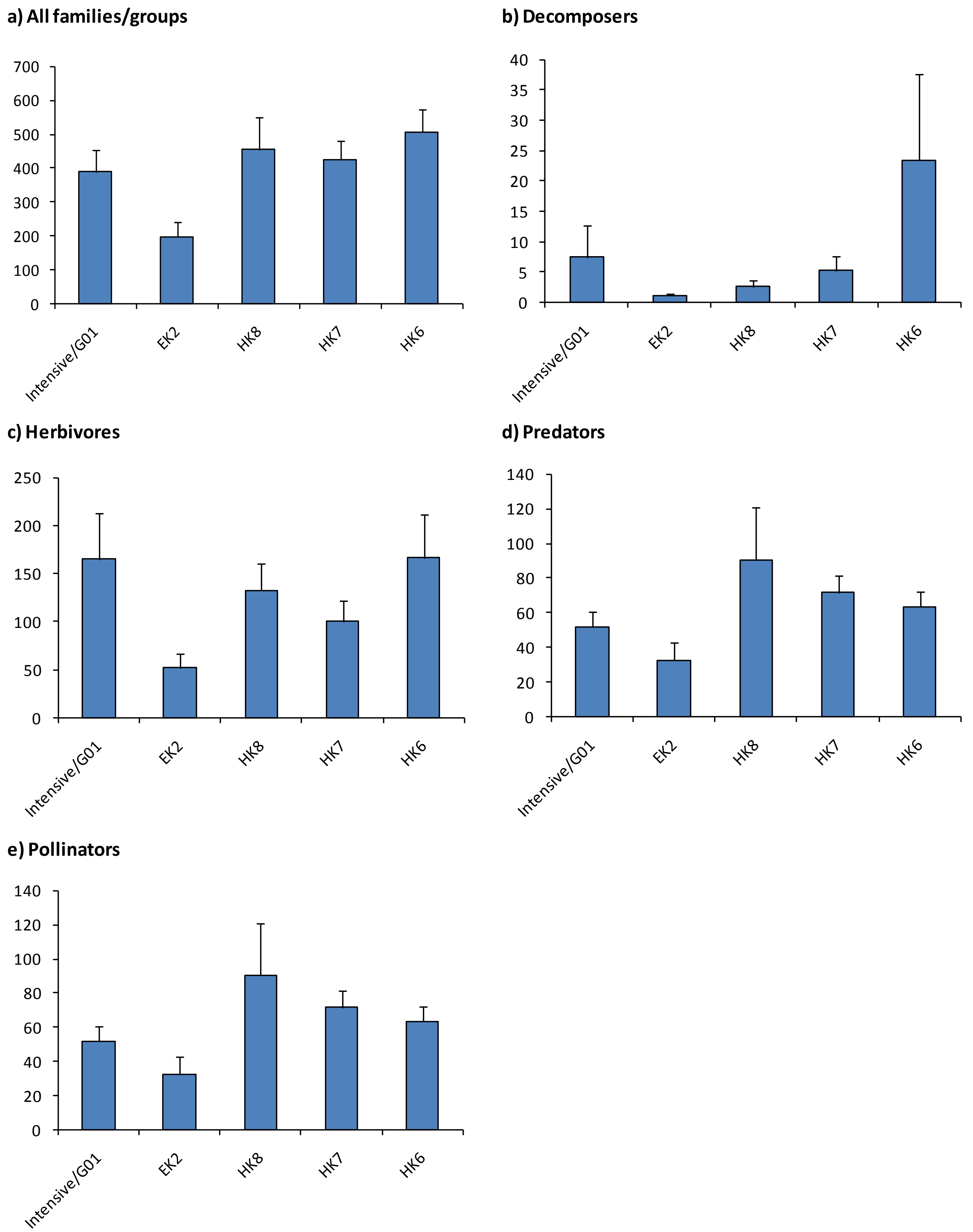


Figure 7.14: Differences in mean (±SE) a) taxonomic richness (family/order), b) abundance, and c) *Bombus* and non-*Bombus* pollinating insects measured from coloured water traps between grassland types

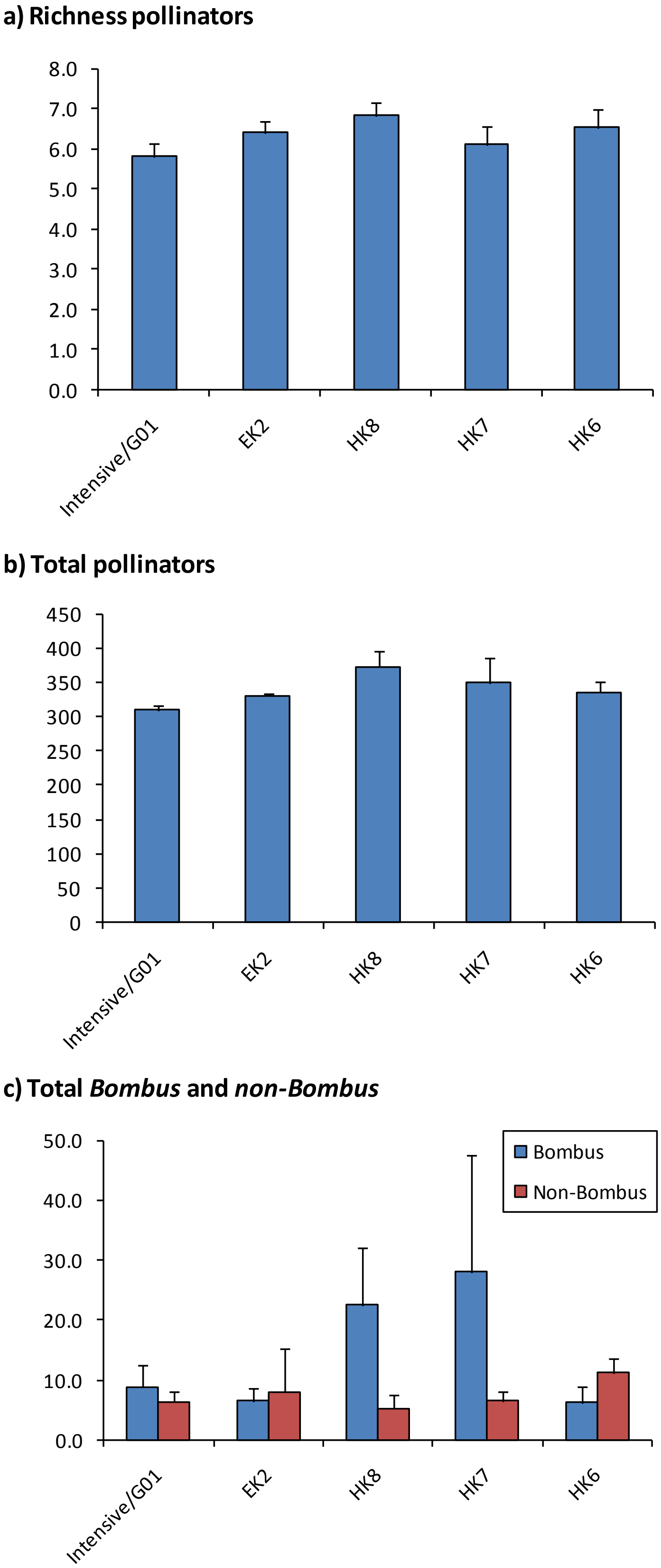


Table 7.4: Differences in the abundance and taxonomic richness of invertebrate functional groups between grassland types (Where: NS = not significant ($p > 0.05$); * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$)

	Covariate (sward height) $F_{1,39}$	Treatment (ANCOVA $F_{4,39}$)	Significant (p<0.05) Tukey's pairwise tests
Taxonomic richness			
Total taxonomic richness	4.96*	3.54*	HK6>EK2
Detritivores	5.34*	1.58NS	-
Herbivores	0.00NS	3.35*	HK6>EK2
Predators	9.60**	2.63*	HK6>EK2
Pollinators	2.67NS	1.02NS	-
Abundance (Log_e N+1)			
Total abundance	7.69**	2.89*	HK6>EK2
Detritivores	7.76**	5.01**	HK6>G01,HK7,EK2,HK8
Herbivores	3.71NS	3.10*	HK6>EK2
Predatory	9.64**	1.87NS	-
Pollinators	3.76NS	0.56NS	-

Finally, the taxonomic richness and abundance of pollinating insects caught in the coloured water traps was highest in re-created grasslands (**HK8**) and lowest in the intensively managed grassland (G01) (Figure 7.14a, b). However, these differences were not significant (taxonomic richness ANOVA F4,36 = 1.62ns; abundance F4,36 = 0.19ns). Abundance of *Bombus* species was highest in the restored (**HK7**) and re-created (**HK8**) grassland, but these differences were also not significant (F4,36 = 2.12ns).

The contribution of HLS to ecosystem goods and services

Appropriateness and effectiveness of grassland management prescriptions

The overall species richness of native vascular plants was significantly higher in the grasslands conserved and restored under the Higher Level agri-environment scheme (HLS) compared with both the Entry Level Scheme (ELS) and grassland managed outside the scheme. Similarly, only grasslands managed under HLS were similar to the High Nature Value (Priority) grassland habitats described in the UKBAP. This confirmed the effectiveness of the HLS targeting policy in selecting suitable sites for intervention management (Mountford *et al.*, 2010). However, the relatively low proportion of sites achieving favourable condition, particularly due to insufficient cover of Positive Indicator species, was a cause for concern. This failure is likely to reflect a lack of appropriate grazing and cutting management which has allowed tall grass species to temporarily dominate the sward. However, previous studies confirm that the introduction of appropriate management can rapidly reverse this situation (Pywell *et al.*, 2004).

Soil function and ecosystem services

The large and highly significant differences in soil fertility between HLS and both ELS and non-scheme grasslands demonstrates the targeting policy for this scheme is effective (Natural England, 2010). The higher concentrations of macronutrients in the ELS and non-scheme grasslands reflect their history of intensive agricultural management, and suggest they have an important role in food production (Pilgrim *et al.*, 2010). Both soil organic matter and carbon were highest in the species-rich grasslands maintained under HLS, confirming the importance of these habitats as a carbon sink in the regulation of greenhouse gases (Hui, 2011; Watson *et al*., 2011). Stocks of organic matter and carbon were lowest in the intensively managed (G01) and ex-arable (**HK8**) grasslands, reflecting their past history of cultivation and disturbance. It remains to be seen if similar stocks of soil carbon can be accumulated in the re-created grasslands and over what timescale. Species-rich grassland had a lower bulk density and higher sand content compared to the intensively managed and ex-arable grassland which indicates a higher soil pore space and greater water infiltration capacity. This suggests that in flood plains the maintenance and restoration of extensive areas of species-rich grassland may provide more effective flood prevention and water storage than intensively managed grasslands. Finally, the lack of significant differences in soil biological activity as measured by bait lamina suggests equal capacity for decomposition and nutrient cycling across all grassland types. However, the data produced by this method were highly variable and there was considerable damage by grazing livestock. It is possible that the bait lamina were insufficiently sensitive to detect differences between the grassland types. Alternative, simple approaches to measuring decomposition and nutrient turnover, such as the use of litter bag (Harmon *et al*., 1999), might be more effective and robust in quantifying these key soil functions.

Plant diversity and productivity

Both the cover of grasses and competitive species, and the cover-weighted Ellenberg fertility scores were all significantly higher in the ELS and non-scheme grasslands compared with the grasslands managed under HLS. This suggests the ELS and non-scheme grasslands are providing a greater service in terms of food production (potential forage yield and livestock live-weight gain) compared with HLS grasslands (**HK6-8**) (Tallowin *et al*., 2005). However, the diversity of functionally important legumes was significantly higher in the HLS grasslands. Legume abundance was highest where species-rich grassland was re-created on ex-arable land (**HK8**). This observation suggests that the HLS grasslands may have a greater capacity to sustain production of food in the absence of inorganic fertiliser addition. Previous studies have shown that ex-arable land sown with seed mixtures containing native grasses, legumes and other forbs produced a greater yield of herbage in the absence of fertilisers than when just grasses were sown (Bullock *et al.*, 2007). This may reflect the ability of legumes species to establish and achieve abundance on ex-arable soils lacking in nitrogen and with high phosphorous concentration (Pywell *et al*., 2002). An abundance of legumes will have beneficial effects in terms of nitrogen fixation to build soil fertility and the production of high quality litter resources to increase sequestration of soil carbon (Cornelissen and Thompson 1997). Finally, members of the *Fabaceae* are also known to have a large number of associated phytophagous invertebrate species relative to other plant families, and produce higher-quality pollen resources for bumblebees (Hanley *et al.*, 2008).

Previous studies have identified a limited number of plant species that are highly preferential to flower visiting insects, but have declined markedly under intensive agricultural management (Carvell *et al.,* 2006). These species (*e.g. Trifolium pratense, Lotus corniculatus, Centaurea nigra*) have been shown to perform well in grassland undergoing restoration and re-creation (Pywell *et al.,* 2003, 2010). This was confirmed by the greater cover-weighted pollinator preference scores for the re-created and restored grasslands under HLS. It is therefore likely management prescriptions to restore and re-create species-rich grassland under HLS have a greater potential to support vital pollination services in the countryside that those managed intensively for food production (G01 and **EK2**). Modelling studies suggest strong exponential declines in both pollinator richness and native visitation rate with distance from semi-natural habitat (Ricketts *et al.*, 2008). These studies suggest visitation rate dropped to half of its maximum at 0.6 km from natural habitat, compared to 1.5 km for richness. Restoration and re-creation of habitat rich in pollinator preference plants may play an important role in sustaining the pollination service both to entomophilous crops and natural ecosystems within intensively managed landscapes.

Finally, the functional stability of the vegetation communities appeared to be strongly affected by management strategy. The non-AES and low input ELS grasslands were dominated by species with competitive and ruderal life-history strategies (Grime, 1979). In contrast, the HLS grasslands had a more balanced composition of all three life history strategies. This suggests that the HLS communities are likely to be more stable when exposed to environmental stresses, such as drought and cold winters. Moreover, hemi-parasitic plants were significantly more abundant in grasslands undergoing re-creation and restoration under HLS. Hemi-parasitic plants have an important role in the regulation and maintenance of plant diversity through the reduction of competitive species (Bullock and Pywell, 2005). Moreover, their introduction to productive grassland has been shown to facilitate the establishment of desirable and functionally important forbs, such as legumes (Pywell *et al.*, 2004), hence they have been promoted actively as facilitators of restoration.

Pest control and pollination services

There was evidence that management strategy had an important influence on the overall diversity and functional composition of the invertebrate community associated with the grasslands (Woodcock *et al.*, 2008; Pywell *et al.,* 2011). All trends and significant effects were suggestive that diversity and abundance of key functional groups of invertebrates was highest where HLS conserved species-rich grassland and lowest in the grasslands managed under the low input ELS and non-scheme grasslands. Overall abundance and diversity of invertebrates was significantly higher in the species-rich grasslands compared with the ELS grasslands, suggesting that High Nature Value grasslands provide an important resource of food to higher trophic levels in the ecosystem (Vickery *et al.*, 2001; Haaland *et al*., 2011). This is likely to be driven by the greater compositional and structural diversity associated with species-rich grassland vegetation. Similarly, both abundance and diversity of herbivorous invertebrates were highest in species-rich grasslands compared with the ELS grasslands, which may be considered a potentially important indicator of the stability and resilience of the plant and associated invertebrate communities associated with the HLS grasslands. There was also a greater diversity of arthropod predators in the species-rich grassland. This diversity too may serve an important regulatory function for the ecosystem, and may have beneficial spill over effects for the regulation of pests in the adjacent crop (*e.g.* Collins *et al.,* 2001). The abundance of detritivores was highest in the species-rich grassland compared with all others, providing further evidence of the ability of this habitat to breakdown and cycle nutrients.

Finally, there were no significant differences in the abundance and richness (resolved to order/family level) of pollinating insects between the different grassland types. This finding is perhaps surprising given the large differences in plant composition and pollinator preference plant scores resulting from the different management regimes. Finer taxonomic resolution (identification to genus and species) might reveal strong preference for certain grassland types. However, an alternative explanation may be the overriding effect of summer livestock grazing in removing the flowering resource available to the insects regardless of restoration strategy (Pywell *et al.*, 2010). In addition the coloured water traps may well attract insects from both the surrounding landscape as well as the grassland site, potentially nullifying any effect resulting from the site specific grassland management regime. Clearly future management prescriptions must reflect the need to restrict summer grazing of flower-rich grassland if support to the pollination service is to be maximised (Pywell *et al.,* 2010).

8 Higher Level Stewardship in its landscape context

By 2011, the earliest HLS agreements were 4-5 years old and many others had been under agreement for at least 2 years, at which point the first Indicators of Success (IoS) were measurable. It was therefore possible to make a preliminary assessment of the progress of the scheme. The baseline survey (**Module 1**) had operated at the agreement scale, with less attention to how HLS delivered benefits for landscape or at landscape scale. As landscape is a primary HLS objective, significant effort in 2011 was devoted to developing a monitoring approach that could explore the interactions between HLS and landscape and its component features, aiming to understand how delivery of environmental benefits reinforced landscape character. A study was therefore undertaken of the environmental benefits within 6 contrasting landscapes (as defined by National Character Areas (NCAs)) through detailed assessments of clusters of agreements within each chosen area (see Section 3b). Four of the objectives to be addressed in 2011/12 were:

1 To assess how HLS delivers at the scale of the landscape (*i.e*. the NCA) through developing and testing a methodology that allows such assessments to be made objectively and in a consistent manner;
2 To assess the extent to which clusters of HLS agreements achieve synergy/ complementarity, delivering not only benefits that are greater than the sum of the component agreements, but also specific benefits that demand a landscape scale approach to environmental management;
3 To compare these deliverable benefits with those set down in the profiles and statements of environmental opportunity for the relevant NCA and thus to assess how HLS targeting might be extended and improved as an approach; and
4 To contribute toward integrated objectives for agri-environment schemes (especially Higher Level Stewardship) which take account of biodiversity and landscape/historical values.

The study that was developed provided the opportunity to examine the relationships between HLS and landscape character, taking into account the views of different stakeholder groups, as well as an opportunity to obtain field survey data that would allow assessment of early progress toward the desired outcomes of the scheme. Section 8a presents a summary of the findings from the field survey of the NCAs, which can be compared with the baseline survey described in Chapter 5. Section 8b examines how landscape character might influence the nature of HLS agreements and the selection of options within them, and outlines the content and outcomes of a series of workshops held with stakeholders and practitioners in the surveyed NCAs.

8a Evidence of Progress: Agreements under HLS for at least two years

NCA survey: Option frequency, species frequency and vegetation structure

The survey of NCAs in 2011 covered 56 different HLS options, and Table 8.1 summarises the 12 options that were surveyed and assessed on at least 5 occasions. As with the baseline survey, options for species-rich, semi-natural grassland (**HK6** and **HK7**) were most frequently assessed, with maintenance of grassland for target features (**HK15**) also widespread in the agreements surveyed.

Table 8.1: HLS options assessed during the survey of 6 NCAs in 5 or more agreements, recording the number of individual RLR parcels surveyed and the mean species-richness of the quadrats recorded as part of the survey. Results are arranged by frequency of assessment.

HLS Option Code	Number of Agreements	Number of Surveys (RLR parcels)	Mean Species Richness
HK7	27	59	15.21
HK6	24	52	17.31
HK15	12	24	11.71
HK18	9	18	15.43
HR6	8	27	11.85
HK3	7	19	10.23
HK8	7	10	13.14
HC7	6	11	15.85
HE3	6	11	8.58
HK16	6	18	12.52
HC8	5	10	16.86
HE10	5	8	10.11

Most of the other options that were well represented in the baseline survey were also frequent in the 6 NCAs *e.g.* maintenance and restoration of woodland (**HC7** and **HC8**) and **HE3** 6m buffer strips, as well as the **HK18** hay making supplement. Three options were relatively commoner in the assessments of these 6 NCAs compared to the main body of the baseline survey *i.e.* **HE10** floristically enhanced grass margins, **HK3** permanent grassland with very low inputs and **HK8** creation of species-rich, semi-natural grassland.

Again, as had been the case in the baseline survey, there was little evidence of trends in species richness when comparing paired maintenance and restoration options, although **HK6** was somewhat richer than **HK7**; and **HC7** similarly had a higher species complement than **HC8**. However, comparison of the results in Table 8.1 with the equivalent information for the baseline survey presented in Table 5.1 showed that the quadrats in agreements that had been under HLS options for at least two years were almost consistently more species-rich, although the difference in the **HC8** woodland restoration option was very small.

Following the approach described for the baseline survey (Chapter 5), each individual quadrat was classified within the types of the *National Vegetation Classification* using MAVIS. Table 8.2 gives a summary of these results corresponding to that given in section 5.2 and indicating the *NVC* types to which the quadrats from the 6 NCAs were most frequently allocated.

For most of the options that were frequently assessed in both surveys, the allocations to *NVC* type were generally similar *e.g.* **HE3, HK7, HK10, HK15, HK18, HR1, HR2** and **HR6**. However, there were some differences in the types of vegetation. For instance, woodland options (**HC7** and **HC8**) did not show the marked association with **W21** hawthorn scrub, but rather covered a wider range of woodland communities. In the **HE3** margins, the main community type remained **MG1** grassland, though in the NCA survey the **MG1a** *Festuca rubra* sub-community was best represented rather than the **MG1b** *Urtica dioica* type. There was also a contrast in the **HE10** enhanced margins, where **MG1** was the main grassland in the fields that had been option for at least 2 years in contrast to the **MG7** *Lolium perenne* grassland that predominated in the examples within the baseline survey.

Table 8.2: HLS options and the types of the *National Vegetation Classification* (*NVC*) most frequently recorded in quadrats of the survey of 6 NCAs

HLS Option Code	*NVC* Community(s) most often recorded	Other *NVC* types frequently recorded
HC7	Various **W** types	
HC8	Various **W** types	**OV25** and **OV27**
HE3	**MG1** (especially **MG1a**)	
HE10	**MG1**	Other **MG** types
HK3	**MG7** (especially **MG7b**)	**MG6**
HK6	**MG5b** and **MG6b**	Various **CG** and **MG** types
HK7	**MG6** (especially **MG6b**)	Various **MG** (and **CG**) types
HK8	Various **MG** and **OV** types	
HK10	**MG10**	
HK13	Various **MG** types	
HK15	**MG6** and **MG10a**	Other **MG** types
HK16	Various **MG** types	
HK18	**MG6b**	Other **MG** types
HK19	**MG6a**	Other **MG** types
HL10	**U2** (especially **U2b**)	
HL15	**U2**	
HP5	Various **SM** types	
HR1	Wide range of *NVC* types	
HR2	Various **MG** types	
HR6	**MG6b** and **MG10a**	Other **MG** types
HR7	Various *NVC* types	

Within the grassland options, in **HK3** the NCA samples were closer to **MG7b** *Lolium perenne-Poa trivialis* leys than to the **MG6** *Lolium perenne-Cynosurus cristatus* sward that was prevalent in the baseline survey. Although species-rich semi-natural fields under **HK6** maintenance option showed a wide variety of *NVC* types in both survey, the **MG5b** *Cynosurus cristatus-Centaurea nigra* grassland (*Galium verum* sub-community) was notably commoner in the longer established agreements. Finally, the **HK10** option for the maintenance of wet grassland for wintering waders and wildfowl appeared to cover a bigger range of **MG** types in the 6 NCAs than in the baseline survey.

Moorland options were only found in one of the NCAs studied. **HL10** and **HL15** contained many different *NVC* types drawn from heath, mire and acid grasslands in the baseline survey, but in the NCA survey there was a marked association for **U2** *Deschampsia flexuosa* grassland, probably reflecting the smaller sample size and inherent geographical bias present in the NCA survey.

Some HLS options were better represented in the NCA survey than in the baseline samples. Quadrats under **HK8** were classified in a variety of **MG** and **OV** vegetation types reflecting the dynamic nature of the species assemblages in the early years of this creation option. The results for the wet grassland creation option **HK13** were also varied though mainly within the mesotrophic grassland (**MG**) group. Fields within the **HK19** raised water-level supplement similarly were allocated to a range of **MG** types. Many more quadrats were gathered in salt-marshes during the NCA survey of the Fens than in the baseline survey and, although almost all referred to salt-marsh (**SM**) communities, no particular *NVC* type was associated with the **HP5** maintenance option.

The distribution and extent of priority habitats in NCAs

The results of the habitat mapping that was a component of the NCA study in 2011 are presented in Tables 8.3 and 8.4. Summarising the areas of Priority Habitat over the six NCAs (Table 8.3), apparently 40% of the land surveyed within agreements was Priority Habitat.

Table 8.3: Total Areas of Priority Habitats within the sample of 62 agreements in 6 NCAs

Priority Habitat	Area (ha)	% of Area
Arable Field Margins	152	4
Blanket Bog	264	6
Coastal and Floodplain Grazing Marsh	60	1
Coastal Saltmarsh	613	15
Lowland Beech and Yew Woodland	26	1
Lowland Calcareous Grassland	137	3
Lowland Heathland	85	2
Lowland Meadows	139	3
Lowland Mixed Deciduous Woodland	54	1
Ponds	47	1
No Priority Habitat	***2510***	***60***
TOTAL	**4160**	**97**

Table 8.4a: Areas of Priority Habitats mapped in survey of 6 NCAs and 62 agreements in 2011 (Broken down by individual NCA)

Priority Habitat		Dorset Downs & Cranborne Chase	Dunsmore & Feldon	High Weald	Southern Pennines	The Fens	Upper Thames Clay Vales
	Area(ha)	**Area(ha)**	**Area(ha)**	**Area(ha)**	**Area(ha)**	**Area(ha)**	**Area(ha)**
Arable Field Margins	156	89	51	2		10	
Blanket Bog	46				264		
Coastal and Floodplain Grazing Marsh	44					60	
Coastal Saltmarsh	258					613	
Lowland Beech and Yew Woodland	1	24					2
Lowland Calcareous Grassland	150	134	2				2
Lowland Dry Acid Grassland	0	2	0				
Lowland Fen	0			2	0	14	1
Lowland Heathland	25			83	2		
Lowland Meadows	146	54	2	55	8		20
Lowland Mixed Deciduous Woodland	228	24	9	18			3
Native Pine Woodlands	12				3	1	
Ponds	103	0	2	2	1	41	0
Purple Moor Grass and Rush Pastures	57			3	1		
Reedbeds	25			0		5	
Traditional Orchards	1	0	0				
Upland Birchwoods	4				3		
Upland Flushes and Swamps	46				4		
Upland Heathland	36				4		
Upland Oakwood	43				6		
Wet Woodland	111		1	6	2	3	2
Wood Pasture and Parkland	3	7					
No Priority Habitat	***2663***	***457***	***415***	***408***	***502***	***376***	***352***
TOTAL	**4160**	**790**	**483**	**580**	**801**	**1123**	**382**

Table 8.4b: Areas of Priority Habitats expressed as percentages of the area mapped during survey of 6 NCAs and 62 agreements in 2011 (Broken down by individual NCA)

Priority Habitat		**Dorset Downs & Cranborne Chase**	**Dunsmore & Feldon**	**High Weald**	**Southern Pennines**	**The Fens**	**Upper Thames Clay Vales**
	% of Area	**% of Area**	**% of Area**	**% of Area**	**% of Area**	**% of Area**	**% of Area**
Arable Field Margins	4	11	10	0		1	
Blanket Bog	1				33		
Coastal and Floodplain Grazing Marsh	1					5	
Coastal Saltmarsh	6					55	
Lowland Beech and Yew Woodland	0	3					1
Lowland Calcareous Grassland	4	17	0				0
Lowland Dry Acid Grassland	0	0	0				
Lowland Fen	0			0	0	1	0
Lowland Heathland	1			14	0		
Lowland Meadows	4	7	1	9	1		5
Lowland Mixed Deciduous Woodland	5	3	2	3			1
Native Pine Woodlands	0				0	0	
Ponds	2	0	0	0	0	4	0
Purple Moor Grass and Rush Pastures	1			1	0		
Reedbeds	1			0		0	
Traditional Orchards	0	0	0				
Upland Birchwoods	0				0		
Upland Flushes and Swamps	1				0		
Upland Heathland	1				0		
Upland Oakwood	1				1		
Wet Woodland	3		0	1	0	0	1
Wood Pasture and Parkland	0	1					
No Priority Habitat	***64***	***58***	***86***	***70***	***63***	***33***	***92***

In addition to the more widespread habitats detailed in Table 8.3, there were also very small areas of Lowland Dry Acid Grassland, Lowland Fen, Purple Moor Grass and Rush Pastures, Reedbeds, Traditional Orchards, Upland Birchwoods, Upland Flushes and Swamps, Upland Heathland, Upland Oakwood, Wet Woodland; and Woodland Pasture and Parkland. Within this survey, the most extensive Priority Habitat was Coastal Saltmarsh, followed by Blanket Bog and Arable Field Margins, Lowland Meadows and Lowland Calcareous Grassland.

However, in examining these results, it is important to bear in mind that they represent a highly selective survey that focussed on just six NCAs, each of which has its own distinctive mixture of Priority Habitats (Tables 8.4a and 8.4b). A more representative indication of the relative distribution of Priority Habitats at the national scale (England) can be gained from the results presented in Chapter 4 of this report (*Analysis of mapped data: habitats under Higher Level Stewardship*). Table 8.4a provides a detailed breakdown of the areas of all Priority Habitats recorded in the six NCAs, whereas Table 8.4b gives the same information but expressed as percentages of the area mapped during the fieldwork of 2011.

The highest proportion of Priority Habitat on HLS land surveyed in 2011 was within the Fens NCA where Coastal Salt-marsh covered more than half the surveyed area. In the Fens 66% of the land under HLS options in the 11 surveyed agreements was Priority Habitat, with Ponds and Coastal and Floodplain Grazing Marsh also important. Mapped agreements in the Dorset Downs and Cranborne Chase NCA had >40% cover by Priority Habitat, especially Lowland Calcareous Grassland, but also contained Lowland Meadow, Arable Field Margins and various types of semi-natural woodland. The extent of Priority Habitat in the High Weald and Southern Pennines NCAs was approximately 30-35% of the holdings included in the survey, with Lowland Heath and Lowland Meadow (and more rarely woodland) important in the Weald whilst Blanket Bog was much the most extensive Priority Habitat in the uplands of the Southern Pennines. Priority Habitats appeared least extensive in the Dunsmore & Feldon and Upper Thames Clay Vales NCAs. In the former, only 51 hectares (14%) of the HLS area covered by the survey was Priority Habitat, and most of those were Arable Field Margins. The Upper Thames Clay Vales had important areas of Lowland Meadows, but overall just 30 hectares (8% of the surveyed area) was Priority Habitat in that NCA. Further information on the distribution of Priority (and Broad) Habitats in the 6 NCAs can be found in the data-packs included as annexes of the interim report describing the project activities in 2011/12 (Mountford *et al.* 2012).

The condition of FEP features in the NCA study

FEP features identified within the survey of NCAs were assessed in the same way as described for the baseline survey (Chapter 5) and 313 distinct assessments of such features were undertaken. Table 8.5a presents the results of these condition assessments for any FEP features whose condition was measured on five or more occasions. In the following description of results, intermediate scores (A/B or B/C) were reallocated as described in Section 5a. Table 8.5b shows how these feature condition scores were distributed through the six NCAs included in the survey.

In these HLS agreements, which had been operative for 2-4 years, the condition of FEP features appeared somewhat improved relative to the results of the baseline survey (Chapter 5). Thus, in these agreements, 38.8% of FEP features were in condition A (baseline survey 30%), 38.3% in condition B (baseline survey 40.5%) and only 22.8% in condition C (baseline survey 29.5%) – see Table 8.5a. Certain habitats were most frequently in good (A) condition *e.g.* G02 semi-improved grassland, grasslands for invertebrates and waders (G11, G12 and G13), T08 native semi-natural woodland and W07 ponds, as well as BAP hedgerows (F02). Other habitat features were most often in moderate (B) condition *i.e.* G04 BAP lowland calcareous grassland, H01 above-ground historic features and H04 large-scale archaeological features, as well as G15 grazing marsh, although this was only assessed on five occasions. Two BAP grassland habitats (G05 lowland dry acid grassland and G06 lowland meadows) were often in poor (C) condition, as were H02 below-ground historic features.

Table 8.5: FEP features and their condition as assessed within the 2011 survey of 6 NCAs

Table 8.5a: Results presented for those features assessed on 5 or more occasions. Features assessed more than once in an agreement (*i.e.* in separate parcels *etc*) are counted as distinct occasions)

FEP Feature	**Sample size**	**FEP feature condition**				
		A	**A/B**	**B**	**B/C**	**C**
C01 BAP coastal salt-marsh	*7*	2	1	3	1	
F02 BAP Hedgerow	*5*	5				
G02 Semi-improved grassland	*67*	31	6	21	1	8
G04 BAP Lowland calcareous grassland	*28*	7	7	5	4	5
G05 BAP Lowland dry acid grassland	*10*					10
G06 BAP Lowland meadows	*47*	4	6	10	5	21
G11 Habitat for invertebrates	*11*	7	2	2		
G12 Habitat for breeding waders (lowland)	*14*	12		2		
G13 Habitat for wintering waders/wildfowl	*5*	3		2		
G15 BAP Coastal/floodplain grazing marsh	*5*	1		4		
H01 Above ground historic feature	*39*	7	2	25		5
H02 Below-ground historic feature	*8*			2		6
H04 Large-scale archaeological feature	*11*	1	1	6		3
T08 Native semi-natural woodland	*18*	7	4	5	1	1
W07 Ponds	*10*	7	1	1		1
W08 BAP Reedbeds	*5*	2		2	1	
ALL FEATURES	**Total**	**96**	**30**	**90**	**13**	**60**
	%	**33.2%**	**10.4%**	**31.1%**	**4.5%**	**20.8%**

Table 8.5b: Results presented by NCA (all features)

National Character Area (NCA)	**FEP feature condition**				
	A	**A/B**	**B**	**B/C**	**C**
Dorset Downs and Cranborne Chase	27	14	12	4	3
Dunsmore and Feldon	6	1	22		12
The Fens	21	2	14	5	3
High Weald	40	12	11	1	11
South Pennines	1	2	9	1	21
Upper Thames Clay Vales	10	2	29	4	16

There was variation between the six NCAs in the general condition of FEP features (Table 8.5b). Within the Dorset Downs and Cranborne Chase, the Fens and the High Weald, 50-60% of features were scored in the highest condition, and only 8-15% in the poorest category. Both Dunsmore & Feldon and the Upper Thames Clay Vales tended to have features scored in the intermediate (B) category. In contrast the South Pennines NCA had 63% of the assessed features in poor (C) condition.

As well as providing some evidence that FEP features were in generally in better condition two years or more after inclusion in HLS, comparison with the results of the baseline survey also suggested that the condition of certain specific features was better once HLS options had been applied *e.g.* G02 semi-improved grassland and T08 native semi-natural woodland. For most grassland habitats, the proportion that was in poor condition appeared generally lower in the NCA study.

A more quantitative assessment of change in FEP feature condition between the first year and Years 2-4 of the agreement is clearly desirable. As a preliminary approach, the results of condition assessments for the baseline survey were summarised, calculating the proportion of scores (possible values ranging from 0.0 to 1.0) for each feature, in the five condition categories (A, A/B, B. B/C and C). The process was repeated for the FEP feature condition assessments made during the NCA survey of 62 agreements. The value for each category from the baseline survey was subtracted from the corresponding value for the NCA survey to provide an index of changing feature condition (see Table 8.6). Positive values indicate that the proportion of a particular condition score for a given feature was higher in the NCA study, whilst negative values indicated the proportion was lower in the NCA work.

Table 8.6: Comparison of RAG assessments of Indicators of Success (IoS) from the baseline survey and the 2011 survey, showing the differences between NCA and baseline feature condition (Only those features that appear ≥10 times in both datasets are shown, and they are ordered from the most numerous in the baseline dataset; values shown are "NCA proportion minus baseline proportion" – see accompanying text for further explanation)

FEP Habitat Feature	FEP Feature Condition				
	A	A/B	B	B/C	C
G02 Semi-improved grassland	0.25	0.08	-0.23	-0.01	-0.13
H01 Above ground historic feature	-0.21	0.01	0.32	0.00	-0.12
G06 BAP Lowland meadow	-0.12	0.13	-0.10	0.08	0.01
G04 BAP Lowland calcareous grassland	0.05	0.08	-0.02	0.09	-0.20
T08 Native semi-natural woodland	0.06	0.16	-0.15	-0.04	-0.10
G05 BAP Lowland dry acid grassland	-0.12	0.00	-0.41	0.00	0.53
W07 BAP Ponds	0.29	0.04	-0.37	0.00	0.04
G12 Habitat for breeding waders (lowland)	0.66	0.00	-0.36	-0.20	-0.30

From this exercise, some trends in individual habitat features can be inferred, although it must be remembered that the condition assessments were gathered from different sets of agreements in the two surveys, that there are numerous site-specific factors influencing the feature condition for any given agreement and that the trends results have not been subject to rigorous statistical testing.

Where features have positive values for condition categories A and A/B, it can be surmised that a greater proportion of the habitat was in good condition where HLS management had been applied for at least two years. Such results were found with semi-improved grassland, lowland calcareous grassland, habitat for breeding waders, ponds and native semi-natural woodland. These same features generally show negative values for condition category C *i.e.* indicating that a smaller proportion of the features are in poor condition. One may cautiously conclude that features showing these trends have benefitted from the application of HLS management.

For those features with negative values for conditions A and A/B, the results imply that the feature was in poorer condition in situations where HLS management had been applied for some time than in situations where the option had only just been introduced. There is some suggestion that this might be the case for lowland dry acid grassland, lowland meadows and for above-ground historic features (at least with regard to the highest condition A). However, all three features had a positive index for the A/B category (albeit that category was less consistently employed than A, B and C). Greater concern might arise from the positive value for condition category C for dry acid grassland, meaning that a greater proportion of that habitat was in poor condition on land under option for >2 years than where HLS had only just been introduced.

Almost all features that occur at least 10 times in both datasets showed a negative index for category condition B, meaning that a much greater proportion of most habitats had been allocated to that category in the baseline survey than in the NCA survey. Taken together with the trends for condition A and C, there seems to be evidence of an overall improvement in feature condition for most of the frequently assessed habitats, although there would be concern that some BAP grassland types (notably lowland meadows and lowland dry acid grassland) do not exhibit this trend. As lowland meadows, in particular, are such a widespread feature within HLS, this needs further examination.

The 62 agreements included in this module of the study were not subject to the panel appraisals used in **Module 1** and described in Chapter 6 of this report. However, equivalent pre-appraisal forms (PAFs) were prepared that included assessments by both the surveyors and the main project team of the quality of management for the key target features. The trends described for feature condition were largely reflected in the choice and implementation of HLS options. There was evidence that the use of HLS options and the management applied had improved during the early years of the scheme *i.e.* cases of inappropriate option choice had diminished and most key features were under suitable management. The problems reported with some grassland types may result in part from an over-estimate of habitat quality in the FEP and consequent poor choice of option. In general however there was clear evidence that HLS management was improving the condition of key environmental features.

Indicators of Success

Indicators of Success (IoS) for HLS options that were assessed in **Module 3**, and felt to be measurable were given a RAG assessment as for the data presented for **Module 1** in Chapter 5. There were 214 assessments of distinct agreement-option combinations, and the results are presented in Table 8.7a for HLS options examined on at least 5 occasions (results for less frequently assessed options are pooled within option groups). As with FEP features, Table 8.7b shows how these RAG assessments for IoS were distributed through the six surveyed NCAs.

As with the **Module 1** baseline survey, it is possible to classify the results from the RAG assessments into three groups: a) all measurable IoS were achieved or judged very likely to be achieved in the future; b) one IoS had failed or where 2-5 indicators seemed likely to fail; and c) where there was clear failure for two or more indicators. A comparison of the rates of likely success in the baseline survey with that for agreements that had been in place for at least 2 years gave a less positive judgement of the likely success of the options.
Despite the rather better condition of the FEP features after 2 or more years of HLS management, Table 8.7a indicates that only 46.5% of options had already achieved all their IoS or appeared certain to achieve these indicators within the span of the agreement (corresponding result for the baseline survey was 62.3%). A further 29% of options had one indicator assessed as Red (very likely or certain to fail) – the baseline survey result was 20.1%. Finally, although only 17.6% of options in the baseline survey received more than one Red assessment for their IoS, almost a quarter of agreements from the NCA survey (24.9%) received a Red assessment.

Table 8.7: RAG assessments of Indicators of Success (IoS) for HLS options within the 2011 survey of 6 NCAs

Table 8.7a: Results presented for those individual HLS options assessed in 5 or more agreements – other results presented at the option group level

HLS option		Results of RAG assessment of measurable IoS		
		Passed all	Failed one	Failed >1
HB options		3	1	
HC less frequent options		6	2	6
HC7		2	3	1
HC8		1	4	1
HD less frequent options		3		2
HD5		2	3	
HE less frequent options		2	1	
HE10		2		4
HF options		5		1
HG options		1		
HJ options		1		
HK less frequent options		11	7	1
HK3		2	2	1
HK6		9	9	6
HK7		8	5	11
HK8		1	2	2
HK15		6	4	2
HK16		3	1	1
HK18		3	2	
HL less frequent options		3		3
HL10		1	3	7
HN options		5	1	
HO options		2	1	
HP options		3	1	
HQ less frequent options		2	4	2
HQ2		5	2	1
HR supplements		5		1
Organic options		2	3	
ALL OPTIONS	**Total**	**99**	**61**	**53**
	%	**46.5%**	**28.6%**	**24.9%**

Table 8.7b: Results presented by NCA (all HLS options)

National Character Area (NCA)	Results of RAG assessment of measurable IoS		
	Passed all	Failed one	Failed >1
Dorset Downs and Cranborne Chase	22	10	3
Dunsmore and Feldon	12	9	8
The Fens	18	12	6
High Weald	25	12	1
South Pennines	13	11	20
Upper Thames Clay Vales	9	8	15

Inspection of the individual options and option groups may produce three categories (as used in the description of baseline survey results – Chapter 5), although the smaller size of the dataset for the NCA survey meant that some options (and groups) were rarely assessed – these results are presented in brackets:

I. Pass all their IoS more frequently than is typical *e.g.* (**HB** options), **HF** options, less frequent **HK** options **HK15**, (**HK16**), **HN** options, **HQ2** and **HR** supplements;

II. Fail one IoS more frequently than is the norm in the survey *e.g*. **HC7**, **HC8**, **HD5**, **HK6** and **HQ** options; and
III. Fail >1 IoS more often than is typical for surveyed agreements *e.g.* (less frequent **HC** options), **HE10**, **HK7**, (**HK8**) and **HL10**.

The results for individual options and option groups are generally similar to those for the baseline survey with the more challenging options to restore (or create) species-rich semi-natural grassland and moorland deemed more likely to fail. Creation of floristically enhanced grass margins (**HE10**) also frequently failed more than one IoS. A direct comparison of the RAG results from the baseline survey with those from the NCA study might be taken to suggest that the likelihood of meeting the desired outcomes had declined from the start of the agreements to their being under HLS management for at least two years. Nevertheless, it is most likely that the RAG assessments made during the first few months of an agreement (*i.e.* the baseline survey), which were essentially predictive, tended to give a greater "benefit of the doubt", meaning that IoS assessed at the outset of the agreement may have been more likely to be given an Amber assessment rather than Red. However, once an agreement had been in place for two or more years, some of the IoS could receive absolute judgements, and it is likely that any apparent discrepancy in trends for RAG assessments between the two modules of the project arises from this.

Distinct trends can be discerned in the six NCAs, although these patterns were very similar to those reported above for FEP feature condition (Table 8.7b). Again HLS options in the Dorset Downs and Cranborne Chase (63%), High Weald (66%) and, to a lesser extent, the Fens (50%) usually passed all their IoS, with only 2.6-8.5% in the poorest category (16.7% in the Fens). Options in the Dunsmore & Feldon NCA showed a trend toward failing one or more of the IoS. The Upper Thames Clay Vales and South Pennines NCAs had the highest rate of likely failure with 45-50% of options judged as failing more than one IoS.

Targeting the key environmental capital

The success of HLS may also be judged by how effectively the scheme has been applied to the most important environmental features within the English countryside and specifically to those features that are characteristic of the local and regional landscape. Data-packs produced for the NCA workshops in 2011/12 (six annexes to Mountford *et al.* 2012) included a description of the habitats and landscapes of each NCA, trends in land-use and land cover and an analysis of the conservation activity in the area both through national and international designations and through the classic agri-environment schemes. The data-packs also contained analyses of how HLS had been applied in the NCA, examining its implementation in terms of options chosen and distribution of activity in relation to target features such as Priority Habitats, SSSIs and important areas for farmland birds.

Given that HLS is intended to be a highly targeted scheme addressing features of the greatest environmental value, the results of these NCA analyses allow an assessment to be made of the success and likely effectiveness of the scheme.

Tables 8.8 and 8.9 portray the uptake of HLS in relation to Priority Habitats and SSSIs for the six NCAs, presenting the results in terms of the maximum area of habitat (or SSSI) where HLS is applied (as estimated from the habitat inventories of *Natural England*), the total area of that feature in the NCA and thus the percentage of the environmental capital that is targeted by HLS.

The relative uptake of the resource into HLS differs markedly between different priority habitats (Table 8.8), although it must be borne in mind that these results are based upon just six NCAs. Uptake is highest in lowland heath, lowland calcareous grassland, fens, upland hay meadows and blanket bog, though three of these habitats were restricted in their distribution: lowland heath being common only in the High Weald and to a lesser extent the Dorset Downs and Cranborne Chase, whilst the results for upland hay meadows and blanket bog are based solely on uptake in the Southern Pennines. Calcareous grassland was a major focus of HLS activity in the Dorset Downs, but in some other NCAs the relative uptake was high despite the habitat being uncommon. Uptake of HLS for fens was moderate to high in all six NCAs, although the habitat is only extensive in the valleys of the Dorset Downs, the High Weald and especially The Fens themselves.

Other habitats appeared to have only moderate uptake of HLS, especially grasslands (lowland dry acid, grazing marsh, lowland meadows and purple moor-grass and rush pastures), but also reedbeds and upland heath. Lowland dry acid grassland was uncommon within the 6 NCAs, but a high proportion of this habitat was covered by HLS in the High Weald. Grazing marsh was an important part of HLS implementation in The Fens, the High Weald and the Upper Thames Clay Vales; lowland meadows and to some extent purple moor-grass and rush pastures showed a similar pattern and lowland meadows were also an important habitat for HLS options in the Dorset Downs and Cranborne Chase. Uptake of HLS in reedbeds followed a similar trend to that for fens, though at somewhat lower rates.

A few priority habitats were poorly represented in HLS agreements in all 6 NCAs, and both raised bogs and upland calcareous grasslands are largely absent from these areas. In contrast HAP woodlands were present in all NCAs, but usually with <10% uptake of HLS. Only in The Fens was HLS frequently used to target such woodlands.

Table 8.8: **Six NCAs:** Take-up of HLS in terms of area (hectares) of each priority habitat from the *Natural England* Habitat Inventory and maximum potential % coverage by HLS: A) Lowland Habitats; and B) Wetland and Upland Habitats

NCA	HLS Take-up	A) Lowland Habitats						
		Habitat Action Plan Woodland	**Lowland Heathland**	**Dry Acid Grassland**	**Lowland Calcareous Grassland**	**Coastal & Floodplain Grazing Marsh**	**Lowland Meadows**	**Purple Moor-grass & Rush Pastures**
Dorset Downs & Cranborne Chase	Area of habitat under HLS	755.7	148.4	10.2	1494.8	323.0	178.3	16.8
	Total area of Habitat	6847.4	425.2	71.8	2869.6	2326.7	298.4	61.0
	% under HLS	**11.04%**	**34.9%**	**14.2%**	**52.1%**	**13.9%**	**59.8%**	**27.5%**
Dunsmore & Feldon	Area of habitat under HLS	191.3	0	0	2.0	6.8	8.0	0
	Total area of Habitat	2070.9	0	0	41.0	493.2	107.6	0
	% under HLS	**8.6%**	**0**	**0**	**4.9%**	**1.4%**	**7.4%**	**0**
The Fens	Area of habitat under HLS	264.4	0	0	52.0	2129.8	1755.5	642.0
	Total area of Habitat	1064.0	11.3	9.4	76.3	5571.2	4166.7	1796.8
	% under HLS	**24.8%**	**0%**	**0%**	**68.2%**	**38.2%**	**42.1%**	**35.7%**
High Weald	Area of habitat under HLS	2431.5	2189.6	134.7	0	235.7	51.4	0
	Total area of Habitat	26547.9	3281.2	142.2	0	583.8	233.7	0.8
	% under HLS	**9.2%**	**66.7%**	**94.7%**	**0**	**40.4%**	**22.0%**	**0%**
Southern Pennines	Area of habitat under HLS	92.7	44.3	101.9	13.9	0	133.3	131.3
	Total area of Habitat	3144.2	378.2	723.1	14.9	99.6	774.3	615.0
	% under HLS	**2.9%**	**11.7%**	**14.1%**	**93.3%**	**0%**	**17.2%**	**21.4%**
Upper Thames Clay Vales	Area of habitat under HLS	175.1	0	0	14.0	1363.1	564.8	7.0
	Total area of Habitat	3368.2	0	0.9	38.0	7183.7	1334.9	16.4
	% under HLS	**5.2%**	**0**	**0%**	**36.8%**	**19.0%**	**42.3%**	**42.7%**
All NCAs	% under HLS	**9.09%**	**58.16%**	**26.05%**	**51.87%**	**24.96%**	**38.92%**	**32.01%**

Table 8.8: continued

NCA	HLS Take-up	B) Wetland and Upland Habitats						
		Fens	Reed-beds	Raised Bog	Upland Hay Meadows	Upland Calcareous Grassland	Upland Heath	Blanket Bog
Dorset Downs & Cranborne Chase	Area of habitat under HLS	41.1	9.8	0	0	0	0	0
	Total area of Habitat	109.2	18.1	0	0	0	0	0
	% under HLS	**37.6%**	**54.1%**	**0**	**0**	**0**	**0**	**0**
Dunsmore & Feldon	Area of habitat under HLS	18.0	1.9	0	0	0	0	0
	Total area of Habitat	62.0	7.1	0	0	0	0	0
	% under HLS	**29.0%**	**26.8%**	**0**	**0**	**0**	**0**	**0**
The Fens	Area of habitat under HLS	264.6	466.4	0	0	0	0	0
	Total area of Habitat	377.4	691.1	0	0	0	0	0
	% under HLS	**70.1%**	**67.5%**	**0**	**0**	**0**	**0**	**0**
High Weald	Area of habitat under HLS	100.0	5.0	0	0	0	0	0
	Total area of Habitat	114.2	288.7	0	0	0	0	0
	% under HLS	**87.6%**	**1.7%**	**0**	**0**	**0**	**0**	**0**
Southern Pennines	Area of habitat under HLS	4.1	0.3	0	13.9	4.3	294.6	12649.8
	Total area of Habitat	15.0	47.5	18.2	14.9	88.2	1420.7	29748.2
	% under HLS	**27.3%**	**0.6%**	**0%**	**93.3%**	**4.9%**	**20.7%**	**42.5%**
Upper Thames Clay Vales	Area of habitat under HLS	136.9	24.7	0	0	0	0	0
	Total area of Habitat	682.0	413.7	0	0	0	0	0
	% under HLS	**20.1%**	**6.0%**	**0**	**0**	**0**	**0**	**0**
All NCAs	% under HLS	**41.53%**	**34.65%**	**0%**	**93.3%**	**4.9%**	**20.7%**	**42.5%**

Table 8.9: Six NCAs: Take-up of HLS in terms of area (hectares) of SSSIs – sub-divided in terms of SSSI condition, as recorded on *Natural England's* ENSIS system (as of March 2011)

NCA	HLS Take-up	Destroyed	Unfavourable			Favourable	SSSI Total
			Declining	No Change	Recovering		
Dorset Downs & Cranborne Chase	Area of SSSI under HLS	0	63.0	29.4	895.7	725.6	1713.9
	Total area of SSSI	0	130.9	62.7	1694.0	1576.3	3463.9
	% under HLS	**0**	**48.1%**	**46.9%**	**52.9%**	**46.0%**	**49.5%**
Dunsmore & Feldon	Area of SSSI under HLS	0	0	31.5	38.3	98.9	168.7
	Total area of SSSI	0	0	31.8	137.7	301.4	471.0
	% under HLS	**0**	**0**	**99.1%**	**38.4%**	**32.8%**	**39.0%**
The Fens	Area of SSSI under HLS	0	35.6	1329.5	523.1	1173.8	3362.0
	Total area of SSSI	0	131.0	2273.9	1805.6	4831.4	9041.9
	% under HLS	**0**	**27.2%**	**58.5%**	**29.0%**	**30.5%**	**37.2%**
High Weald	Area of SSSI under HLS	0	0	0.005	2690.7	360.0	3050.7
	Total area of SSSI	0	558.7	141.7	4076.8	1161.0	5435.4
	% under HLS	**0**	**0%**	***ca* 0%**	**66.0%**	**31.0%**	**56.1%**
Southern Pennines	Area of SSSI under HLS	0	0.05	241.3	10778.3	177.1	11196.8
	Total area of SSSI	0	1.4	1333.9	20262.4	349.3	21947.1
	% under HLS	**0**	**3.6%**	**18.1%**	**53.2%**	**50.7%**	**51.0%**
Upper Thames Clay Vales	Area of SSSI under HLS	0	10.6	0.1	283.0	434.4	727.9
	Total area of SSSI	8.8	178.6	58.4	2478.5	1298.7	3640.8
	% under HLS	**0%**	**5.9%**	**0.2%**	**11.4%**	**33.4%**	**20.0%**
All NCAs	**% under HLS**	**0%**	**10.62%**	**41.82%**	**49.94%**	**31.2%**	**45.95%**

Despite the limited sample (especially for upland habitats), some broad conclusions can be made about how effectively HLS is dealing with the resource of priority habitats. Overall, HLS uptake on priority habitats is around 34%, and appears most successful where a habitat is particularly characteristic of, and thus addressed, in a Target Area or NCA *e.g*. fens in The Fens, chalk grassland on the Dorset Downs and blanket bog in the Southern Pennines. For woodlands, HLS is the not the main instrument for their conservation management, and especially not for the largest woodland blocks. Instead **HC** options focus on the small fragmentary farm woods that represent a small proportion of the priority habitat resource.

An alternative measure of high quality environmental capital is the area designated as nationally important for nature conservation through the system of SSSIs. Of the total extent of SSSIs in the six NCAs, almost half the area was being managed under HLS, being especially high in the High Weald and Southern Pennines, and lowest in the Upper Thames Clay Vales (Table 8.9). HLS is designed to be a key mechanism for improving the management of SSSIs, especially where the site is in unfavourable condition. Inclusion in an HLS agreement with suitable management is a major consideration in the process whereby a site in unfavourable condition is classed as recovering. Evidence from this survey confirms that HLS uptake is indeed highest in SSSIs with unfavourable condition (no change and recovering), and that the proportion of SSSIs with declining condition is very low where HLS management has been introduced. There is also evidence that those SSSIs that are in favourable condition and being managed under HLS are mainly under maintenance options.

Landscape assessments: methods and results of the field survey

In order to determine the representativeness of each holding surveyed a simple landscape character assessment was undertaken. This assessment sought to determine two things:

- The character of the landscape of the holding itself and how this compared to the NCA and relevant subzone.
- The character of the landscape surrounding the holding and how this compared to the NCA and relevant subzone.

The landscape characteristics used were drawn from the original NCA descriptions and subsequent text developed in 2005 to inform the possible targeting of ES. The latter also contained information for distinctive sub areas of the NCA; these areas are referred to as subzones.

Survey protocols were created using the Landscape Character Assessment Guidance developed by *Natural England* and *Scottish Natural Heritage*[2] to ensure both that there was a consistent approach to the assessment of landscape criteria by the field survey teams and that the approach used was consistent with current guidance. Landscape assessment forms were drafted for each of the six NCAs (see Table 8.10).

The forms listed firstly the key rural landscape characteristics that applied throughout each NCA and secondly those that varied between the subzones of the NCA, categorised as:

- physical landform and settlement pattern;
- hedges, trees, woodland and semi-natural features;
- enclosure pattern and form;
- agricultural land management; and
- other features.

[2] www.naturalengland.org.uk/ourwork/landscape/englands/character/assessment/default.aspx

Table 8.10: An extract from the landscape assessment form for NCA 96 (Dunsmore and Feldon)

KEY RURAL LANDSCAPE CHARACTERISTICS FOR DUNSMORE AND FELDON (NCA 96) SUB-ZONES	Zones	Land within HLS Holding		Landscape Context
		Apparent(Y/N)	Contribution	Apparent (Y/N)
KEY RURAL LANDSCAPE CHARACTERISTICS FOR DUNSMORE AND FELDON (NCA 96)				
Much of the landscape is gently undulating with localised low hills and plateaux.	**All**		prominent occasional localised	
The area is underlain by lower Lias clays and Mercia mudstones, with extensive surface deposits of glacial drift.	**All**		prominent occasional localised	
There is a general lack of woodland cover across the area, although there is a well-wooded character in Dunsmore.	**All**		prominent occasional localised	
Fields are usually large, with regular or rectilinear shapes, although there are some smaller fields.	**All**		prominent occasional localised	
Feldon is dominated by pasture, while in Dunsmore there is more mixed farming, including areas of intensive arable.	**All**		prominent occasional localised	
Much of the landscape is gently undulating with localised low hills and plateaux.	**All**		prominent occasional localised	
Many areas of ridge and furrow show the location of medieval open fields.	**All**		prominent occasional localised	
Large country houses set in mature parkland are a recurring feature	**All**		prominent occasional localised	
Comments :				
Physical landform and settlement pattern				
Open plateau, fringed by a more enclosed, rolling landscape	**1**		prominent occasional localised	
Gently undulating landscape of low hilltops and clay vales	**2**		prominent occasional localised	
A large scale rolling topography with occasional steep scarp slopes	**3**		prominent occasional localised	
Settlement of the plateau farmlands is sparse, comprising scattered farmsteads and isolated barns, while around the plateau fringes, settlement is more nucleated in loose clusters	**1**		prominent occasional localised	
Comments :				
Hedges, tress woodland and semi-natural features				
Generally well-wooded appearance but more open on the plateau summit	**1**		prominent occasional localised	
Many hedgerow and roadside trees in places, frequent hedgerow elm stumps in the vales and occasional woodlands	**2**		prominent occasional localised	
Large woodlands, often associated with rising ground and scarps	**3**		prominent occasional localised	

The assessments were complemented by a series of photographs that covered:

- The key characteristic landscape features found at the HLS option survey point within the agreement holding; and
- The surrounding landscape in which the agreement holding is located. The field surveyors were asked to choose viewpoints that were both relocatable and which would permit repeat photography.

Specific training in the use of the landscape assessment forms was given to the survey teams in order to ensure consistency of approach. The outputs of the survey were:

- A description of the landscape character and summary of the condition of the key landscape features found at the option survey point.
- A description of the landscape character and a summary of how representative the landscape within which the agreement holding is situated is of the NCA as a whole.
- A set of photographs relevant to each description.

On the holding itself, the contribution of the key characteristics was ranked as prominent, occasional or localised. From this contextual information we were able to draw some general conclusions about how well or otherwise an agreement is contributing to the maintenance and enhancement of the landscape character of the NCA. The results for all subzones were reported in the interim report for the 2011/12 programme (Mountford *et al*. 2012), but those for the key rural landscape characteristics are summarised in Table 8.11.

Table 8.11: Six National Character Areas (surveyed agreements 2011): Summary of Landscape Assessments for key rural landscape characteristics that apply to the whole of each NCA. Results presented as percentages in each category for all the key characteristics scored by the field survey.

Levels of Landscape Assessment	Score	Dorset Downs & Cranborne Chase	Dunsmore & Feldon	The Fens	High Weald	South Pennines	Upper Thames Clay Vales
Apparent in land within HLS holding?	YES	62.0	62.5	53.3	62.2	86.5	63.75
	NO	37.0	25.0	16.3	29.8	12.5	36.25
	n/a	1.0	12.5	32.6	14.9	1.0	-
Contribution in land within HLS holding	Prominent	22.0	40.9	45.9	33.9	71.2	32.5
	Occasional	24.0	14.8	5.2	5.0	10.6	11.25
	Localised	14.0	8.0	2.2	22.3	4.8	20.0
	n/a	40.0	36.4	45.9	38.8	13.5	36.25
Apparent in the context landscape around HLS Holding?	YES	81.0	75.0	68.9	72.7	97.1	65.0
	NO	15.0	12.5	30.4	15.7	2.9	22.5
	n/a	4.0	12.5	0.7	11.6	-	12.5

Surveyors then assessed the landscapes both within the HLS holdings themselves and in the surrounding land that provided a context for the holding, to gauge whether the key characteristics were present or not. The table states whether the characteristic was apparent on the holding, how prominent it was and whether it was apparent in the area surrounding the surveyed agreement.

Within the holdings themselves, the landscape was generally found to be typical of the NCA although the degree of representativeness varied, being highest in the South Pennines at 86% and with most of the other NCAs showing an apparent fit of about 60-65% with the typical landscape. Representativeness was lowest in the Fens where several of the agreements surveyed stood apart from the typical Fenland landscape; in some cases this exceptional nature was the very reason for HLS activity. The South Pennines holdings also had the most prominent contribution of these key characteristics whilst in the Dorset Downs, High Weald and Upper Thames Clay Vales NCAs the key characteristics were poorly represented or not applicable.

Such regional variation in the contribution of key landscape characteristics partly reflects the quality of the source material for the original NCA descriptions, an issue now being addressed by *Natural England* through work to update them. This new information was not available at the time (2011) when the surveys were undertaken.

The contextual landscapes of the 62 surveyed holdings were more typical of the broader NCAs, with in all cases at least 65% of key characteristics apparent in the areas surrounding the holdings and in the South Pennines as much as 97%.

HLS options, landscape connectivity and buffering

The data gathered in **Module 1** and especially in **Module 3** are amenable to an examination of the degree to which option targeting is achieving connectivity between habitat fragments within a landscape. Information on option usage in the 6 NCAs showed that the selection of management options did reflect the priorities for each NCA or HLS Target Area (see data-pack annexes from Mountford *et al.* 2012).

However GIS-based spatial analyses of the location of particular options and their ability to buffer or connect key environmental features has not as yet been undertaken but will be part of the continuing analysis of the project data. It would be desirable to focus on habitat creation options *e.g.* **HK8** for species-rich grassland and **HL11** for moorland. However the total uptake of such options is low: 480 agreements and 4543 ha for **HK8** and only 18 agreements and 1919 ha for **HL11**. The only creation option to be within the top 40 most extensively used (measured by frequency or area – see Tables 2.1 and 2.2) is **HK17** grassland for target features. Manifestly the target feature of this option varies from agreement to agreement and hence a spatial analysis of the impact of **HK17** must take account of the particular features addressed.

Hence the power of such spatial analyses of improved landscape connectivity may be limited by the few available data, although a focus on the ability of HLS options in general to buffer high quality habitats in landscapes is more viable.

8b Relationships between HLS, landscape and stakeholder priorities

The field survey of 6 NCAs was complemented by two other components:

- A desk-based spatial analysis of available datasets for each NCA to establish its character and thus the context within which HLS had been implemented since 2005;
- A series of workshops examining landscape and stakeholder priorities.

The spatial analysis produced 6 data-packs which included a comprehensive description of the context of HLS delivery within each NCA, and which were used as source material for discussions within the workshops. The data-packs were included as appendices in the 3rd Interim Report of the project (Mountford *et al*. 2012). The desk-study and data-packs addressed four main groups of issues:

1) How has the landscape of each NCA evolved over time and particularly in the past century? Are the number and distribution of HLS agreements related to landscape type and land-use history? Which habitats are represented within the NCA and what is their extent both within and without HLS agreements?

2) How much of the NCA has been designated for its nature conservation or landscape importance? What is the evidence that such designated land requires environmental management of the type provided by agri-environment schemes and how much effort had there been in AES prior to the introduction of Environmental Stewardship (ELS and HLS)?

3) What has been the take-up of HLS (and other components of Environmental Stewardship)? How is this take-up related to a) the occurrence of broad and priority habitats in the NCA; b) the known distribution of other target features such as farmland birds; and c) the occurrence and condition of designated areas such as SSSIs?

4) How had the field survey of 2011 addressed delivery of HLS in each NCA? Were the agreements that had been included in the survey representative of the NCA as a whole and the local priorities for HLS?

The data-packs were provided to all participants in a series of workshops convened by *Natural England* during the winter of 2011/12, together with a document that included the key background statements on each NCA: a). the published description of the character area; and b) all the relevant regional theme and target area statements for HLS.

This focus on a small group of NCAs allowed a comprehensive and in-depth examination of the nature of HLS delivery in each area and the extent to which management was reinforcing or enhancing key characteristics of the landscape. The workshops used qualitative methods in an attempt to identify the relationships between stakeholder priorities, landscapes and the HLS scheme, asking the participants to consider two key questions:

A. How does landscape character influence the nature of HLS agreements, including the selection of options, *etc*?

B. How do local circumstances dictate where options and agreements go?

Workshops: approach and objectives

The NCA workshops were conceived with four intentions:

I. To provide some feedback to stakeholders on HLS, how it is planned to provide benefits at landscape scale, how option choice influences the scale of those benefits and how outcomes are monitored. Such feedback is good practice in any situation, but was especially timely for an agri-environment scheme for which desired outcomes were due;

II. To present the interim results of the agreement monitoring to a range of stakeholders, as a means of testing their validity of these results;

III. To examine how a workshop format could inform *Natural England* and CEH on the complex relationships between landscape character prior to HLS, landscape character after/during HLS and the perceptions and values of stakeholder groups; and

IV. To take the opportunity provided by the workshops to conduct a series of exercises in qualitative social science as this relates to implementation of agri-environment schemes in order that the two key questions (see above) could be answered.

Workshops: participants, exercises and methods

The workshops began with introductory presentations describing HLS and the purpose of the research, followed by a summary account of the material within the data-pack and the expected opportunities for HLS in the particular NCA. As the planning of the workshops was undertaken in conjunction with local *Natural England* advisers, and was intended to provide a framework for discussion of their local issues and priorities, the workshops varied somewhat in their foci and the constitution of the participants. These participants were typically drawn from three groups; farmers and land managers, representatives of third sector organisations (Wildlife Trusts, RSBP, NT *etc*) and *Natural England* staff drawn from the local Land Management teams. There were insufficient numbers of participants in all but the Dunsmore & Feldon workshop to divide them into 3 distinct groups. Therefore it was not possible to determine differences in the perceptions, based upon potentially competing land use priorities, of these differing groups.

1. ***Dunsmore and Feldon***, Warwickshire, had a good representation of local agreement holders (some of whose agreements had been surveyed) and *Natural England* staff, as well as several representatives of relevant NGOs. **23 participants**

2. ***The Fens*** workshop was dominated by stakeholders from NGOs but with a few *Natural England* staff and a few farmers actively involved in conservation. **12 participants**

3. ***Upper Thames Clay Vales*** was similar in character to Dunsmore and Feldon, including several land managers whose agreements had been surveyed in 2011. **16 participants**

4. The ***High Weald*** workshop differed from the other four in the absence of the usual exercises and a focus on the relationship between HLS and the AONB. **10 participants**.

5. ***Southern Pennines*** was dominated by *Natural England* and the NGOs, with the main representation from agreement holders coming from large corporate landowners. **20 participants**

6. It was not possible to organise a workshop for the ***Dorset Downs and Cranborne Chase*** within the time available although a full data-pack was produced and all the other quantitative analyses were performed.

In total there were **81 participants**, with **71** taking part in the exercises.

Two exercises were conducted with the participants in four of the workshops:

Exercise 1: Asked the participants to a) identify the key priorities for HLS in the area at a broad level; b) say how well the current pattern of option uptake reflected these priorities; and c) state what effect ES had on the 'landscape' of this NCA.

Exercise 2: The participants were asked to evaluate habitats and agri-environment options based upon a series of photographs. This exercise was subject to a qualitative analysis and is described fully below.

Exercise 1: Identification of key HLS Priorities

Workshop participants were asked to undertake a simple ranking exercise to explore their perceptions of the key HLS priorities for the NCA. The wording of the criteria varied slightly between NCAs, reflecting differing local priorities and circumstances. The criteria reflected the key objectives for ES and comprised:

- Conservation of Wildlife
- Enhancement of Landscape
- Conservation of the Historic Environment
- Conservation of natural resources

- Provision of Access
- Mitigation of Climate Change

In the Dunsmore and Feldon workshop it was possible to analyse the results by stakeholder cohorts.

Exercise 2: Photographic Assessment Exercise

Introduction

In order to assess the impact of specific ES options on landscape character, provision of habitat for biodiversity and goodness of fit with agricultural management, a simple photographic assessment exercise was devised. Participants were asked to score photographs of typical option management that had been taken in their NCA in relation to these criteria. Although this exercise was a qualitative assessment and based upon perception and the understanding by the participants of the likely impact of the option, the evidence gathered allowed the research team to draw some broad conclusions on the likely impact of these selected options. Two analyses of the data were undertaken. The first looked at the range and balance of scores across the three criteria and the second considered the impact of the option on existing landscape character and quality alone.

Outline of Approach: Research Question

The participants took part in a series of interactive exercises designed to explore their reactions to the interim results for their NCA. Because of time restrictions, photographs were used rather than site visits. Participants were asked to assess the impact of specific options on a range of environmental and agricultural outcomes. The project team were also interested in a number of other questions.

(1) Could the workshop format provide insight into stakeholder group perceptions and values?

(2) Could anything be concluded about the way in which landscape character influences the selection and/or the location of options in HLS agreements?

(3) What did participants think about the relationships between landscape character and HLS before, during and after the introduction of the scheme?

(4) What are the lessons from this initiative that could be applied to future qualitative social science activity in this context?

Description of the Process

The photographic exercise was delivered in 4 of the 5 workshops held (the focus of the High Weald workshop on delivery of AONB priorities meant that workshop did not require a photographic assessment). The management options depicted in the photographs were chosen as having applicability in the National Character Area under review. In total some 40 different images were considered by the participants. The photographs used were taken by the CEH field surveyors in the summer of 2011 and were therefore contemporary with the field data and current influence of ES on the farmed landscape. The exercise asked the participants to consider the impact of the option depicted in terms of: a) Landscape character; b) Biodiversity; and c) Agricultural efficiency.

The participants could rate the impact of the ES in one of four categories:

- Very positive ++
- Positive +
- Neutral 0
- Negative -

The approach taken in the Southern Pennines workshop differed slightly in terms of the questions put to the participants, where they were asked to consider the additionality which the option was making in terms of the conservation of biodiversity and landscape character and quality. The assessment of fit with the agricultural system was omitted, reflecting the more marginal farming which characterises much of this NCA and the wish of the project team to explore how environmental value could be added within different options for grazing management.

Participants were specifically asked to score impact based upon their local knowledge and expertise. They were not asked to provide evidence to support their judgement. They were also encouraged to discuss their ideas and perceptions with other participants as part of the judgement making process. The results therefore are qualitative in nature and should be viewed accordingly and due to the small number of participants taking part, the evidence must be treated as anecdotal.

List of Options assessed

The options assessed encompassed a wide selection of option groups. Appendix 4 contains a list of the options and the results of the assessment for the 3 criteria - biodiversity, landscape, character, and agricultural efficiency.

Analysis of workshop results

Exercise 1: HLS Priorities

This exercise was undertaken in three workshops, with the results shown in Figures 8.1-8.3 below. In all three workshops, across a variety of stakeholders, the highest priority outcome was the conservation of wildlife and the creation of new habitats. In two of the three workshops, conservation of landscape was the second highest priority, whilst in contrast, in the Fens NCA management to protect water bodies and minimise diffuse pollution was second highest priority. The other objectives lagged some way behind these 3 clear preferences.

Figure 8.1: Stakeholder perception of ES priorities in the Upper Thames Clay Vales

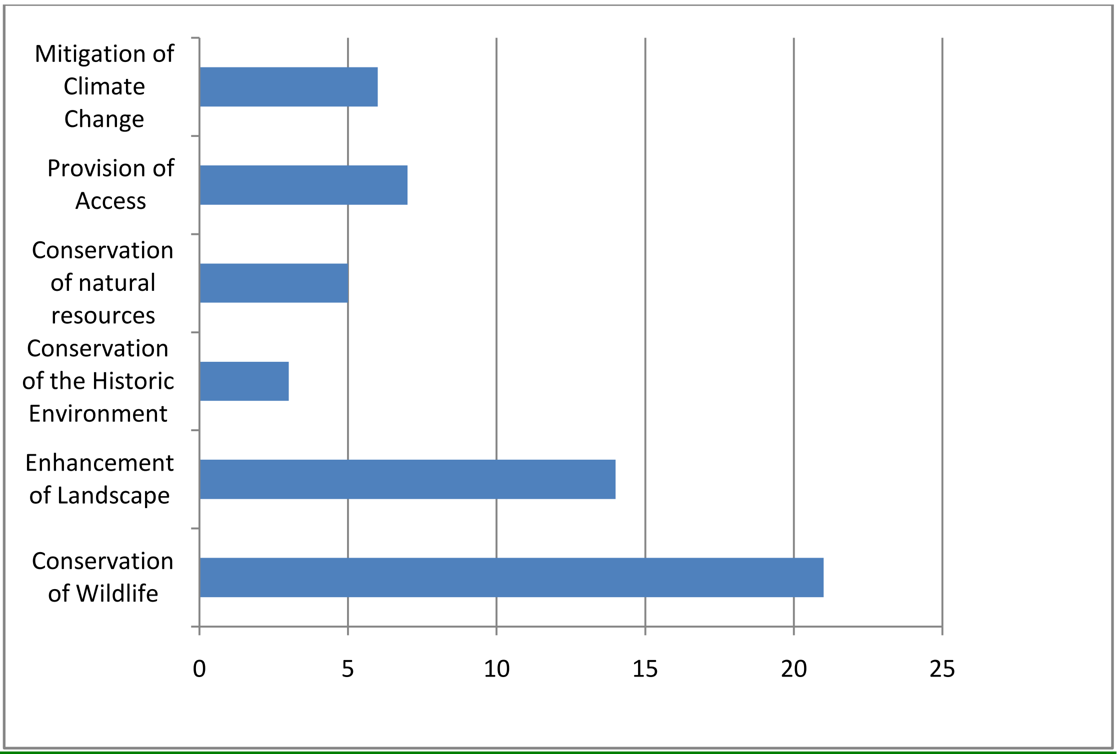


Figure 8.2: Stakeholder perception of ES priorities in The Fens

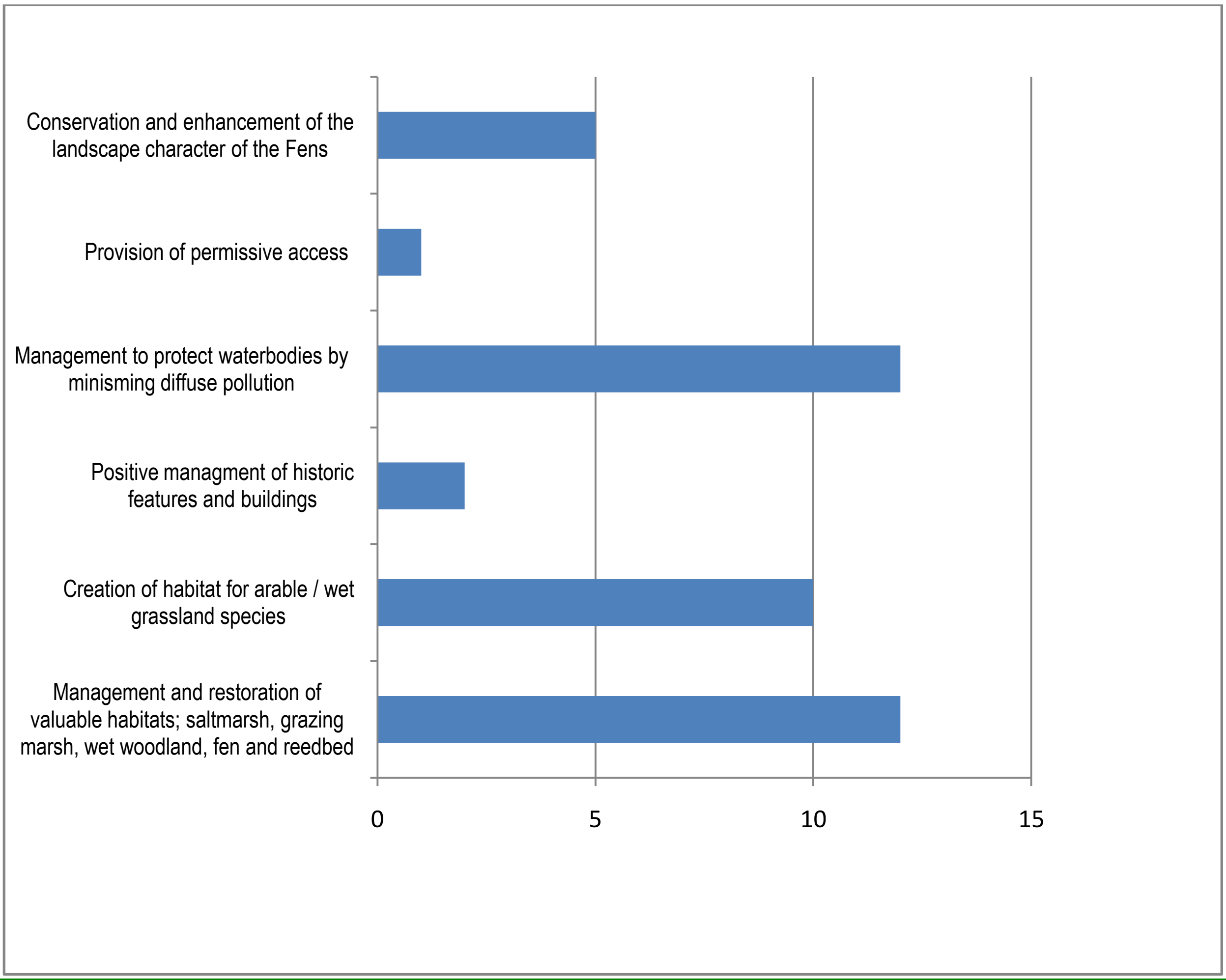
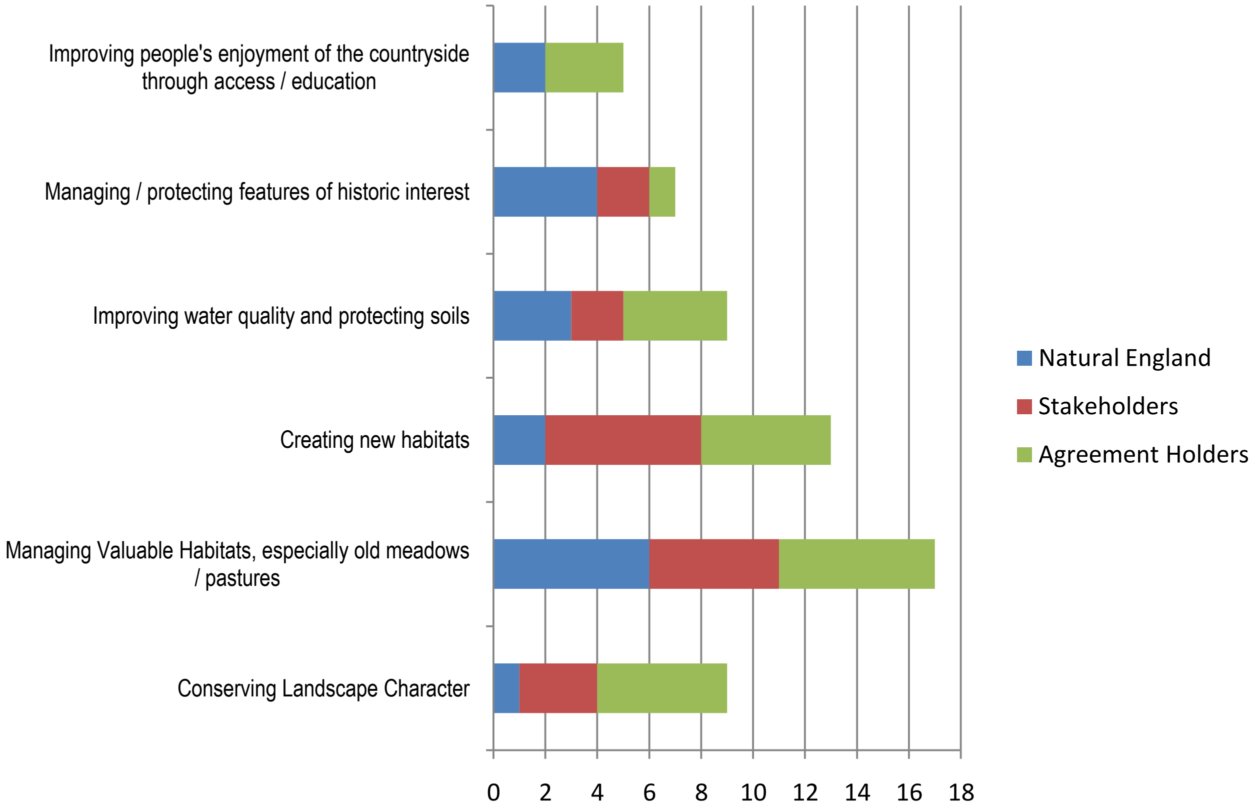


Figure 8.3: Stakeholder perception of ES priorities in Dunsmore and Feldon



Exercise 2: Photographic Assessment Exercise

Following each workshop the score-sheets completed by individual participants were collated and the scores transferred into a spreadsheet. For analytical purposes the scores for each photograph were used to create a set of bar charts, which were reviewed in order to determine the balance of scores between the 3 criteria assessed by the participants. This review of bar charts was undertaken visually for each photograph, which in the majority of cases enabled a rapid evaluation process. It was usually clear that there was divergence between fit with agricultural practice, which tended to be scored as a either a neutral or negative, and the biodiversity and landscape scores which tended to be either positive or very positive, although in general impact on landscape tended towards positive rather than very positive.

For the assessment of the impact of landscape character and quality this balance was loosely classified into 3 groups *i.e.*:

- Contribute to maintaining existing landscape character
- Potentially detrimental to existing landscape character
- Detrimental to existing landscape character

As a reference each option was also coded with the probable landscape impact as defined by the Defra ERDP Research and Development project **BD5303** '*Developing a method for reporting and monitoring the direct and cumulative effects of environmental stewardship on the maintenance and enhancement of landscape character and quality'* (led by Land Use Consultants)[3]. This approach allowed for a degree of comparison between the participants' scores and a more authoritative analysis. In the majority of instances these was a good matching of probable landscape impacts between the 2 sources (see Appendix 5).

[3] Ongoing research which will not finally report until 2013

Compatibility with agricultural practice

About a third of the ES options depicted were considered to be totally compatible with local agricultural practice *i.e.*:

- In the Upper Thames Clay Vales NCA: **HB12** (Management of Hedgerows of very high environmental value), **HK7** (Restoration of species-rich semi-natural grassland: managed as pasture) and **HK11** (Restoration of wet grasslands for breeding waders)

- In the Dunsmore and Feldon NCA: **HF12** (Wild bird cover), **HK3** (Low-input grassland) and **HK6**/**HK7** (Management / Restoration of species rich grassland)

- In the Fens NCA: **EB6** (Ditch management), **HE3** (Buffer strip on cultivated land), **HP5** (Maintenance of coastal salt marsh).

Very few options were considered completely incompatible with agricultural practice - rather the participants normally considered that the impact was neutral or sometimes positive.

Post assessment classification in order to determine impact on landscape character and quality

In this analysis the majority of the options were considered to be contributing to the maintenance of existing landscape character. Only in a few instances was the enactment of an option considered to be detrimental to landscape character, specifically:

- In the Fens NCA: **HC10** (Creation of woodland) and **HK9** (Maintenance of wetland and grassland for breeding waders).

Slightly more options were considered by the participants to have some potential to be detrimental to landscape character, including:

- In the Upper Thames Clay Vales NCA: **HF12:** (Enhanced wild bird seed mix plots) and 'typical' arable management

- In the Dunsmore and Feldon NCA, 'typical' intensive grassland management

- In the Fens NCA**: EE9** (Buffer strip on cultivated by a watercourse) and **HF12/NR** (Enhanced wild bird seed mix plots)

In the Southern Pennines all the options assessed were considered to be contributing to the maintenance of landscape character.

This was an interesting exercise, albeit it threw up some questions around exactly what the participants were judging; were they looking at the management option as a concept, or were they specifically assessing the management being delivered in the photograph chosen. It is possible that the latter may have resulted in some rather counterintuitive results.

Following on from the photographic exercise, participants were invited to provide feedback on their perceptions of what worked well in the local area, and how aspects of the schemes might in their eyes be improved. These discussions were captured by the project team.

Commentary, lessons learnt and conclusions from the operation of the Workshops

Overall the workshops were considered to be a success: the discussions were lively, people participated enthusiastically in the exercises and appreciated the opportunity to comment on the interim survey results. Although the approach taken to the workshops was broadly consistent, there were differences in the way exercises were presented and in the way participants were organised.

For example, as the Dunsmore and Feldon workshop had three fairly evenly balanced groups (local farmers and land managers, representatives of environmental NGOs and Natural England staff) the discussion groups were broadly established by sector. In contrast, the Fens workshop predominantly comprised representatives of NGOs and *Natural England* staff, with a few land managers. In this and the other workshops, participants were randomly allocated to discussion groups.

1. The first aim of the exercise was met: participants appreciated being asked to comment on interim conclusions. Questions and discussion after the presentations were lively: the different groups (land managers, NGO representatives, *Natural England* staff) all contributed. The overall atmosphere was positive, confirming the desirability of this kind of feedback.

2. The second aim of the workshops was also met. Attendees participated enthusiastically and openly in the exercises. The analysis of the photographic exercises adds additional valuable insights and would suggest that there is a relationship between landscape character and selection of HLS options

3. There has been no attempt at detailed textual analysis of the comments made in response to the questions that did not involve photographs. This is because of the range in the make-up of the groups and variations in the presentation of the topics from workshop to workshop. It is clear, however, that groups such as these do respond well to this kind of workshop experience.

4. The detailed notes from these workshops could provide further themes and ideas for future surveys. Should this be done, it is important to remember that qualitative social survey methods provide great insights into the views of specific groups, but are not predictive in the way that large scale quantitative surveys are. The main benefits of such methods are:

    - To provide initial insights into a subject where little is known about the topic and/or the participants: these insights can then inform the design of further studies at a larger scale (which could use either qualitative or quantitative methods or both); and

    - To provide deep insights into perceptions, motivations and meanings from a relatively small cohort of respondents who are selected because they are representative of a larger group. To be of most use as a research tool, there needs to be consistency between the make-up of the groups at different workshops, and great attention to detail in writing and delivering the 'script' followed by workshop organisers. This consistency in approach, delivery and participants increases the validity of the exercises, especially if organisers wish to compare the results between groups and between locations.

Implications for Higher Level Stewardship

The evidence, although anecdotal, supports the contention that HLS options are in general complementing the underlying landscape character in 3 out of the 5 NCAs assessed. In the South Pennines, UTCV and Dunsmore and Feldon NCAs HLS options have been located in areas which are typical of the wider landscape and are of a nature that is helping to strengthen landscape character. However in landscapes which possess more unique characteristics, such The Fens or The High Weald, better and more pro-active targeting of HLS agreements may be needed if they are to enhance the key landscape characteristics of the area. In these instances other targeting priorities have resulted in HLS agreements occurring in places which may be atypical of the wider landscape as it exists at the start of the 21st century. Thus within The Fens the landscape is effectively dominated by cultural; drainage and agricultural features, rather than by any geomorphological features or processes. As a result the few remaining semi-natural features of The Fens are almost exceptional or atypical within the landscape.

If this phenomenon is also occurring in other more unique landscapes, such as The Brecks or the Forest of Dean, there is a risk that the multiple benefits that it is intended HLS will bring are not being realised in these places at landscape scale.

In general HLS options which were either very positive or positive (in terms of their impact on landscape character) were also considered to be compatible with agricultural systems and practices. This is a key finding and demands further research as the implication of this may be important in making future agri-environment schemes more widely acceptable to land managers. Options which fit in with everyday farm management practice will, by their very nature, be more attractive.

Only a few options were considered to be detrimental to underlying landscape character by the consultees. These options were often associated with habitat creation. This corresponds to the conclusion of the consultants undertaking **BD5303**, suggesting that there is a degree of correlation between the two studies. The sighting and location within the landscape of these options should be handled with care if these potentially adverse effects are to be avoided, albeit it is recognised that these options may be important in terms of realising benefits for biodiversity or resource management. Again there is a risk that multiple benefits may not be realised if inappropriate locations are chosen.

9 Higher Level Stewardship: Measuring progress and effectiveness

A representative baseline

The design and scale of investment of resources into Higher Level Stewardship has benefited from more than 2 decades experience with agri-environment schemes in the UK, and the aims of the scheme are consequently more ambitious and require more expert support. From the outset of the scheme in 2005/6, the need for careful monitoring of progress was identified and there have been several reviews of scheme processes and options, as well as enhancements to support targeting. However, given that this scheme targeted some of the most valuable environmental features in England and that agreements last for 10 years, it was realised that a rigorous and defensible monitoring approach needed to be introduced to assess progress and to provide the evidence to justify the investment in the scheme and provide feedback enable further improvements to agreement design and option implementation.

The project described here represents one of several major pieces of work commissioned by *Natural England* and Defra to monitor and evaluate agri-environment schemes, both to fulfil the statutory role of enabling reporting on the EU *Rural Development Programme for England* and to understand whether agri-environment delivery is making the expected contribution to a range of domestic policy priorities. The central objectives of the work were to provide a holistic assessment of HLS delivery as a whole and in particular to create a rigorous and consistent baseline from which progress could be demonstrated. In those respects the project has gained from being conducted by a small team of agri-environment specialists and field ecologists, ensuring a consistency of approach. The project was conducted as a close partnership between *Natural England* and the NERC *Centre for Ecology and Hydrology*, providing scope for new modules to be introduced as desirable and ensuring that the relevance of the research to HLS implementation was kept at the forefront.

The approach primarily focussed on agreements in their first year, allowing for a resurvey within the duration of the agreements. However from the outset wholly random sampling was not adopted, and instead a stratified approach designed to ensure adequate coverage of high value options used *i.e.* those delivering the greatest environmental benefits and requiring the most complex management methods. Consequently, the baseline dataset of 174 agreements includes many examples of options for maintenance and restoration of species-rich, semi-natural grasslands, grasslands with target features and unenclosed moorland. Compared with their overall frequency in the HLS programme, both arable and woodland options are somewhat under-represented, although there are still numerous examples of many options in the baseline.

The present project has delivered immediate outputs through the design of a structured appraisal process to review the building of HLS agreements and the initial implementation of management, whilst through **Module 3** (landscape context) it has contributed to an early evaluation of progress toward the desired outcomes. However, to a large extent, the value of the data gathered for the baseline survey (**Module 1**) will be exploited in the future, as resurveys of these agreements can be compared with a thorough baseline comprising habitat mapping, condition assessment, quantitative vegetation data and expert appraisal of agreement design.

Has HLS been well targeted?

HLS was introduced to address the needs of specific priorities in England, with objectives relating to biodiversity, landscape, historic environment and resource protection, as well as access provision. *Natural England* has put significant effort into identifying Target Areas where these priorities coincide. To that end, holdings should mainly have been accepted into the scheme within these Target Areas and/or where, in a competitive process, there was evidence of high priority features being present on the holding. As a result of this selective approach, the quality of features on HLS agreements should be consistently higher than equivalent land outwith the scheme.

To test this differential in quality, the data gathered from the baseline survey was compared with ecologically equivalent information from the same habitats and landscape types but outwith the scheme. This was achieved by using the vegetation data from the *Countryside Survey* (Carey *et al.* 2009) and a series of analyses were performed taking great care to ensure that like was being compared with like and that the approach was defensible. The results of these analyses are reported in Chapter 5 and Appendix 3. It should also be borne in mind that as the HLS data were from holdings in their first year of agreement, the impact of scheme management would be minimal and that any difference between HLS land and the wider countryside would probably result from the targeted selection of holdings for the agri-environment scheme.

The analyses were conducted by broad habitat and then compared across the scheme afterward, using established parameters representing the ecological attributes of species and overall vegetation composition. For example, the question might be asked: "Did those species with a marked preference for infertile situations occur more frequently (and/or with higher cover) in land under agreement or in the wider countryside?" Similar queries were tested for a range of ecological attributes reflecting habitat quality.

For most habitat types, the overall pattern of the results was consistent indicating that land under HLS was more species-rich, that the habitats had fewer ruderals and indicators of fertile conditions and that species tolerant of stress (such as infertility, drought, salt-exposure, very high or very low pH *etc*) were commoner than in land not in HLS, but otherwise similar in soils, climate and broad habitat. Those habitats that showed this pattern included all woodland types, both improved and neutral grassland, and arable land, as well as bracken-dominated sites. Since these habitats represent some of the main foci of HLS, one might conclude that, in general, land in HLS agreements was indeed of higher environmental quality and that the targeting of the scheme had been effective.

However, there were exceptions to this main conclusion, specifically with acid grassland and wetlands (bog and fen/marsh/swamp). The size of the datasets for these habitats was generally smaller than for arable, woodland and other grasslands, and the conclusions therefore somewhat less robust. Nonetheless, there was a significant indication that these types of habitat on HLS agreements reflected more fertile situations where competitors and ruderals have higher cover. This pattern may partly arise from the fact that on agreement land, areas of fen/marsh/swamp are often small and likely to be influenced by the management practices on the surrounding agricultural land, raising the fertility. Extra nutrient inputs may also contribute to the apparently poorer condition of acid grassland, though the data for such habitats are sparse.

These comparisons can also be examined through the condition assessments of FEP features (also reported in Chapter 5). Here, the condition of 70% of habitat features was shown to be moderate to good. Amongst the 30% of features assessed as in poor condition, BAP grasslands and lowland heath were quite frequently represented. This result might be taken to indicate a problem with the process of selection of grasslands for HLS options and their subsequent management. However, it is probably more likely that the poor condition of BAP grasslands and lowland heath reflects the wider condition of the habitat resource.

Given that resources for agri-environment schemes are limited, it is important that management options be applied to features and in areas where they are most likely to achieve success. The issue of effective targeting was assessed in two ways. Firstly the appraisal panels examined the design of each agreement, asking whether:

- the FEP was accurate and demonstrated the presence of features that merited intervention through HLS;
- the agreement addressed the local priorities for agri-environment action stated within the objectives of the relevant Target Area or regional Theme statements; and

- the HLS options had been well chosen to benefit the target FEP features, with the right allocation of maintenance, restoration and creation options.

The panel appraisals concluded that by and large HLS had been well targeted in England. Most FEP documents were at least adequate and often good, confirming the value of the Farm Environment Plan as a basis for developing agreements, by identifying the features of value on a holding and suggesting how they might be managed. The panels also found that agreements broadly addressed priorities set out in the regional and area targeting statements although they also noted that statements sometimes listed a wide range of priorities with equal emphasis when it was arguable that perhaps some objectives needed to be stressed more than others. There was recognition that in assessing agreement targeting and in particular the effort afforded to specific priorities, there was a need to recognise how agreements complemented each other and indeed other environmental management at relevant scales, and this was not possible in much of this project.

The weakest aspect of HLS targeting lay in matching options to features. 55% of agreements were assessed as having no major discrepancies between features and options or as having all key features under appropriate management options. However, a significant minority (42.5%) showed at least one mismatch between feature and option that could adversely affect the desired environmental outcomes, and a few (2%) had serious mismatches that were likely to result in some adverse outcomes. Grasslands were the feature group where option use was most often criticised, reflecting partly the frequency and importance of **HK** options in the HLS scheme as a whole, but also the need to tailor grassland management to the particular type and condition present. Mismatches between feature and option most often arose from overestimation of the quality or condition of a feature, such that maintenance options were applied where restoration management would have been required.

The second main way of assessing the effectiveness of targeting lay with comparing the habitat maps and FEP codes recorded by the surveyors during the field survey against the options used and the habitats recorded on the original FEP map. This approach is described and discussed in Chapter 4 of this report. Within grasslands, the match between option and feature was appropriate in most cases, with options for species-rich semi-natural grasslands targeted on BAP grasslands, whilst those for birds and for other target features were mainly matched to semi-improved and improved swards. There was confirmation, however, of the practice of “grassland inflation” in some cases, with grasslands under the **HK6** maintenance of species-rich grassland option that were not of the expected quality, whilst **HK15** (maintenance of grassland for target features) was often applied on grass moorland and even upland heath where **HL** options may have been more appropriate. Within the uplands themselves, matching of maintenance and restoration options was generally good, although the preponderance of the blanket bog resource under **HL10** restoration suggested examples of that habitat in existing good condition and meriting **HL9** maintenance were rare.

For some examples of application of grassland and heathland creation and restoration options, the assessment of field survey data during the appraisal process suggested that the starting condition was very different to the desired outcome and that, although the creation techniques and/or restoration management might in time achieve success, it was highly unlikely that this would happen within the duration of the current agreement. This observation brought into question whether certain agreements and particular management approaches required a longer-term commitment both from *Natural England* and the agreement holder.

Is HLS meeting its objectives?

Most of the effort within this project was devoted to creating a comprehensive baseline sample of HLS agreements from which, through future resurvey, it will be possible to judge objectively whether the scheme is meeting its objectives. It is through that resurvey that the full value of the data will be realised. The baseline survey and information on overall option uptake (Tables 2.1, 2.2 and 5.1) describe the balance of effort devoted to particular types of HLS option and hence the priorities for management as actually implemented. On this basis, the apparent priorities of HLS are the maintenance and restoration of species-rich semi-natural grassland and moorland (at least as reflected in the frequency of options encountered by the survey), as well as grassland for target features, farm woodlands, arable margins and farmland birds. Objectives for archaeological features and access are also well covered by existing HLS activity.

However, in the short term the data gathered during **Module 3**, looking at the 62 agreements that had been in place for at least two years, allows some preliminary judgements to be made about progress toward meeting the scheme objectives. **Module 3** also contributes to an assessment of how agreements work together complementarily in an area to achieve HLS aims. The justification for agri-environment management is increasingly seen in terms of the provision of environmental goods and services. The results of **Module 2** therefore provide some evidence to help understand the relationship between HLS and delivery of certain ecosystem services.

Evidence for progress: comparing results from agreements in their first and third years

The survey of National Character Areas (NCAs) in **Module 3** covered most of the same habitats and options that were represented in the baseline survey. However the dataset was smaller (62 agreements compared to 174) and, most importantly, there was an inherent bias in the data being derived from just six NCAs: Dorset Downs & Cranborne Chase, Dunsmore & Feldon, the Fens, High Weald, South Pennines and Upper Thames Clay Vales. However, some cautious direct comparison is possible as an indication of scheme progress.

There was evidence from the RAG assessments that the design of agreements included in **Module 3** was slightly poorer than in the baseline survey (**Module 1**), largely because the 62 agreements were older and the building of the later agreements included in the baseline survey had to some extent benefited from lessons learned after 2-3 years of implementing HLS agreements.

For all those options that were well-represented in both the baseline survey and the agreements that had been under way for at least 2 years, the vegetation samples for the older agreements were more species-rich. This improvement in species-richness was observed whether the option was restorative (**HK7** and **HK16**) where some increase would be expected or for maintenance (**HC7**, **HK6** and **HK15**), suggesting that bringing a habitat under appropriate HLS management was often sufficient to enhance the diversity of the site flora regardless of the initial status. Indeed even where the change in management was relatively modest in scale (*e.g.* **HE3** 6m buffer strips and **HK3** very low inputs to grassland) sites that had been agreement for at least two years were clearly more species-rich than those only recently included within the scheme.

Similarly, comparison of feature condition in the baseline survey and in samples from **Module 3** indicates improvement related to duration under HLS management. When compared with the newly launched agreements assessed in **Module 1**, certain habitat features were generally assessed as higher quality: semi-improved grassland, lowland calcareous grassland, breeding wader habitat, ponds and semi-natural woodland. Although trends in most other habitat features were less clear, there was some evidence that certain BAP grassland types, and especially lowland dry acid grassland, were in poorer condition. This habitat had also emerged from the analysis of HLS feature condition against the wider countryside as in less good condition. There was some regional variation in progress also, with feature condition generally good in the Dorset Down, Fens and High Weald, moderate in the Upper Thames and Dunsmore & Feldon, but often poor in the uplands of the South Pennines.

Although feature condition had generally improved, some doubt remained as to whether options would achieve all their Indicators of Success (IoS). The IoS assessments in **Module 3** were based on actual progress and if reported to the scheme adviser should serve to influence the management of these sites in the latter years of the agreement. Further analyses are required to test the differences between baseline agreements and those that had been under way for two years or more, but the early indication is of some moderate progress in any aspects of the agreements.

Ecosystem services

The assessment of ecosystem services within this project (**Module 2**) comprised an attempt to quantify the effectiveness and appropriateness of a range of agri-environment management prescriptions for both restoring biodiversity and enhancing ecosystem function and associated ecosystem services in grassland. The approach compared measures of ecosystem service delivery from grasslands under maintenance (**HK6**), restoration (**HK7**) and creation (**HK8**) options in HLS with both low intervention restoration of grassland biodiversity (ELS option **EK2**) and with intensively managed, non-AES grassland.

Biodiversity and intermediate ecosystem functions which are either directly or indirectly related to ecosystem services were successfully measured using simple and repeatable techniques in sixty grasslands along a gradient of management intervention under the agri-environment schemes. The grasslands selected for the more demanding and better rewarded Higher Level scheme were indeed of higher quality and contained significantly more native species than those both in the Entry Level Scheme (ELS), and grasslands outside the AES. This confirmed the effectiveness of the AES targeting policy in selecting suitable sites for intervention management. Grasslands outside the AES and in the basic ELS were considerably more fertile and were dominated by plant species associated with more highly productive environments than those in the HLS. Grasslands are an important sink of for atmospheric carbon, and species-rich grasslands contained the largest stores of organic matter and carbon. It remains to be seen if similar stocks of soil carbon can be accumulated in the ex-arable grasslands undergoing restoration and over what time scale. Replacing intensively managed grassland with extensive areas of species-rich grassland in river flood plains is also likely to effective for flood prevention and water storage.

The diversity of functionally important legumes was significantly higher in the HLS grasslands suggesting a greater ability to support production in the absence of fertiliser addition. Similarly, the greater diversity of pollinator food plants supported by species-rich grasslands suggests they may play an important role in sustaining the pollination service within intensively managed landscapes. Consistent measurements of invertebrate taxa important in the delivery of ecosystem services were more difficult to achieve due to local variation in weather conditions and management factors, in particular summer grazing of the grasslands. Nevertheless, the diversity and abundance of potentially beneficial predators, herbivores and detritivores were significantly higher in the species-rich HLS grasslands.

In conclusion, species-rich grasslands maintained and restored under the agri-environment schemes may play an important role in the delivery of a number of key ecosystem functions and services. Further research is required to quantify the scale at which these beneficial functions operate. This will be critically important in future policy decisions regarding the location, size and connectedness of the species-rich grassland resource.

Evidence from particular options

The relative success of maintenance and restoration options may be compared by pooling results from the RAG assessments for all options in each category. The results from the baseline survey (assessments made before the indicators of success (IoS) could be objectively measured) predicted that restoration options would be more successful than those intended to maintain existing high quality habitat features. However, within agreements that had been in place for at least two years (and hence when some IoS were fully measurable), maintenance options had a consistently higher rate of success than those aimed at habitat restoration *i.e* 40% passing all IoS in maintenance in contrast to only 29% for restoration options. These assessments support the contention that restoration options are both more ambitious and harder to achieve than those designed to maintain existing habitat value.

Habitat creation is intended to be an important facet of HLS helping England (and the UK) to meet its goals in Biodiversity Action Plans. Altogether over 26,000 ha of land has been devoted to habitat creation options in England, although only one option (**HK17** grassland for target features) has seen large areas adopted under HLS – in this case 9,648 ha on some 904 agreements. Other more widely practised creation options (≥ 1500 ha extent in each case) are those for successional scrub (**HC17**), species-rich semi-natural grassland (**HK8**), wet grassland for breeding waders or wintering waterfowl (**HK13** and **HK14**) and upland heathland (**HL11**). Not surprisingly, therefore, data for creation options were sparse in both **Module 1** and **Module 3** of the current study, although those few results that are available suggested an even lower rate of success as measured by the IoS than for restoration options.

Amongst historical options only **HD5** management of archaeological features on grassland was assessed at all frequently. Within the baseline survey, the predicted success for **HD** options (and **HD5** itself) was *ca* 70%, but in those few samples assessed at least two years after implementation, the objectively measured rate of success was only 50%. The main reasons for failing IoS were excess scrub cover on archaeological features and erosion due to over-grazing of the grassland overlying the feature.

Evidence for complementarity between agreements

The use of HLS options was compared within the six different NCAs examined in **Module 3**. Although some options, notably those for species-rich semi-natural grassland (**HK6** and **HK7**) and **HE3** 6m buffer strips, were frequent in several NCAs, all NCAs had a distinctive spectrum of major HLS options that addressed the scheme objectives for that area.

The focus in the Dorset Downs and Cranborne Chase was on the maintenance and restoration of species-rich semi-natural calcareous grassland on the downland scarps, with **HC7** woodland maintenance in the valleys and **HE3** strips applied to the arable land on the plateaux above the downs.

The clear focus in the Dunsmore & Feldon areas was on arable options, including those for nectar and floristically enhanced margins (**HE3, HE10, HF1** and **HF4**) that favoured farmland birds and insects. However the archaeological importance of this area is reflected in the frequent use of **HD5**.

Arable options were also important in the largely cultivated Fenland landscape, especially **HE3** and **HE10**. The characteristic focus of this region, however, was lowland wet grassland for both breeding and wintering waders and wildfowl, including maintenance (**HK9**) and creation options (**HK13**). Where grassland was unsuitable for wetland birds or insufficiently species-rich for **HK6/HK7**, maintenance for other target features (**HK15**) was frequent.

HLS in the High Weald also addressed species-rich semi-natural grassland, although the focus was on lowland meadows and acid grassland. These grassland options were complemented by **HK15** for other target features. The Weald has significant areas of old woodland, with the **HC7** maintenance option important in HLS agreements, and of wood pasture and parkland, maintained under **HC12**.

The upland character of the Southern Pennines results in moorland restoration (**HL10**) being especially important, with maintenance and restoration of rough grazing for birds (**HL7**/**HL8**) prevalent on the in-bye land surrounding the moorland plateaux. Other grassland types occupy the valley slopes and are frequently managed by hay-making (**HK18**) and restoration of either species-rich semi-natural swards or for other target features (**HK16**).

The Upper Thames Clay Vales are renowned for their wet hay meadows and management under HLS especially employs **HK6** and **HK7**, although the prevalence of ridge and furrow in these grasslands is linked to the use of **HD5**. Arable land covers 45% of the area in this NCA and **HE3** buffer strips are frequent where HLS agreements include tilled fields.

In all six NCAs, there was confirmation that the choice and frequency of HLS options used has been determined by the typical semi-natural habitats of that area (including BAP Priority Habitats) and by the priorities set out within the relevant Target Area statements. There is therefore evidence that meeting the objectives of HLS both nationally and regionally has influenced the scale and disposition of HLS management effort. To that extent the agreements should complement one another in addressing overall HLS goals. Appraisals by expert panels showed that 75% of agreements were adequate in delivering their objectives and providing significant environmental benefits, but the evidence for the complementarity of agreements and the degree of both synergy and additionality was more difficult to demonstrate.

Suggested improvements to the building of HLS agreements

The expert panels suggested some improvements to the way that HLS agreements are built, focussing on the use and content of the Farm Environment Plan (FEP), the choice of options, the design of prescriptions and indicators of success (IoS) and the role of the capital works programme. The panels also made proposals for the storage and processing of the agreement documentation.

The FEP was acknowledged as a vital basis upon which to build an agreement. Although a complex and time-consuming document to produce, a well-drafted FEP should ensure that the agreement misses no important opportunities and adopts options that are appropriate to deliver the desired outcomes. However, to achieve such utility, it is important that the FEP is complete, including a comprehensive audit of environmental features and their condition. The accurate recording of feature condition is especially important to ensure that the correct level of HLS management is adopted. Exaggeration of feature quality might smooth the progress of agreement building but can also mean that the HLS goals are less likely to be met within the ten-year duration.

The main elements of an HLS agreement are the annual management options, and their selection should entail a rigorous process that avoids “aspirational” choices and/or packing the agreement with diverse options and supplements as makeweights, but rather focuses on those options that address the key environmental features and are tailored to the situation on the particular holding. Although there may be occasions when generic sets of prescriptions and IoS are adequate, in many cases agreement quality is greatly improved by adapting the options and their prescriptions to address specific the local situation. Such tailoring of option prescriptions is especially important on large or complex agreements, where the prescriptions should ideally be augmented with management and implementation plans. The process of adapting options and their prescriptions should be undertaken with care to ensure that critical components (*e.g.* guidance on fertiliser application) are not omitted or compromised. Further training should be given to *Natural England* advisers in ways of adapting HLS options and prescriptions as a way of assuring agreement quality.

The choice of options and drawing up of both prescriptions and IoS can be regulated by drafting preambles to the overall agreement and to its components. These preambles should set out clearly the justification for the selection of options and why the approach to management is apt. The justification should always indicate the target features set to benefit and how their condition should be maintained or enhanced.

The panels found that the elements of the HLS agreement documentation that were most prone to error and poor quality were the IoS. The indicators should be meticulously drafted and reviewed to ensure that they are measurable by the agreement holder and by the *Natural England* advisers. The IoS should be closely referenced to the target features and staged over the duration of the agreement in order to allow progress to be quantified objectively and to allow timely and adaptive remedial management if required. IoS should be numerous enough to test progress with all aspects of the HLS option. Where Entry Level options have been adapted to Higher Level Stewardship and included as “more of the same” options, the use of IoS should be made mandatory, rather than discretionary as at present. Where relevant the IoS should be explicitly linked to the capital works programme, so that the integration of the works and their success in underpinning annual management options can be measured. Finally, tailoring of the IoS is generally desirable and should also be considered where an option is being applied to parcels whose condition and character is different. In such situations, IoS that are specific to each parcel should be considered.

The panels generally found few problems with the manner in which capital works were employed in HLS agreements, but proposed a few ways to improve the quality of the works. The capital works specification given in Part 5 of the agreements needs to be tailored to the particular site where appropriate rather than reproducing the generic specifications. There ought also to be more safeguards to ensure prompt implementation of the works, as delays in installing works could potentially limit the benefit provided by annual management options.

Once an agreement has been made, its efficient implementation may depend on the quality of the documentation to which both agreement holder and *Natural England* adviser will refer. The panel therefore recommended that there be thorough version control on both the *Genesis* database and in the hard copies used by the stakeholders. Numerous examples were encountered on the database where several editions of agreement documents were present without a clear indication as to which was operative. Sometimes the most recent version of the agreement held on *Genesis* had key elements missing and an audit of each agreement should be undertaken to ensure all parts were present.

The *Genesis* database stores maps, both from the FEP and showing the agreement options, as PDFs rather than in a form amenable to manipulation using a Geographical Information System. Compiling the spatial information in a geo-referenced database would require significant effort, especially for established agreements where the existing maps would require digitisation. However, there would be considerable advantages in managing the agreements, estimating option effort and assessing how well HLS agreements were contributing to overall agri-environment objectives both regionally and nationally.

Agreement management through the *Genesis* database would also benefit from greater clarity around the agri-environment history of each holding under HLS. This was found to be an issue in relation to tracing management history under previous schemes, but also with HLS agreements that had been subject to major revision, where it was often difficult to trace the original agreement, and its associated documentation. Where a holding had previously been managed under the "classic" schemes such as Countryside Stewardship (CSS) and Environmentally Sensitive Areas (ESAs) this management history will be very relevant to building the agreement and judging the success of HLS. The management history of a holding is often outlined in the Farm Environment Plan, but this can only be accessed through reading the relevant PDF of the FEP. It is desirable that the documentation (or at least pointers to it) of previous schemes be included as supplementary information on the *Genesis* database. This would enable *Natural England* to audit HLS more efficiently, prioritising and targeting future agri-environment effort in a rigorous and objective manner.

The future of HLS monitoring

The core of this project has been to create a rigorous baseline from which to judge future progress with HLS in meeting its desired outcomes (**Module 1**). The other modules make some contribution to monitoring the success of the scheme through assessing its contribution to ecosystem goods and services (**Module 2**) and examining early evidence that HLS is delivering (**Module 3**). However it is the baseline module that was created to initiate a programme of monitoring. **Module 1** adopted a consistent survey approach to a representative sample of agreements in their first year, and thus should be the basis for an assessment of the scheme in the future.

Timing a resurvey

The timing of any future monitoring should be determined by the measurability of the desired outcomes. Where a comprehensive set of IoS have been drafted, these are normally measurable after 2 years, 5 years, 7 years and/or at the end of the agreement (10 years). Assuming that a programme of HLS monitoring would be used not only to judge the success of the scheme but also to influence its further development, then timing a resurvey at the end of the agreements would be less useful than scheduling the assessment for a date in the second half of the agreement *e.g*. between Years 5 and 9.

The agreements that comprise the baseline were largely established in 2008 (100 lowland agreements with grassland and/or arable options) or in 2009 (50 upland agreements), although a few (24) with wetland, heathland or chalk grassland options were set up in 2010. Timing a resurvey for

2015/16 or preferably 2016/17 would mean that for most options, the IoS were either fully measurable or sufficiently close to delivery for a reasonable assessment to be made.

Although a complete resurvey is clearly desirable with results that would be more robust, the resources required would be significant and consideration could be given to a partial resurvey. The methods used for the original sample selection are amenable to a stratified subsample being adopted that should be reasonably representative of the whole in terms of options assessed and geographical spread. Such an approach might allow for a resurvey to be conducted over a single field season.

Alternatively a rolling programme of monitoring might be considered, conducting a resurvey where the 174 baseline holdings (or a representative stratified sub-sample) were resurveyed over several years. The advantages of this approach would be in terms of spreading the annual cost, but the resurvey would pose some difficulties in data analysis and comparison with the baseline assessment of **Module 1**.

Critique of methods

It would be assumed that any resurvey would follow the methodology adopted for **Module 1**, at least as far as possible. Consistency of methodology between the baseline and any resurvey is clearly desirable in order to make analysis of change as powerful as possible. However, the original baseline methods should not be applied uncritically as experience gathered during this project would suggest some slight improvements.

The preparation phase for the monitoring resurvey should begin a year in advance. This would enable not only revision of the survey manuals and training but also more importantly the compilation of all relevant data onto a database that could be loaded onto a tablet computer for use in the field. This database should not only contain the original agreement documentation but also, from the baseline survey, the digital maps, locations of photographs and quadrats, quadrat data and condition assessments both from the FEP and the baseline survey. Ideally more quadrats than the minimum recorded in the baseline survey should be included in the resurvey to provide a more precise assessment of vegetation composition.

In **Module 1**, the field surveys and assessments focussed on vegetation composition, but it would be desirable to support these with a focus on individual species – an aspect of HLS agreements that was left largely unassessed in the baseline survey. Methods particular to the main target species would need to be developed during the preparatory phase for any monitoring campaign.

Data capture using PDAs or tablet computers, supported by specially developed recording forms and databases, improved greatly during the three field seasons of the current project. Given the rate that developments in Information Technology are progressing, it is highly likely that a resurvey in *ca* 2016 could make use of new hardware and software. Prior to the preparatory phase for the monitoring, a review of available machines and software should be conducted to ensure high speed and capacity in recording as well as consistency with the baseline information.

Finally the HLS monitoring developed within this project is one key element of an overall programme that explores the evidence for the effectiveness of agri-environment schemes at landscape, agreement and feature/option scale. Methods applied in any resurvey would need to be reviewed in the context of their relevance and application to other components of this programme.

Building on the results of the project

The design of the project was intended to inform any necessary amendments to English agri-environment schemes and the timing of the work (reporting finally in 2012) was planned so that schemes could be developed for the next EU Common Agricultural Policy (CAP) programme due to take place from 2013 onward. The project provided a painstaking review of the delivery from Higher Level Stewardship and an expert critique of the way that agreements have been built and the scheme as a whole implemented.

The second major role was in the evaluation of the *Rural Development Programme for England (RDPE), 2007-13*. This evaluation was required by the European Commission (EC) and mandated *Defra* to report on the impact of HLS in relation to particular indicators set out under the Common Monitoring and Evaluation Framework (CMEF). The evaluation should also be extended to meet English policy demands. Hence the outputs from this project will provide objective evidence that allows *Natural England* to report on**:**

- **CMEF "result" indicators *i.e.* evidence for the success of management designed to provide benefits relevant to each of the primary scheme objectives;**
- The contribution that Environmental Stewardship is making towards domestic policy priorities and delivery initiatives;
- The quality of agri-environment scheme delivery at an agreement scale; and
- An overall evidence programme for Environmental Stewardship.

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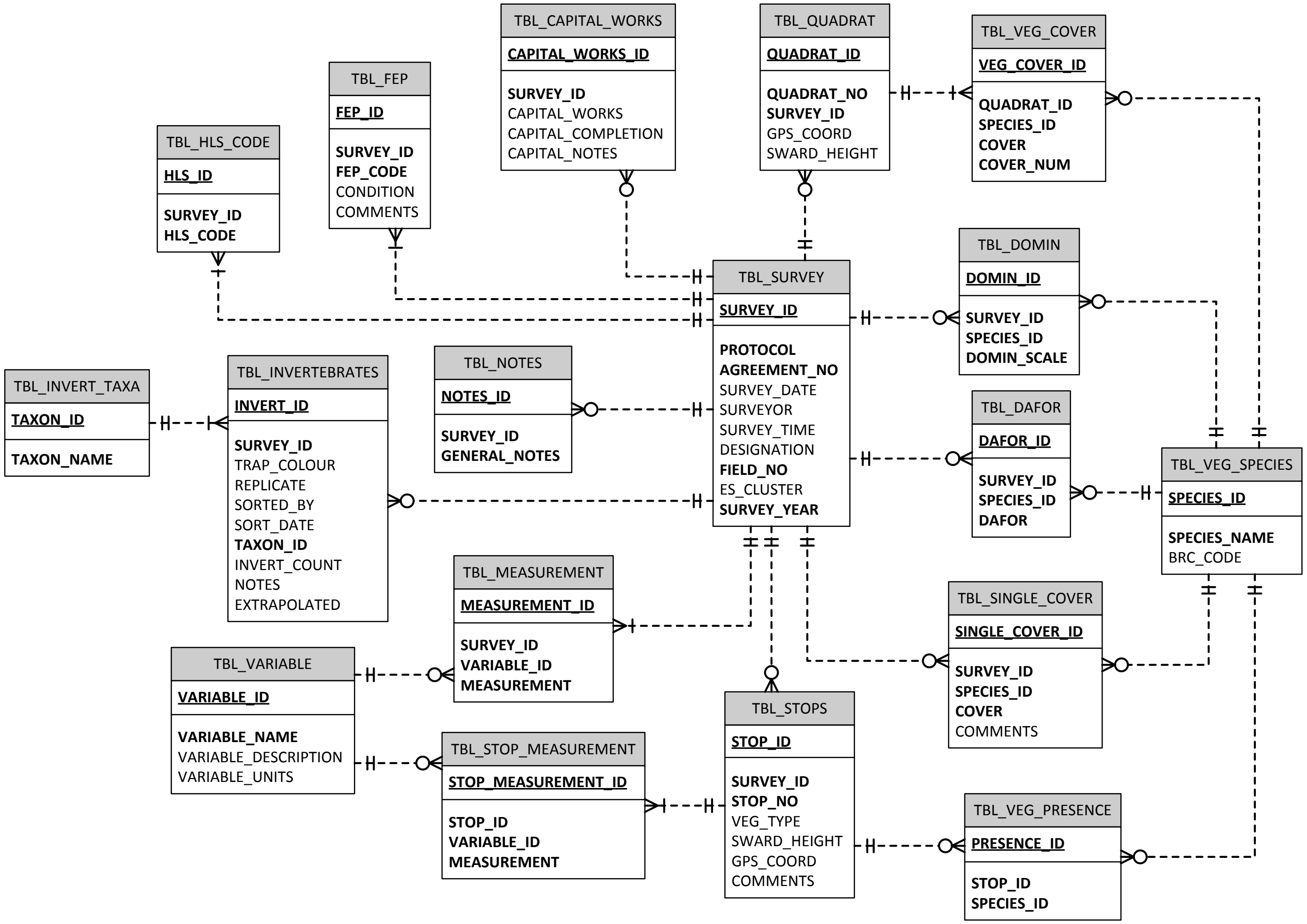
Appendix 1 Structure of the project databases

Survey data from all three years are stored in an Oracle 10g relational database (Figure A1).

Figure A1: Relationship diagram for the HLS survey database



For the database design, all data collected were considered as coming from the same unit of survey, regardless of the type of survey being conducted (*e.g.* upland, NCA) or the method of data capture (*e.g.* MS Access forms, paper forms). As a result the central table in the database is TBL_SURVEY, which contains a unique combination of protocol/habitat type, agreement number, parcel number, date and surveyor and from which all the data tables radiate. All other tables, whether directly or indirectly, link to this table with SURVEY_ID.

The largest quantity of data came from the assessments (of quadrats and feature condition) conducted for each unit of survey which for the purposes of the database were considered as a series of questions (referred to in the database as 'variables') and answers (referred to in the database as 'measurements'). These data are stored in TBL_VARIABLE and TBL_MEASUREMENT respectively. Other data, such as HLS option code, FEP codes and capital works are stored in separate tables. Most vegetation survey data were collected as percentage cover of species within a quadrat and stored in TBL_QUADRAT for basic quadrat information and TBL_VEG_COVER for the percentage cover data. Other vegetation survey data (*e.g.* DAFOR and DOMIN scores) are stored in separate tables. Where the vegetation percentage cover survey was conducted not within quadrats but either over the whole feature area (*e.g*. ponds) or a large subset of the feature area (*e.g.* hedgerows), the data were stored in table TBL_SINGLE_COVER. A brief description of the contents of each table is given in Table A1.

Table A1: Description of the data contents of each table in the HLS survey database, excluding SSSI, upland and indicators of success data

Table Name	Table Contents
TBL_HLS_CODE	HLS option code as identified by the surveyor during the survey
TBL_FEP	FEP feature code as identified by the surveyor during the survey, the condition assessment for each feature and any notes on the assessment given
TBL_CAPITAL_WORKS	Capital works as identified by the surveyor during the survey, a statement about completion and if the works have been completed as prescribed
TBL_NOTES	Any general notes/observations from the surveyors
TBL_INVERTEBRATES	Species counts of invertebrates from Vortis and pan trapping samples
TBL_INVERT_TAXA	Look-up table for invertebrate species (for TBL_INVERTEBRATES)
TBL_MEASUREMENT	One of the main data tables, this contains the main body of information from each assessment (*i.e.* the answers to or measurements from the questions asked during each assessment)
TBL_VARIABLE	Look-up table for providing a description of the variable (*i.e*. the question asked)
TBL_QUADRAT	Location and basic (non-vegetation) information about the quadrat
TBL_VEG_COVER	Vegetation survey data for each quadrat
TBL_DOMIN	DOMIN score given to vegetation cover (2010 ecosystem services data only)
TBL_DAFOR	DAFOR score given to vegetation cover (2010 and 2011 only)
TBL_SINGLE_COVER	Vegetation survey data where the entire area or only one large area was surveyed (*e.g.* ponds, hedgerows)
TBL_VEG_SPECIES	Look-up table for plant species

Due to the different method of data collection, data from SSSI or upland surveys have an intermediate table between TBL_SURVEY and the data (measurement and vegetation survey) tables. Site assessments and species presence were recorded at up to 20 'stops' for each survey, rather than one assessment, and percentage cover of species for multiple quadrats for each survey and details of each of these stops are stored in TBL_STOPS. The contents of tables relevant to SSSI and upland surveys are described in Table A2.

Table A2: Description of the data contents of each table in the HLS survey database relevant to SSSI and upland data

Table Name	**Table Contents**
TBL_STOPS	Location and basic information about the stop
TBL_STOP_MEASUREMENT	Contains the main body of information about the stops (*i.e*. the 'answers' to the 'questions' asked during each stop), linked to look-up table TBL_VARIABLE
TBL_VEG_PRESENCE	Presence of species at each stop, linked to look-up table TBL_VEG_SPECIES

The Indicators of Success (IoS) data can have a slightly different structure to the main database as each indicator is often scored for the whole agreement and only by field/unit of survey where more than one parcel was assessed under a particular option. However, the data do link back to TBL_SURVEY via an intermediate table TBL_AGREEMENT which holds some basic information on each agreement (Figure A2). Table A3 provides a description of each table relevant to the IoS.

Figure A2: Relationship diagram relevant to the Indicators of Success data

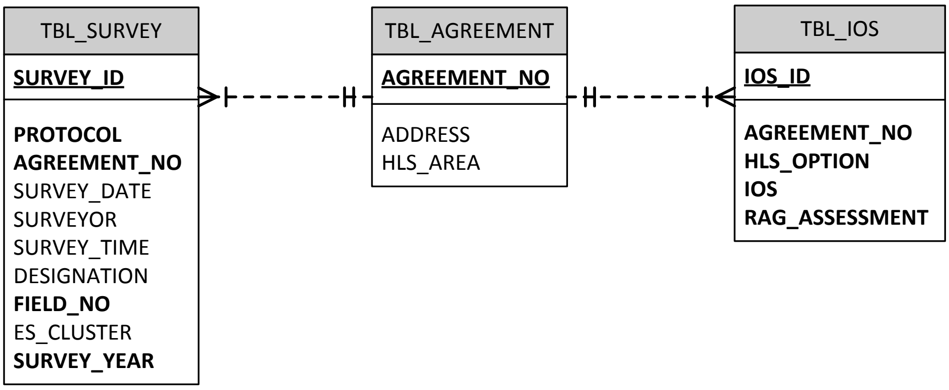


Table A3: Description of the data contents of each table in the HLS survey database relevant to Indicators of Success data

Table Name	**Table Contents**
TBL_AGREEMENT	Basic information about the HLS agreement, currently the address and area covered by the HLS agreement.
TBL_IOS	Contains the Red/Amber/Green assessment of each indicator of success for each HLS option within the agreement.

A number of controls have been added to the tables to prevent errors, such as unique constraints on identifying data to prevent duplicates and prevention of deletion of identifying data to decrease the risk of orphaned data.

Appendix 2 Capital works

Table A4: Total extent of works within the baseline survey 2009-2011

Capital Works (arranged alphabetically by code)	Number of Agreements	Total Extent	Mean (per agreement)	Unit
Hard standing: disabled path (ADC)	2	896	448	m^2
Bench (B)	5	18	3.6	each
Chemical bracken control: area (BCA)	26	729.51	28.06	hectare
Chemical bracken control: base payment (BCB)	25	33	1.32	Base payments
Difficult site supp. (BDS)	13	444.07	34.16	hectare
Mech. bracken control: area (BMA)	7	177.95	25.42	hectare
Mechanical bracken control: base payment (BMB	5	5	1	Base payments
Stone-faced hedge bank repair (BR)	3	90	45	metres
Stone-faced hedge bank restore (BS)	2	40	71.5	metres
Culvert (C)	6	9	2.67	each
Coppicing bank-side trees (CBT)	12	377	31.42	each
Cattle grid (CCG)	3	5	1.67	each
Cattle drinking bay (CDB)	3	6	2	each
Hard standing for car park (CP)	2	130	65	m^2
Ditch/dyke/rhine restoration (DR)	8	14436.5	1804.56	metres
Removal of eyesore (E)	10	25	2.5	each
Earth-bank restoration (ER)	11	4209	382.64	metres
Casting-up Supp. ERC	11	15401.5	1400.14	metres
Wooden foot-bridge (FB)	4	4	1	each
Deer fencing (FD)	3	5025	1675	metres
Fencing Supp: difficult sites (FDS)	40	63094.8	1577.37	metres
FEP payment (FEP)	1	1	1	agreement
High-tensile fencing (FHT)	2	8080	4040	metres
Orchard tree pruning (FP)	5	378	75.6	each
Permanent electric fencing (FPE)	1	600	600	metres
Rabbit fencing supplement (FR)	1	1109	1109	metres
Sheep fencing (FSB/FSH)	102	281488	2759.69	metres
Post & wire (FW/B)	17	24752	1456	metres
Bridle gate (GB)	5	19	3.8	each
Grip blocking drain/channels (GBC)	3	6428	2142.67	block
Kissing gate: disabled access (GD)	2	6	3	each
Wooden field/river gate (GF)	95	541	5.69	each
Kissing gate (GK)	12	33	2.75	each
Hedge Supp. – remove fence (HF)	20	27576	1378.8	metres
Hedgerow restoration (HR)	65	63180.4	972	metres
Hedge Supp. – pre-work (HSC)	13	9211	708.54	metres
Hedge Supp. – top binding (HSL)	5	3245	649	metres

Table A4: continued

Capital Works (arranged alphabetically by code)	Number of Agreements	Total Extent	Mean (per agreement)	Unit
Wooden wings for gate (LWW)	4	11	2.75	each
Planting fruit trees (MT/SF)	18	551	30.61	each
Otter holt: log construction (OH1)	9	10	1.1	each
Otter holt: concrete pipe *etc* (OH2)	1	1	1	each
Professional help with plan (PAH)	33	71	2.15	each
Pond creation: first 100m^2 (PC)	15	4697.5	313.17	m^2
Pond creation: over 100m^2 (PCP)	8	8853	1106.625	m^2
Hedgerow planting (PH)	36	22140	615	metres
Pond restoration: first 100m^2 (PR)	12	2592	216	m^2
Pond restoration: over 100m^2 (PRP)	9	9882	1098	m^2
Cross drains under farm tracks (RPD)	1	3	3	each
Soil bund (S1)	4	270	67.5	each
Timber sluice (S2)	5	19	3.8	each
Scrub management: base (SS)	54	67	1.24	Base payments
Scrub management: <25% cover (SA)	23	129.29	5.62	hectare
Scrub management: <25-75% (SB)	24	67.98	2.8325	hectare
Scrub management: >75% cover (SC)	28	76.16	2.72	hectare
Bird/bat box (SBB)	23	356	15.48	each
Bird strike markers (SBS)	2	2655	1327.5	each
Scrape creation: over 100m^2 (SCP)	10	8950	895	m^2
Scrape creation: first 100m^2 (SCR)	15	4295.33	286.36	m^2
Small mammal boxes (SSM)	3	32	10.67	each
Timber stile (ST)	4	5	1.25	each
Standard parkland/hedge tree (STT)	10	916	91.6	each
Welded steel tree-guard (TGS)	1	164	164	each
Help with teachers' info. pack (TN)	8	8	1	each
Orchard tree guard: tube/mesh (TO)	9	486	54	each
Orchard tree guard: post/rail (TOF)	9	576	64	each
Parkland tree guard (TP)	10	230	23	each
Spiral rabbit guards (TR)	6	17841	2973.5	each
Tree removal (TRE)	7	839	124.14	m^3
Tree surgery – minor (TS1)	8	132	16.5	each
Tree surgery – major (TS2)	14	5570	397.86	each
Tree & shrub/whip planting (TSP)	33	25249	765.12	each
Tree tube & stake (TT)	37	29177	788.57	each
Stonewall Supp: top wiring (TW)	22	17948	815.82	metres
Creation of gutters (WGC)	1	500	500	metres
Stonewall restoration (WR)	38	17825	469.08	metres
Stonewall Supp: difficult sites (WRD)	16	3956	247.25	metres
Stonewall Supp: from quarry (WRQ)	10	2406	240.6	metres
Stonewall Supp: from holding (WRS)	11	4755	432.27	metres
Water supply (WS)	25	14604	584.16	metres
Water trough (WT)	29	90	3.1	each
No capital works	10	nil	nil	nil

Table A5: Miscellaneous other capital works within the baseline survey 2009-2011 (measured by total expenditure)

Capital Works (alphabetically by code)	Number of Agreements	Total Cost	Minimum cost	Maximum cost	Notes
Livestock handling facilities (CLH)	11	£45930.39	£990.00	£16861.72	
Native Seed Mix (GS)	17 (11)	£41285.60	£135.00	£12600.00	6 agreements listed no cost against this capital work
Historic & archaeological feature protection (HAP)	32 (22)	£203488.40	£500.00	£62700.00	10 agreements listed no cost against this capital work
Restoration of historic buildings (HTB)	4 (3)	£306182.40	£1000	£164076.00	1 agreement listed no cost against this capital work
Major preparatory work for heath restoration (LHX)	3	£146352.00	£550.00	£124232.00	
Special Projects (OES)	33	£753187.00	£50.00	£165257.01	
Construction of water-penning structures (WPS)	2	£57830.00	£22230.00	£35600.00	

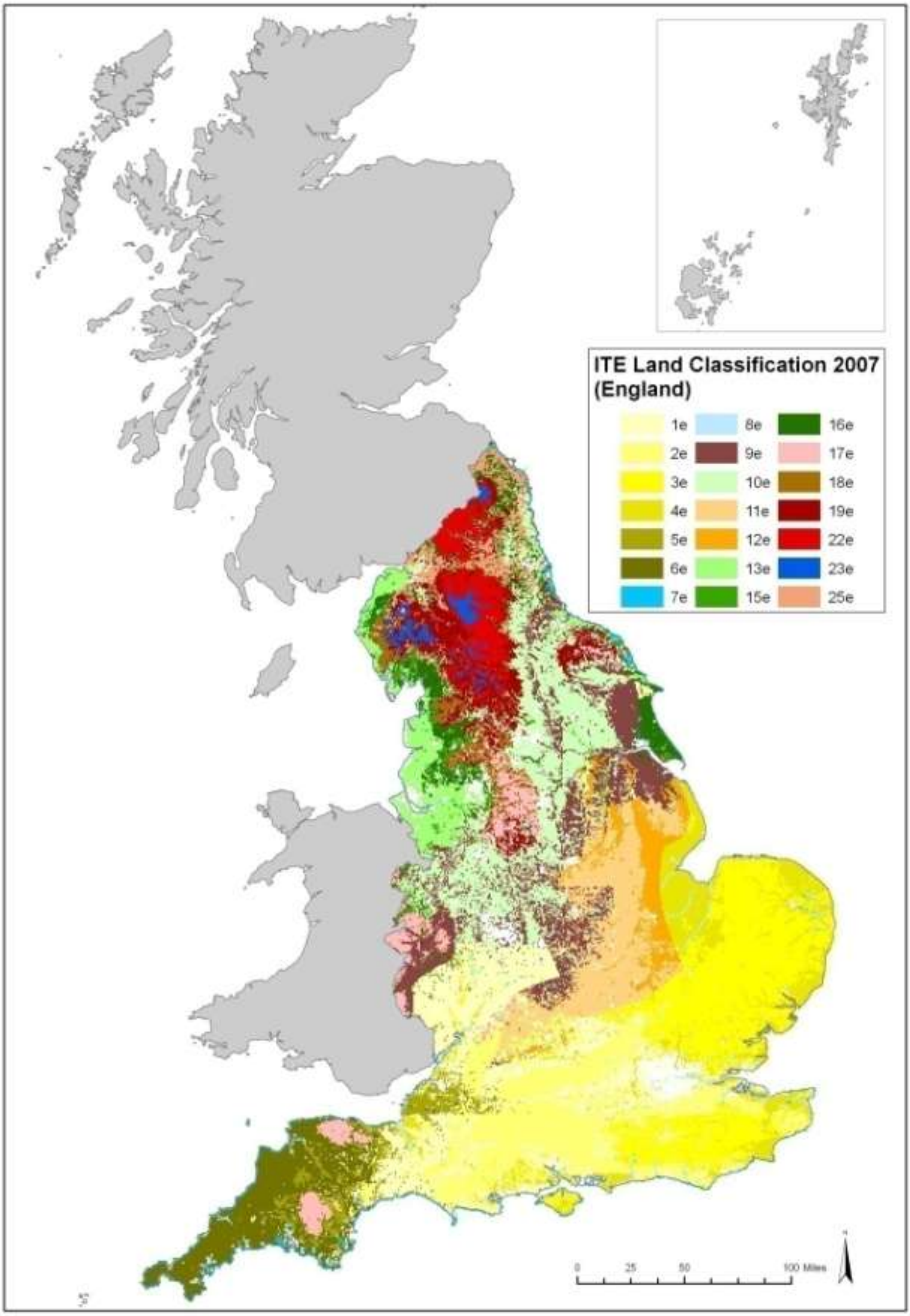
Appendix 3 Methods and results of comparison of HLS quadrats with the Countryside Survey

Appendix 3A: Definition of ITE Land-classes

Table A6: Summary names for those ITE land classes used to make direct comparisons between CS and HLS data. All land classes are for England (suffix e) except 5w which is described for Wales but occurs in the Marches. The detailed distribution of each land class is shown in Figure A3 below

Land Class Code	Summary name of Land-class
1e	Flood plains/shallow valleys, S England
2e	Low calcareous hills/variable lowlands, S England
3e	Flat/gently undulating plains, E Anglia/S England
4e	Flat coastal plains, E Anglia/S England
5e	Shallow slopes/flood plains, S-W England
5w	Shallow slopes/flood plains, Wales
6e	Complex valley systems/table lands, S-W England
7e	Sea cliffs/hard coast, England
8e	Estuarine/soft coast/tidal rivers, England
9e	Almost flat plains, N Midlands, NE England
10e	Gently rolling/almost flat plains, NE England/N Midlands
11e	Flat plains/small river floodplains, E Midlands
12e	Large river floodplains, flat plains, margins, E Anglia
13e	Coastal plains/gently rolling low hills, NW England
15e	Flat river valleys/lower hill slopes, NW England
16e	Gently rolling low hills/flat river valleys, NW England
17e	Upland valleys/rounded hill sides, England
18e	Upland valley sides/low mountains, N England
19e	Upland valleys/plateaux, N England
22e	Intermediate mountain tops/broad ridges, N England
25e	Flat/gently undulating river valleys, N England

Figure A3: Map of ITE land classes used to make direct comparisons between CS and HLS data. The summary names for each land class are given in Table A6



Appendix 3B: Analytical methods – detailed description

Countryside Survey (CS) quadrat data

Species presence and cover data were extracted for **X** and **M** plots[4] from *Countryside Survey.* **M** plots are 1 x 1m in size and located in arable fields in England where a grass or uncropped margin was observed to be present. **X** plots are located randomly but away from linear features to sample vegetation in unenclosed land, fields and woodlands. As part of the 2007 *CS* a 1 x 1m nest was censused at the centre of each **X** plot to enable comparison with data from agri-environment monitoring schemes. These CS data can thus be directly compared with grassland and arable margin quadrats gathered as part of the HLS survey. In the case of woodlands, the present project employed woodlands 10 x 10m plots, and thus comparison was made with the 10 x 10m X plot nest from the CS woodland data.

Certain other less frequent broad habitats (Fen, Marsh & Swamp, Dwarf Shrub Heath and Bog) required further processing of CS data because the HLS monitoring deployed a 4 x 4m quadrat in these habitats but in CS **X** plots the nearest nest sizes were 2 x 2m and then 5 x 5m. Species richness and composition was imputed for a 4 x 4m plot size by fitting a species area curve equation to each CS plot and estimating the richness at this area given the solution of each fitted curve. The difference in species richness between the imputed estimate and the richness observed at the 2 x 2m nest was then used to select individual species to add in to the species list so as to allow computation of adjusted response variables. This was achieved by selecting species present at higher nest sizes in order of their occurrence in the cumulative species list and then by their cover if more than one species was eligible for selection. Species area curves were fitted in WinBUGS using a random slopes and intercepts model (Kéry 2010) to fit $S=c.A^z$ (where S = species richness in nest size A and c and z are parameters estimated for each CS **X** plot). 1479 plots were available that occurred in the same land classes and same broad habitats as the HLS plots.

Land class adjustments to CS data

Even though vegetation samples may share a common Broad Habitat assignment, differences in response variables would be expected between upland and lowland or eastern and western examples. In upland and western land classes, bogs, dwarf shrub heath and acid grassland could be more species rich, have higher mean Ellenberg wetness (F) values and lower mean Ellenberg fertility (N) values. These trends may arise from factors such as species area effects and a more oceanic climate favouring a greater density per plot of species typical of these habitats in those areas where they are most extensively developed across the landscape. For such habitats, targeting concentrated in lowland areas (as was the case in the first year of the baseline survey 2009) would likely lead to a sample that is somewhat different in character from more upland, northern and western situations and so result in an unfair comparison. In addition, the fen, marsh & swamp broad habitat is heterogeneous, varying in manner partly related to upland versus lowland gradients of ecological variation. To ensure appropriate like-with-like comparisons the land class distributions of plots for Fen, Marsh & Swamp, Dwarf Shrub Heath, Bog and Acid Grassland were examined and any major upland versus lowland imbalances between HLS and CS samples were addressed by removing or adjusting the proportions of land classes represented in the CS. This resulted in adjustments for some habitats *i.e.*:

- ***Bog*** (Figure A13): No change.
- ***Fen, Marsh & Swamp*** (Figure A12): No change.
- ***Dwarf Shrub Heath*** (Figure A11): No change was made but it should be noted that the HLS survey had many samples located in ITE Land Class 6e in Cornwall and Devon, which is an area represented by fewer samples in CS. The best representation of this Broad Habitat in CS is based on samples from the Lake District and Pennines (ITE land classes 17, 18 and 19). Overall there were too few plots to allow for a feasible adjustment to the sample.

[4] For details see Carey *et al* (2008) and www.countrysidesurvey.org.uk/sites/default/files/pdfs/reports2007/CS_UK_2007_TR2.pdf

- ***Acid Grassland*** (Figure A9): Reduction in the number of CS plots in ITE land class 22e (mid and northern Pennines) to the same proportional contribution of the land class as found in the HLS survey sample.

HLS quadrat data

6446 plots were present in the HLS survey database, of which 100 plots had no land class and 93 plots had no Broad Habitat assignment. Only 1 plot occurred in both datasets. This left 6254 plots to be compared with CS data. In the HLS survey broad habitats 13 (standing open water and canals), 14 (rivers and streams) and 21 (littoral sediment) were represented by 6, 3 and 2 plots respectively and could not be analysed.

46% of HLS plots were assigned to a unique Broad Habitats in the field. 54% were assigned probabilistically using the profile of *NVC* units to which each plot was classified by running the MAVIS software on groups of plots. This process allotted the most likely broad habitat for each of these plots based on the observed distribution of broad habitats by *NVC* units obtained from the cross-tabulation of those 46% of plots with field assignments. This observed matrix was used to compute the parameters of a multinomial model in WinBUGS. Given the profile of *NVC* allocations for each of the unknown plots, an assignment was made based on the most likely broad habitat estimated from a 1000 draws from the model for each plot. This process allocated 95% of the unknown plots to Neutral Grassland. Therefore, in the HLS versus CS comparisons that followed all plots, whether assigned by surveyor or using MAVIS, were analysed together apart from Neutral Grassland. Analysis of this broad habitat comprised one comparison against the 'known' field assigned group and another against the subset of plots assigned probabilistically.

Analysis of comparisons between CS and HLS

Generalised linear mixed models were used to test the effect of survey membership (CS or HLS) on deviations from the overall mean of each response variable (see Chapter 5b). Two random factor levels were specified: 1km CS square or agreement number if an HLS plot, and the wider ITE Land Class into which CS squares and agreements were nested. Both factors were treated as class variables with random intercepts drawn from a zero mean, normal distribution. These factors take into account any non-independence between plots in the same agreement, 1km square and land class and so help to avoid Type 1 errors where too many tests appear to show significant differences between surveys. In the case of species richness a log link function and Poisson error structure were specified. Ericoid cover data were analysed first by specifying gamma distributed error, but this model failed to converge. Results were finally obtained by analysing square root transformed cover with normal errors. Analyses were carried out using ***proc mixed*** or ***proc glimmix*** in SAS (Little *et al.* 2000).

Appendix 3C: Plot totals from HLS survey and CS2007

Table A20: Numbers of HLS quadrats assigned to Broad Habitats either based on surveyors in the field or using a probabilistic model based on the assignment of grouped plots to *NVC* units using the MAVIS software and then assigning these units to Broad Habitats. See Chapter 5 Methods.

	Assignment method		
Broad Habitat	**In field**	**Probabilistic from *NVC* allocation**	**Total**
1	166	14	180
2	15		15
4	234		234
5	432		432
6	1081	3247	4328
7	262	19	281
8	321	69	390
9	29		29
10	79		79
11	127	54	181
12	30		30
13	6		6
14	3		3
17	2		2
19	62		62
21	2		2
Grand Total	**2851**	**3403**	**6254**

Table A21: Counts of Countryside Survey 2007 random X plots by Broad Habitat

Broad Habitat	**Count of plots**
1	118
2	42
4	512
5	370
6	216
7	5
8	69
9	20
10	64
11	15
12	20
17	18
19	2
21	8
Grand Total	**1479**

Appendix 3D: Results of CS- HLS comparison – arranged by Broad Habitat

Table A7: Count of M plots in CS and of HLS plots in the “Arable Margins, Buffer Strips and Field Corners” protocol (Plots grouped by Broad Habitat). Class indicates whether the broad habitat assignment was mapped in the field (map) or estimated from *NVC* allocation (pr).

Plot count	Broad Habitat	Survey	Class
1	Coniferous woodland	CS	CS
68	Arable & Horticultural	CS	CS
211	Arable & Horticultural	HLS	Map
6	Improved grassland	CS	CS
37	Improved grassland	HLS	Map
12	Neutral grassland	CS	CS
24	Neutral grassland	HLS	Map
516	Neutral grassland	HLS	Pr
15	Calcareous grassland	HLS	Map
1	Fen, Marsh & Swamp	HLS	Pr
3	Rivers & Streams	HLS	Map
2	Urban	HLS	Map

Table A8: Broad Habitat 4 (Arable & Horticultural). Comparison of CS M plots versus HLS plots in the Arable Margins, Buffer Strips and Field Corners protocol.

Response	N plots	F	P	Difference if significant
Grass:forb ratio	279	0.96	0.3395	
C	279	0.07	0.7996	
S	279	2.69	0.1131	
R	279	0.00	0.9785	
cC	279	6.15	0.0198	CS higher
cS	279	2.42	0.1325	
cR	279	15.5	0.0006	CS higher
Ellenberg N	279	0.49	0.4896	
Ellenberg R	279	0.78	0.3881	
Ellenberg F	279	0.05	0.8310	
Ellenberg cN	279	48.03	<.0001	CS higher
Ellenberg cR	279	29.83	<.0001	CS higher
Ellenberg cF	279	46.48	<.0001	CS higher
Species richness	279	0.86	0.3628	

Table A9: Broad Habitat 1 (Broadleaved Mixed & Yew woodland)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	266	0.97	0.3262	
C	287	1.86	0.1739	
S	287	12.21	0.0006	CS lower
R	287	0.00	0.9535	
cC	287	31.11	<.0001	CS higher
cS	287	2.68	0.1029	
cR	287	1.64	0.2010	
Ellenberg N	288	15.77	<.0001	CS higher
Ellenberg R	288	8.04	0.0049	CS higher
Ellenberg F	288	7.04	0.0084	CS lower
Ellenberg cN	288	64.52	<.0001	CS higher
Ellenberg cR	288	58.87	<.0001	CS higher
Ellenberg cF	288	26.34	<.0001	CS higher
Species richness	288	8.61	0.0040	CS higher

Table A10: Broad Habitat 2 (Coniferous woodland)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	46	9.68	0.0033	CS lower
C	55	0.10	0.7481	
S	55	2.08	0.1556	
R	55	0.17	0.6835	
cC	55	1.96	0.1668	
cS	55	1.68	0.2003	
cR	55	1.07	0.3047	
Ellenberg N	55	7.11	0.0101	CS higher
Ellenberg R	55	7.21	0.0096	CS higher
Ellenberg F	55	3.14	0.0821	
Ellenberg cN	55	8.06	0.0064	CS higher
Ellenberg cR	55	7.11	0.0101	CS higher
Ellenberg cF	55	8.57	0.0050	CS higher
Species richness	55	1.19	0.287	

Figure A4: Broadleaved, Mixed & Yew Woodlands (% of plots by survey and land class)

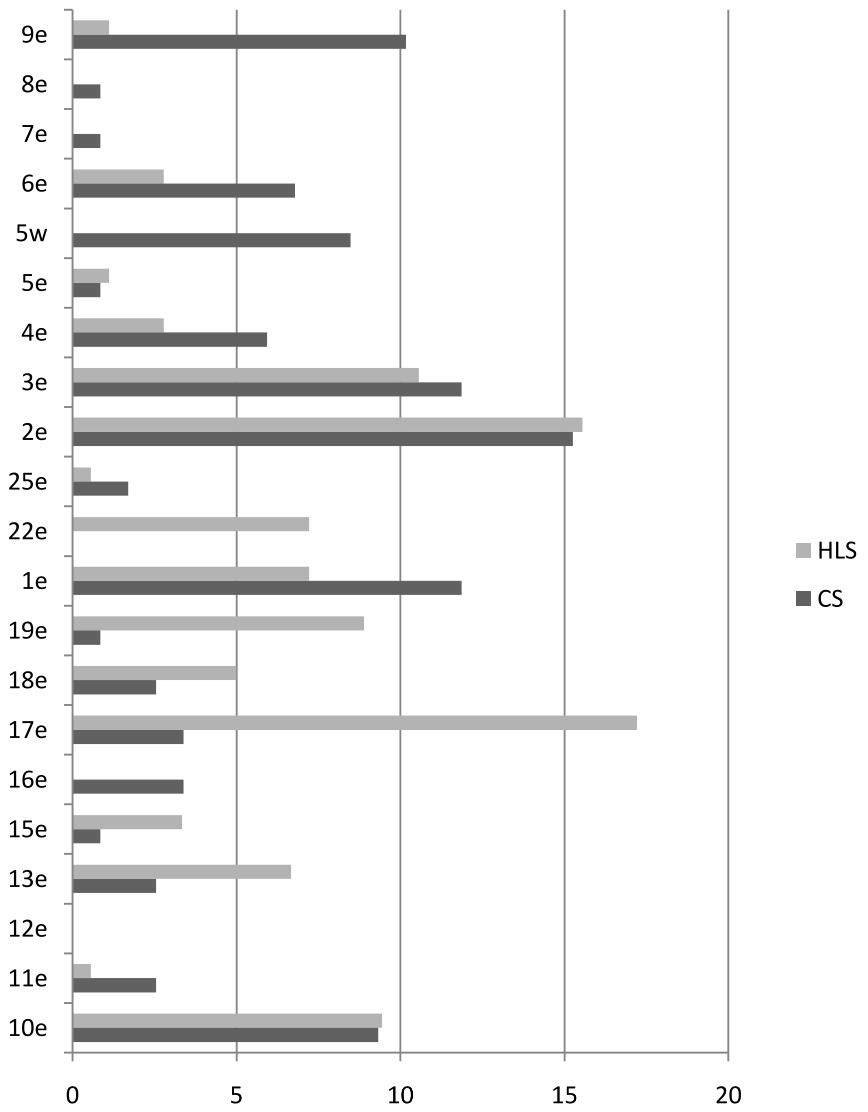


Figure A5: Coniferous Woodland (% of plots by survey and land class)

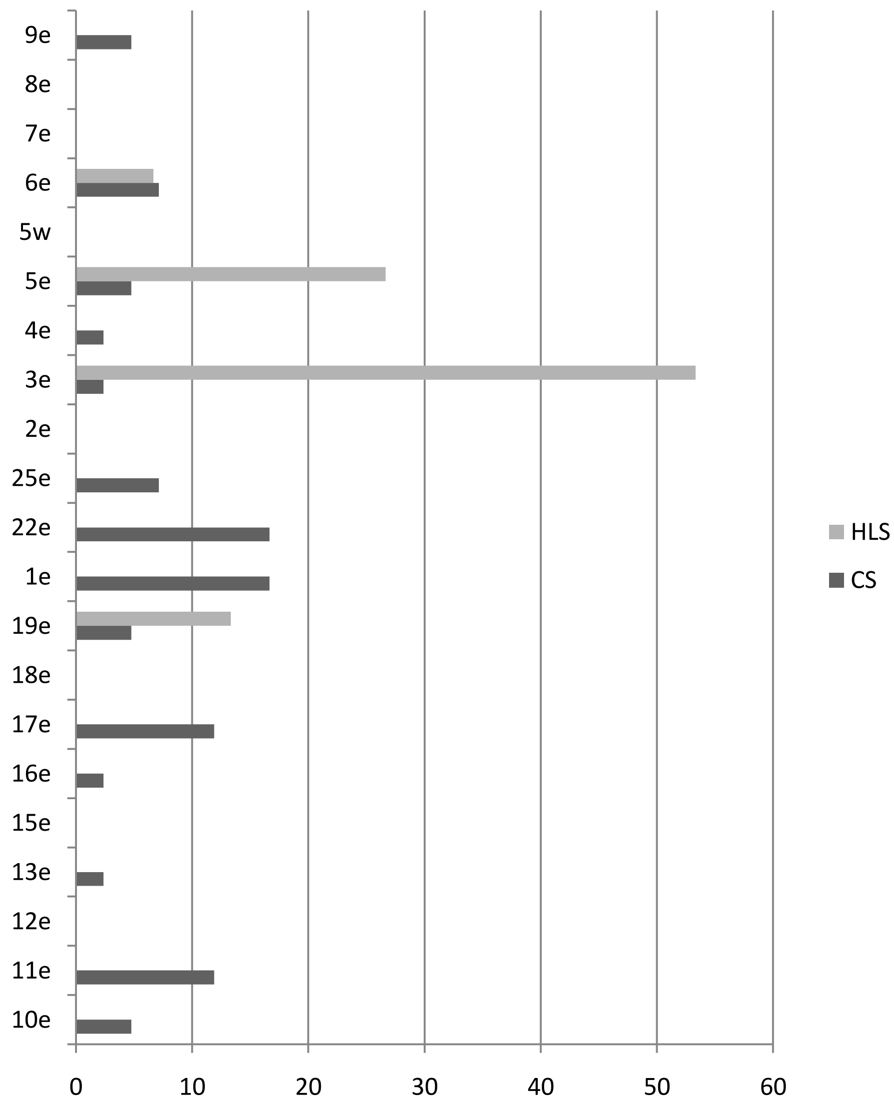


Table A11: Broad Habitat 4 (Arable & Horticultural)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	383	0.12	0.7308	
C	282	4.33	0.0383	CS lower
S	282	34.46	<.0001	CS lower
R	282	5.37	0.0212	CS higher
cC	282	8.05	0.0049	CS lower
cS	282	27.83	<.0001	CS lower
cR	282	1.08	0.3006	
Ellenberg N	385	30.58	<.0001	CS higher
Ellenberg R	385	5.69	0.0175	CS higher
Ellenberg F	385	1.28	0.2593	
Ellenberg cN	385	25.83	<.0001	CS higher
Ellenberg cR	385	15.68	<.0001	CS higher
Ellenberg cF	385	4.25	0.0399	CS higher
Species richness	385	10.81	0.0015	CS lower

Table A12: Broad Habitat 5 (Improved grassland)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	693	28.48	<.0001	CS higher
C	689	0.20	0.6574	
S	689	20.20	<.0001	CS lower
R	689	11.80	0.0006	CS higher
cC	689	4.90	0.0272	CS higher
cS	689	0.76	0.3849	
AcR	689	17.34	<.0001	CS higher
Ellenberg N	693	29.66	<.0001	CS higher
Ellenberg R	693	10.02	0.0016	CS higher
Ellenberg F	693	5.72	0.0170	CS lower
Ellenberg cN	693	59.82	<.0001	CS higher
Ellenberg cR	693	51.82	<.0001	CS higher
Ellenberg cF	693	31.74	<.0001	CS higher
Species richness	693	40.24	<.0001	CS lower

Figure A6: Arable & Horticultural
(% of plots in each survey by land class)

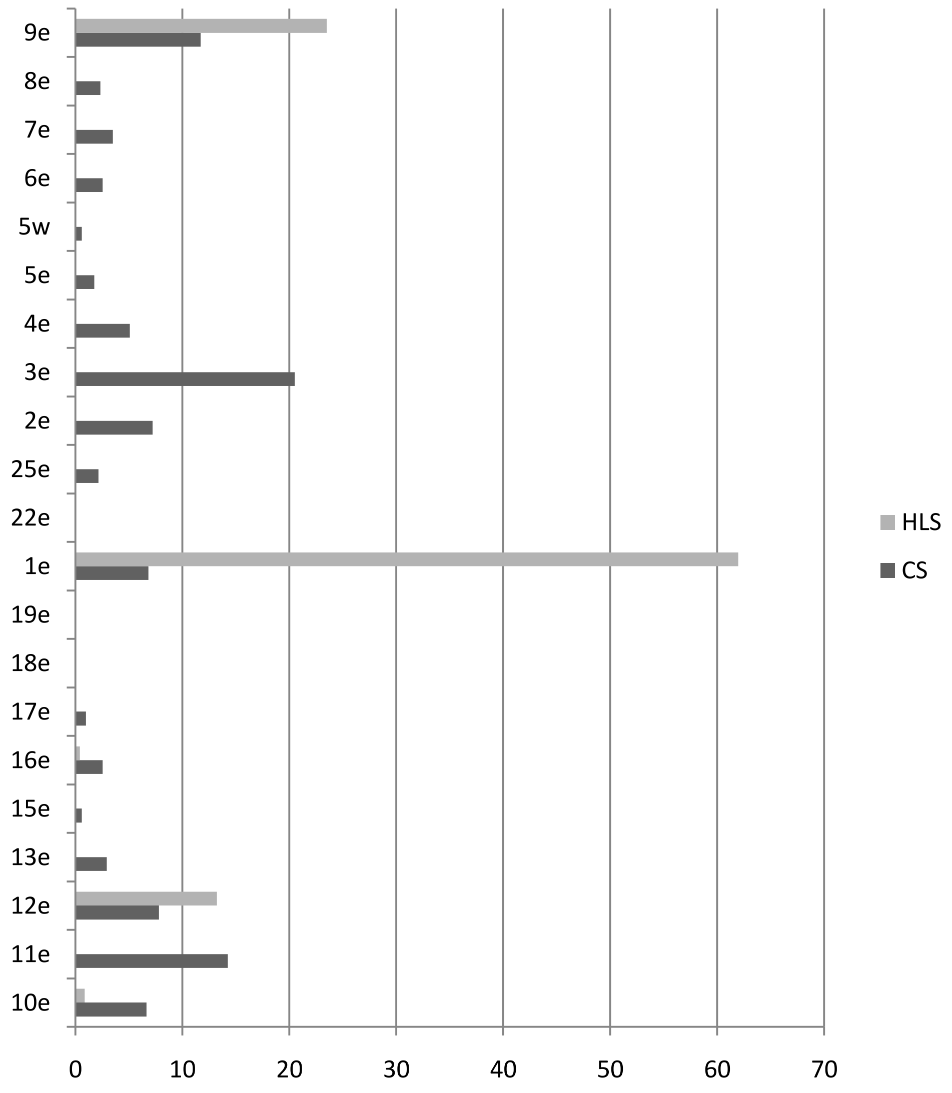


Figure A7: Improved Grassland
(% of plots in each survey by land class)

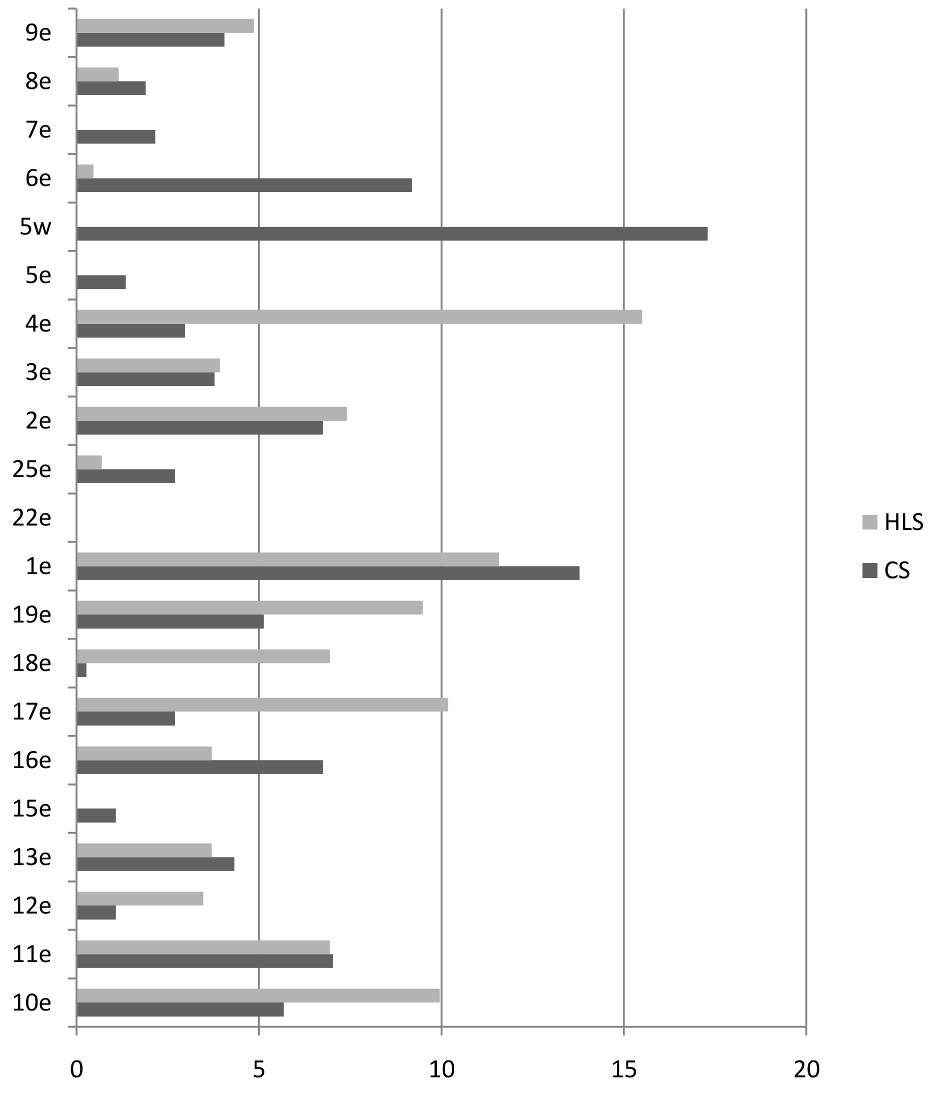


Table A13: Broad Habitat 6 (Neutral grassland where plots assigned by field surveyors)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	1239	17.53	<.0001	CS higher
C	1242	2.63	0.1049	
S	1242	23.37	<.0001	CS lower
R	1242	0.25	0.6174	
cC	1242	22.97	<.0001	CS higher
cS	1242	0.03	0.8741	
cR	1242	13.80	0.0002	CS higher
Ellenberg N	1243	21.93	<.0001	CS higher
Ellenberg R	1243	0.58	0.4448	
Ellenberg F	1243	1.66	0.1982	
Ellenberg cN	1243	48.26	<.0001	CS higher
Ellenberg cR	1243	27.00	<.0001	CS higher
Ellenberg cF	1243	33.13	<.0001	CS higher
Species richness	1244	34.66	<.0001	CS lower

Table A14: Broad Habitat 6 (Neutral grassland where plots were assigned probabilistically using *NVC* allocations)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	2881	18.31	<.0001	CS higher
C	2914	0.54	0.4627	
S	2914	23.62	<.0001	CS lower
R	2914	27.77	<.0001	CS higher
cC	2914	17.72	<.0001	CS higher
cS	2914	1.13	0.2887	
cR	2914	46.57	<.0001	CS higher
Ellenberg N	2915	18.63	<.0001	CS higher
Ellenberg R	2915	2.29	0.1302	
Ellenberg F	2915	7.54	0.0061	CS lower
Ellenberg cN	2915	39.51	<.0001	CS higher
Ellenberg cR	2915	25.75	<.0001	CS higher
Ellenberg cF	2915	4.01	0.0454	CS higher
Species richness	2916	2.72	0.1004	

Table A15: Broad Habitat 8 (Acid grassland)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	437	0.19	0.6630	
C	442	19.14	<.0001	CS lower
S	442	19.25	<.0001	CS higher
R	442	6.00	0.0147	CS lower
cC	442	0.14	0.7060	
cS	442	15.93	<.0001	CS higher
cR	442	1.34	0.2483	
Ellenberg N	442	4.48	0.0349	CS lower
Ellenberg R	442	7.94	0.0050	CS lower
Ellenberg F	442	0.10	0.7576	
Ellenberg cN	442	0.51	0.4757	
Ellenberg cR	442	0.22	0.6396	
Ellenberg cF	442	3.83	0.0510	
Species richness	442	0.00	0.9497	

Table A16: Broad Habitat 9 (Bracken)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	43	0.13	0.7161	
C	48	0.09	0.7651	
S	48	0.00	0.9600	
R	48	0.26	0.6153	
cC	48	5.62	0.0220	CS higher
cS	48	1.77	0.1894	
cR	48	0.42	0.5220	
Ellenberg N	48	2.18	0.1470	
Ellenberg R	48	1.43	0.2384	
Ellenberg F	48	1.34	0.2529	
Ellenberg cN	48	5.03	0.0297	CS higher
Ellenberg cR	48	6.84	0.0120	CS higher
Ellenberg cF	48	6.47	0.0144	CS higher
Species richness	48	0.16	0.6977	

Figure A8: Neutral Grassland
(% of plots in each survey by land class)

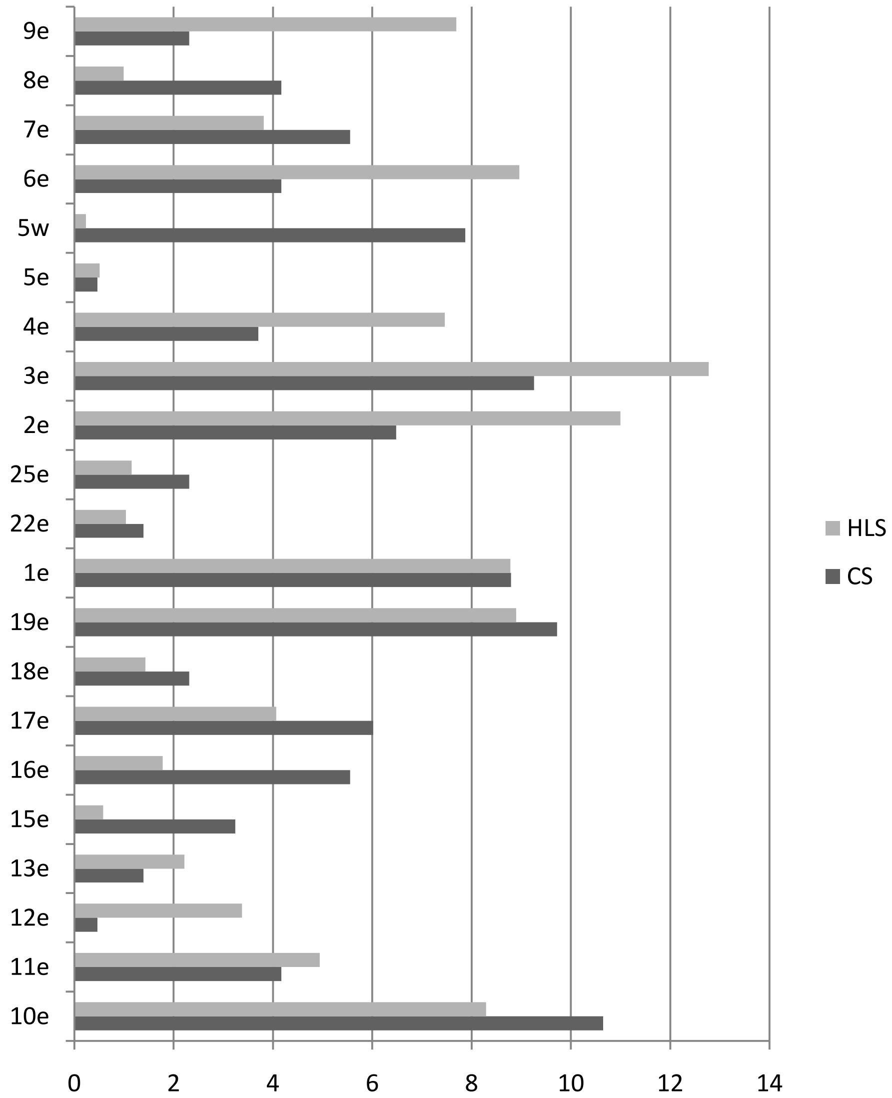


Figure A9: Acid Grassland
(% of plots in each survey by land class)

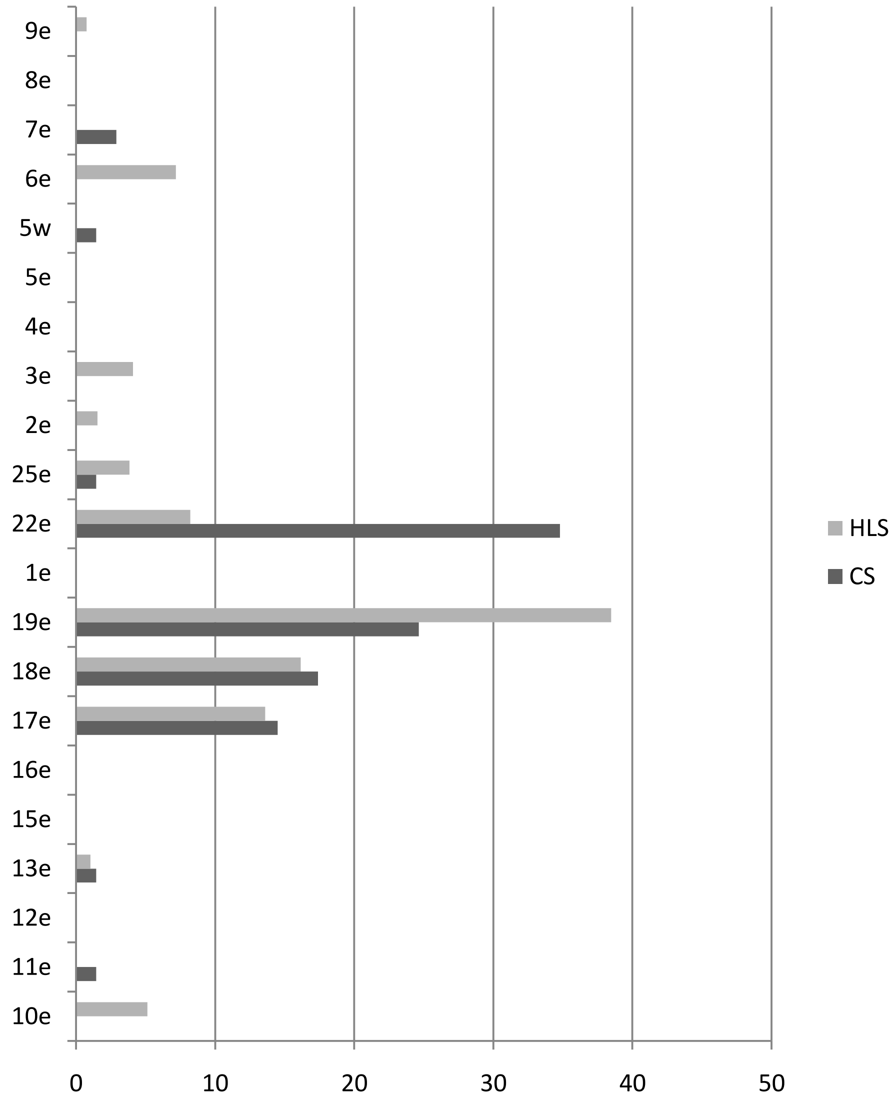


Figure A10: Bracken
(% of plots in each survey by land class)

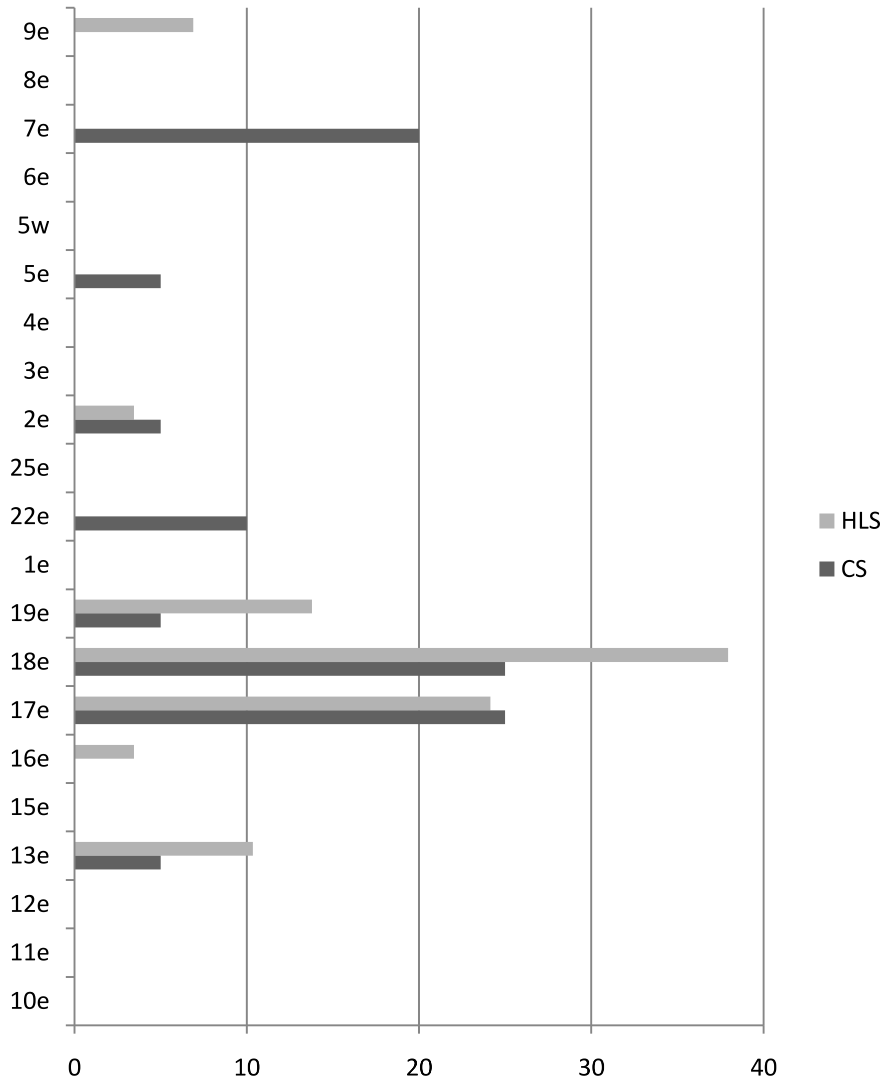


Figure A11: Dwarf Shrub Heath
(% of plots in each survey by land class)

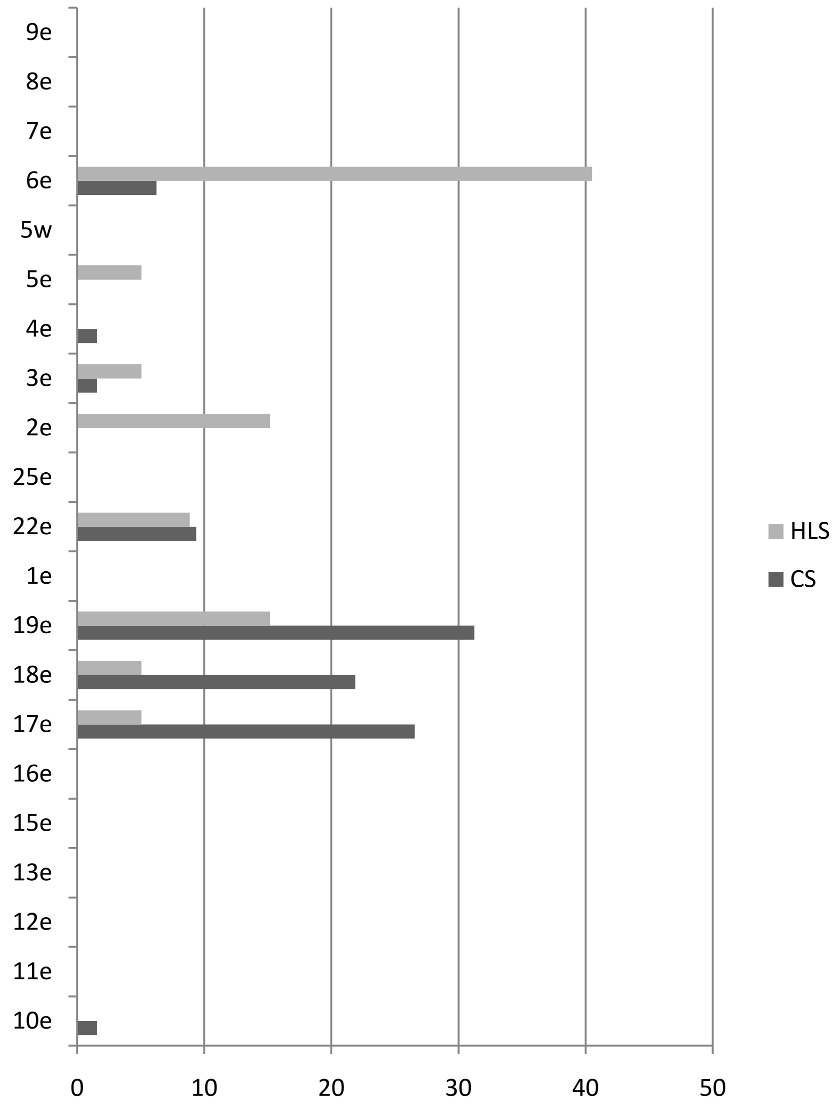


Table A17: Broad Habitat 10 (Dwarf Shrub Heath)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	124	0.80	0.3720	
Ericoid cover	141	4.78	0.0304	CS higher
C	141	4.36	0.0386	CS lower
S	141	2.94	0.0884	
R	141	0.02	0.8939	
cC	141	20.34	<.0001	CS higher
cS	141	26.63	<.0001	CS higher
cR	141	10.03	0.0019	CS higher
Ellenberg N	141	3.89	0.0504	
Ellenberg R	141	9.22	0.0029	CS lower
Ellenberg F	141	0.07	0.7898	
Ellenberg cN	141	1.33	0.2508	
Ellenberg cR	141	0.88	0.3506	
Ellenberg cF	141	20.67	<.0001	CS higher
Species richness	141	0.15	0.6962	

Table A18: Broad Habitat 11 (Fen, Marsh & Swamp)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	191	0.10	0.7495	
C	192	1.42	0.2351	
S	192	2.99	0.0852	
R	192	1.46	0.2291	
cC	192	3.50	0.0629	
cS	192	10.47	0.0014	CS higher
cR	192	0.48	0.4913	
Ellenberg N	194	5.25	0.0230	CS lower
Ellenberg R	194	10.45	0.0014	CS lower
Ellenberg F	194	0.50	0.4791	
Ellenberg cN	194	0.30	0.5871	
Ellenberg cR	194	0.28	0.5964	
Ellenberg cF	194	2.68	0.1035	
Species richness	194	1.90	0.1761	

Table A19: Broad Habitat 12 (Bog)

Response	N plots	F	P	Difference if significant
Grass:forb ratio	43	0.39	0.5381	
Ericoid cover	49	9.59	0.0033	CS higher
C	49	0.08	0.7811	
S	49	0.34	0.5648	
R	49	2.22	0.1431	
cC	49	63.92	<.0001	CS higher
cS	49	39.49	<.0001	CS higher
cR	49	31.40	<.0001	CS higher
Ellenberg N	49	3.01	0.0893	
Ellenberg R	49	6.29	0.0156	CS lower
Ellenberg F	49	0.21	0.6500	
Ellenberg cN	49	15.61	0.0003	CS higher
Ellenberg cR	49	19.61	<.0001	CS higher
Ellenberg cF	49	37.65	<.0001	CS higher
Species richness	49	0.16	0.6955	

Figure A12: Fen, Marsh & Swamp
(% of plots in each survey by land class)

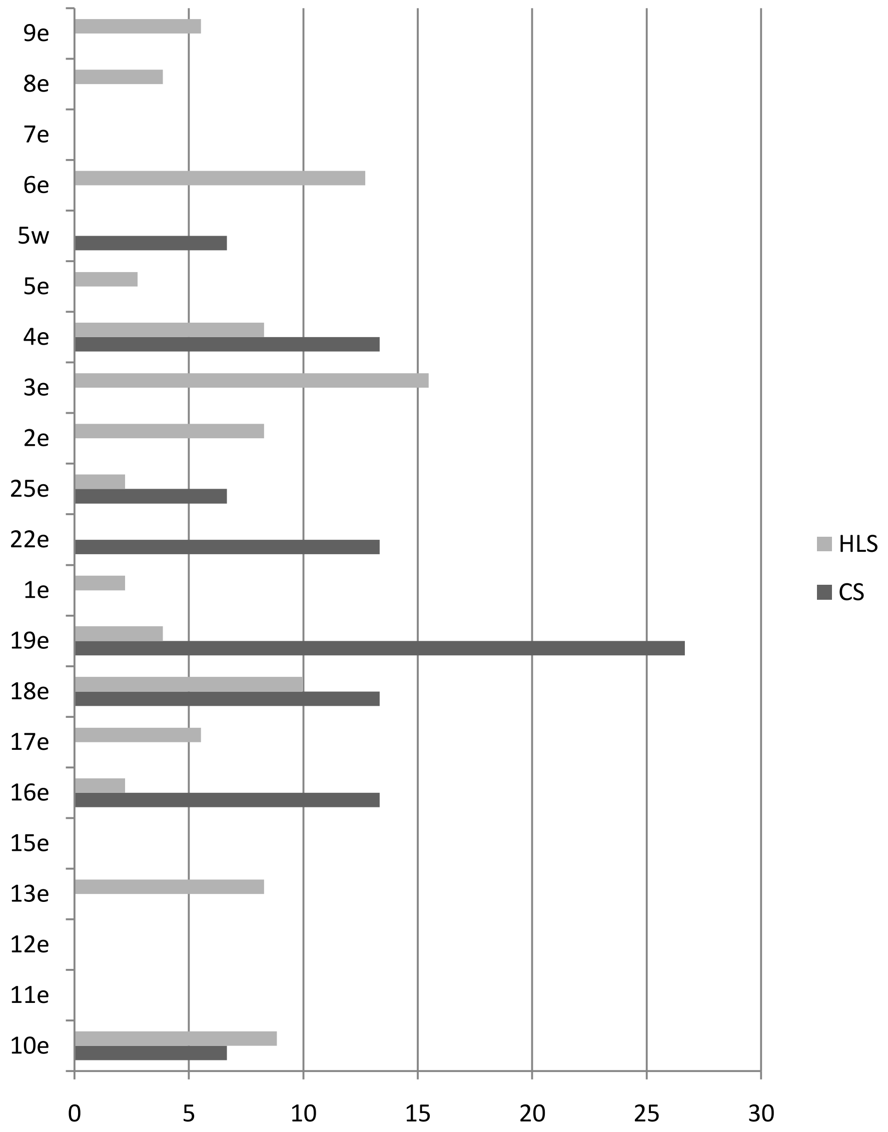
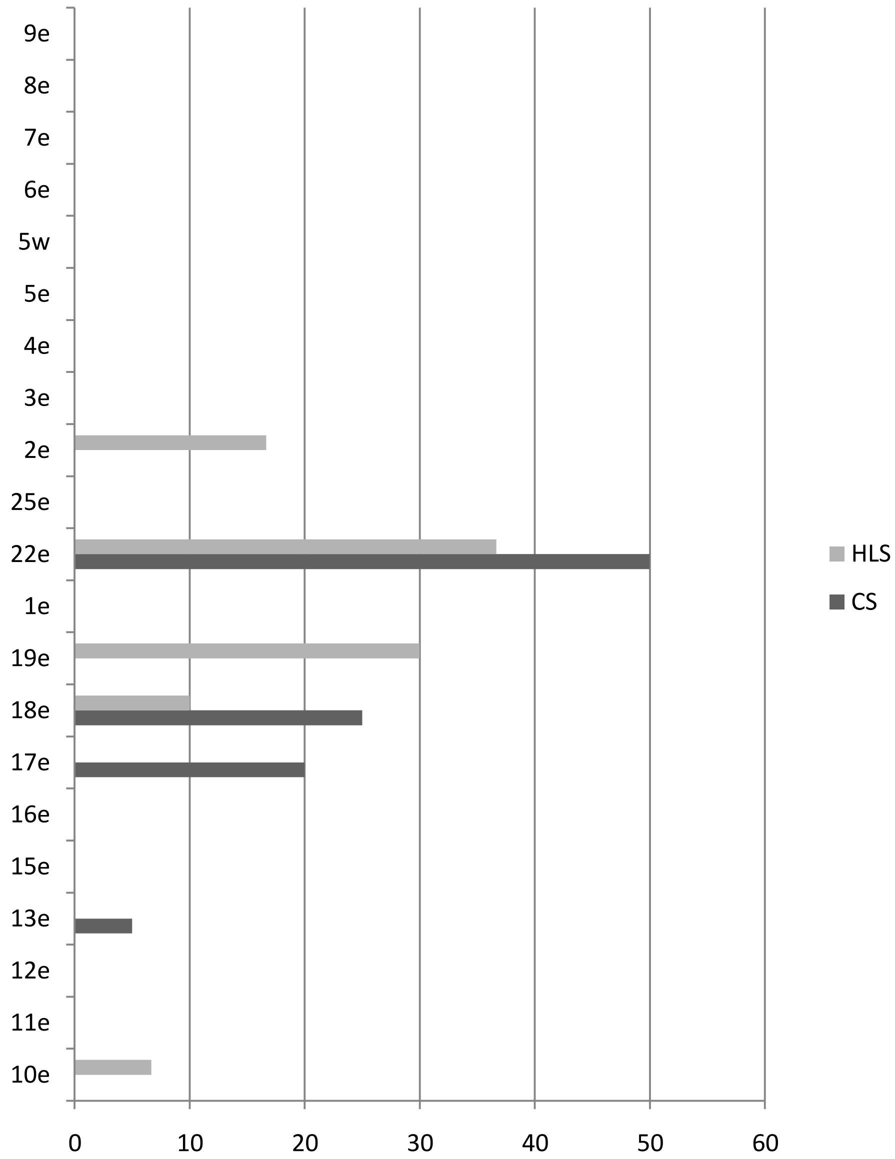


Figure A13: Bog
(% of plots in each survey by land class)



Appendix 4 Results of workshop assessments (Scores in bold illustrate options which have a balance of scores)

Upper Thames Clay Vales	**Option(s)**	Biodiversity				Landscape				Agriculture			
		++	+	o	-	++	+	o	-	++	+	o	-
	HB12	**10**	**4**	**1**	**1**	**11**	**4**	**1**	**0**	**2**	**6**	**8**	**0**
	HK7	10	5	1	0	1	12	3	0	0	2	5	9
	HK7	**4**	**10**	**1**	**1**	**3**	**9**	**4**	**0**	**2**	**6**	**7**	**1**
	Arable cropping	0	1	8	7	1	5	6	4	0	5	11	0
	EE3/HE3	4	10	2	0	4	5	6	1	0	4	7	5
	HK6	7	6	3	0	3	7	6	0	0	5	8	3
	HK11	**7**	**5**	**4**	**0**	**6**	**8**	**1**	**1**	**0**	**6**	**7**	**3**
	HF12	12	4	0	0	1	7	5	3	0	2	9	5
	HE10	13	3	0	0	7	6	3	0	0	3	8	5
	HK15/HD5	2	11	3	0	5	7	4	0	0	3	8	5

Dunsmore and Feldon	**Option(s)**	Biodiversity				Landscape				Agriculture			
		++	+	o	-	++	+	o	-	++	+	o	-
	Intensive grassland	1	0	6	16	1	8	10	4	17	5	1	0
	Arable cropping	0	7	4	12	2	11	9	1	16	2	4	1
	HD5	3	15	4	1	8	12	3	0	0	9	11	3
	HF12	**6**	**15**	**1**	**1**	**0**	**10**	**13**	**0**	**1**	**8**	**10**	**4**
	HK6/HK7	**22**	**1**	**0**	**0**	**12**	**9**	**2**	**0**	**0**	**10**	**7**	**6**
	HF12	19	4	0	0	3	7	11	2	0	5	10	8
	HB12	15	7	1	0	12	5	5	1	1	10	10	2
	HK8	21	2	0	0	15	8	0	0	0	11	7	5
	HE10	20	2	1	0	8	12	3	0	0	7	11	5
	HK3	**9**	**10**	**3**	**1**	**3**	**13**	**7**	**0**	**0**	**10**	**6**	**7**

The Fens	**Option(s)**	Biodiversity				Landscape				Agriculture			
		++	+	o	-	++	+	o	-	++	+	o	-
	HQ3/HQ4/HQ5	8	3	1	0	6	5	1	0	0	0	6	6
	HK3	1	7	3	1	1	7	4	0	0	4	5	3
	HK10	7	5	0	0	8	4	0	0	1	2	8	1
	HE3	**7**	**4**	**1**	**0**	**3**	**7**	**2**	**0**	**3**	**3**	**5**	**1**
	EB6	**4**	**6**	**1**	**1**	**4**	**7**	**1**	**0**	**3**	**3**	**5**	**1**
	HP5	**6**	**5**	**1**	**0**	**7**	**3**	**2**	**0**	**1**	**4**	**6**	**1**
	HC10	2	9	1	0	1	4	2	5	0	3	3	6
	HK9	**8**	**1**	**2**	**1**	**4**	**5**	**0**	**3**	**1**	**2**	**5**	**4**
	EE9	5	5	2	0	2	6	4	0	1	5	5	1
	HF12	10	1	1	0	4	4	4	0	2	0	8	2

Appendix 4: continued

Southern Pennines	Option(s)	Biodiversity				Landscape				Additionality			
		++	+	o	-	++	+	o	-	++	+	o	-
	EL2	0	8	12	0	0	10	9	1	0	6	10	1
	EL4	4	10	4	2	3	12	4	1	2	7	7	1
	HL7	7	9	4	0	4	10	6	0	3	6	7	1
	HC9	6	9	4	1	5	9	5	1	2	10	4	1
	HK7	13	6	1	0	7	12	1	0	5	9	3	0
	HK6	10	10	0	0	9	8	3	0	5	9	3	0
	HK16	15	5	0	0	9	8	3	0	6	11	0	0
	HL10	16	4	0	0	12	4	4	0	11	3	3	0
	HL10/HL15	16	4	0	0	13	6	1	0	8	7	2	0
	HL11	6	11	3	0	3	14	2	1	2	8	7	0

Appendix 5 Post-assessment classification for impact on landscape character & quality

Green	Contribute to maintaining existing landscape character
Amber	Potentially detrimental to existing landscape character
Red	Detrimental to existing landscape character

Area	Code	Option	Is there a landscape impact? (**Y**es or **N**o)	Is impact **P**ositive, **N**egative, or neither (**O**)? (Repeated letters show high impacts)	Multiple Benefits
Upper Thames Clay Vales	HB12	**HB12 : Management of Hedgerows of very high environmental value**	Y	PP	y
	HK7	**HK7 : Restoration of species-rich semi-natural grassland: managed as hay**	Y	PP	x
	HK7	**HK7 : Restoration of species-rich semi-natural grassland: managed as pasture**	Y	PP	y
		Typical arable management			ne
	EE3/HE3	**EE3/HE3 : 6m buffer strip in arable**	Y	PP	x
	HK6	**HK6 : Maintained of species-rich semi-natural grassland**	Y	PP	x
	HK11	**HK11 : Restoration of wet grasslands for breeding waders**	Y	O/P	x
	HF12	**HF12 : Enhanced wild bird seed mix plots**	Y	O/N	x
	HE10	**HE10 : Flower rich 6m margins**	Y	P/N	x
	HK15/HD5	**HK15: Maintenance of grassland for target features (semi-improved grassland). HD5 : Management of archaeological features on grassland**	Y	P	x
Dunsmore and Feldon		**Intensive grassland management**			x
		Arable cropping			x
	HD5	**HD5 : Semi-improved rough pasture**	Y	PP	x
	HF12	**HF1 : Field corner management**	Y	P/N	x
	HK6/HK7	**HK6 / HK7 : Management / Restoration of species rich grassland**	Y	PP	x

	HF12	**HF12 : Wild bird cover**	Y	O/N	x	
	HB12	**HB12 : Field boundary management**	Y	PP	x	
	HK8	**HK8 : Creation of species-rich grassland**	Y	PP	x	
	HE10	**HE10 : Flower rich margins**	Y	P/N	x	
	HK3	**HK3 : Low - input grassland**	Y	P	x	
The Fens	HQ3/HQ4/HQ5	**HQ3** Maintenance of reed beds, **HQ4** Restoration of reed beds, **HQ5** Creation of reed beds	Y	PP	x	
	HK3	**HK3** Permanent grassland with very low inputs	Y	P	y	
	HK10	**HK10** Maintenance of wet grassland for wintering waders and wildfowl	Y	O/P	x	
	HE3	**HE3** Buffer strip on cultivated land	Y	P/NN	y	
	EB6	**EB6** Ditch management	Y	PP	y	
	HP5	**HP5** Maintenance of coastal salt marsh	Y	PP	y	
	HC10	**HC10** Creation of woodland	Y	P	x	
	HK9	**HK9** Maintenance of wetland and grassland for breeding waders	Y	P/NN	x	
	EE9	**EE9** Buffer strip on cultivated by a watercourse	Y	O/N	y	
	HF12	**HF12/NR** Enhanced wild bird seed mix plots	Y	O/N	x	
Southern Pennines	EL2	**EL2: Permanent Grassland with low inputs in SDA £35/ha**	Y	P	y	-
	EL4	**EL4: Management of Rush Pastures in SDA £60/ha**	Y	P	y	+
	HL7	**HL7: Maintenance of Rough Grazing £80/ha**	Y	PP	y	+
	HC9	**HC9: Creation of woodland in SDA £200/ha**	Y	PP	y	+
	HK7	**HK7: Restoration of species rich semi-natural grassland £200/ha (HK18, HR2, HR6 = £380/ha)**	Y	PP	y	+
	HK6	**HK6: Maintenance of species rich semi-natural grassland £200/ha**	Y	PP	y	+
	HK16	**HK16: Restoration of Grassland for target species (Twite) £130/ha**	Y	P	y	+
	HL10	**HL10: Restoration of moorland (blanket bog) £40/ha**	Y	PP	y	+
	HL10/HL15	**HL10+HL15: Restoration of moorland/upland heath with seasonal exclusion of livestock £80/ha**	Y	PP	y	+