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# Pilot Results-Based Payment Approaches for Agri-environment schemes in arable and upland grassland systems in England

# FINAL REPORT

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YORKSHIRE DALES
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# Project Details

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# Executive Summary

**Background to the project**

There have been well documented questions about the effectiveness of conventional action-based agri-environment schemes (AES). These define specific management actions, often referred to as prescriptions, which are expected to result in a desired environmental outcome. There is widespread evidence that following prescriptions doesn't always guarantee results. Additionally, concerns about the ability to demonstrate that management actions have been adhered to have often resulted in bureaucratic evidence and record keeping requirements for participants in conventional schemes. Consequently, there is widespread interest in the potential for results-based approaches to be adopted more widely in AES to help address the limitations of action-based approaches.

The key characteristic of a result-based approach is that the value of the payment is directly linked to the level of environmental outcomes achieved, not to the management inputs/actions undertaken. Result-based approaches have a number of inherent strengths:

- The link between payment and result focuses farmers on owning and understanding the results, rather than simply following prescriptions, promoting genuine behaviour change.
- Payment is only made when results are delivered, improving the cost-effectiveness of schemes. If payments are structured effectively farmers may be motivated to achieve higher environmental outcomes to secure higher payment rates.
- No need for evidence that lots of individual prescriptions have been fulfilled as payment is based on results not inputs/actions.
- Farmers can manage as they see fit to achieve outcomes in their specific location. Allowing them the freedom to use their own local knowledge and expertise. The lack of prescriptions provides flexibility at the field, farm, local, regional level – rather than a national 'one-size fits all' set of prescriptions. This can bridge the gap between the delivery efficiencies of a national scheme and local flexibility.
- The onus is on the farmer to seek advice and to improve their skills and knowledge to enable them to deliver the results.
- An opportunity to greatly simplify schemes focused around objectives (removing separate supplements and capital items as these become embedded as tools supporting the delivery of the objective rather than separate payment items).

Interest in result-based approaches is not new in England, for example the Peak District National Park Authority ran a small local project for hay meadows briefly during the 1980s. However, despite this longstanding interest the result-based approach has not been tested or adopted to any extent in England. To test how results-based AES could work in a range of different farming systems and for the delivery of different biodiversity objectives the European Commission provided 70% funding for a Results-Based Agri-Environment Pilot Scheme (RBAPS) in England. The project ran from January 2016 to December 2018. Co-funding and support was provided by the project partners – Natural England and the Yorkshire Dales National Park Authority. These partners have considerable expertise in AES design and implementation. The overall aims of the pilot were:

- To set up result-based agreements in 2 geographical locations looking at 2 environmental outcomes (broadly equivalent to conventional scheme 'options') in upland grassland and lowland arable farming systems.
- To assess the environmental performance of habitats under result-based agreements.
- To compare the result-based approach to control sites within the pilot boundary.
- To test the accuracy of farmer self-assessment of results.
- To test the cost effectiveness of the result-based approach.

- To explore agreement holder and stakeholder attitudes to result-based approaches.

**Selection of biodiversity targets**

The pilot tested the RBAPS approach in the delivery of 4 environmental objectives:

- Species rich hay meadows,
- Habitat for breeding waders,
- Provision of winter bird food,
- Provision of pollen and nectar resources for pollinators.

These targets were selected as examples of key priority biodiversity objectives in grassland and arable farming systems and where there is evidence of significant variability in their performance within conventional AES.

**Development and testing of results indicators**

A key design principle of the pilot was to develop result measures that could be self-assessed by participants. The rationale for this was to develop ownership and understanding of the outcomes by the participants and enable this to directly inform their management decisions in a timely fashion, rather than relying on a periodic expert assessment (which would be resource intensive and have more limited scope to inform in-year management decisions). For the purposes of the pilot all sites were subject to participant self-assessment and independent expert assessment to enable analysis of self-assessment accuracy to be undertaken. A small proportion of expert assessments were also subject to independent review to test the consistency of the methodology.

Developing result measures for the hay meadow outcome was relatively straightforward. Species rich grassland has featured widely in results-based approaches developed elsewhere and these existing examples provided a strong starting point for a measure based on the presence of positive and negative indicator plant species. In this case the result measure is a direct measure. However, for the arable outcomes and the breeding wader habitat the result measures are necessarily proxy measures of intermediate outcomes rather than direct measures of bird or pollinator populations or wader breeding success (which cannot easily be measured at the farm or field level), and there are fewer existing examples to draw on. Table 1 summarises the result measures.

| Objective | Result indicator |
|---|---|
| Species rich hay meadow | Species richness score based on presence of positive and negative indicator species. |
| Habitat for breeding waders | Score based on positive and negative habitat structural characteristics/features. |
| Provision of winter bird food | Score based on number of specified seed bearing plant species present. |
| Provision of pollen and nectar resources for pollinators | Score based on number of specified flowering plant species present and in 2nd year after establishment % cover of specified species. |

Table 1. Result measures.

**Setting payment rates to recognise and reward quality**

In action-based schemes, participants receive a fixed payment rate for all land enrolled in a management option, regardless of results. The results-based approach adopts a variable payment linked to the quality of the biodiversity results, which are assessed by the scoring system for results indicators. To establish payment rates the conventional approach of calculating the income lost and net additional costs incurred as a result of adopting the farming practices necessary to support the biodiversity targets was used. This establishes the net difference in income and costs between a conventional farming system, for the relevant land type, and the farming system necessary to deliver the maximum biodiversity results. Achieving the maximum results assumes that the participant has to incur the full range of potential costs. The calculations also made an allowance for the participant's time to undertake the self-assessment of results and time to attend training events. This approach

to the calculation of payments ensures consistency with the WTO green box requirements for agri-environmental programmes.

The payment structure adopted equally spaced payment rates, based on five tiers (grassland pilot) or six and ten tiers for the two arable objectives which also included a zero payment. The payment for the top tier was based on the maximum rate calculated, the minimum rate was established based on assumed minimum costs incurred to deliver the lowest level of result indicator score and the intermediate rates as equal bands between. These payment tiers were mapped across to the result indicator scores to give points scoring bands related to each payment rate. The inclusion of a zero payment, making this a pure results-based approach rather than a hybrid (with a guaranteed base payment and result-based 'top-up'), was a deliberate decision to test attitudes towards potential risk associated with non-delivery under a result-based approach. The payment structure aimed to achieve a balance between incentivising farmers to deliver the highest possible score (and therefore payment) and limiting the sensitivity of payments to the scoring system as a result of minor changes in result scores. The number and value of the steps in a tiered system are important considerations as they are key drivers for encouraging farmers to produce better results and increase their payment. The project used evenly spaced payment tiers, primarily for simplicity and lack of strong evidence for an alternative approach. There is potential to explore how motivation changes with non-linear payment rates.

**Implementation and Farmer participation**

A call for expressions of interest for participant farmers was made using a range of existing data sources within the target area boundaries. Those expressing interest were checked for eligibility against a range of published criteria. Those deemed eligible were then invited to submit an application. In total 34 farmers were recruited to participate with a total of 230 hectares of land enrolled in 2 year agreements. Details of the number of farmers and areas entered under each measure are given in Table 2. Over the two year farmer contract period, the total spend for results-based measures was £117,800.

| | **Grassland** | | **Arable** | | **TOTAL** |
|---|---|---|---|---|---|
| **Farms** | **19** | | **15** | | **34** |
| | **Species rich hay meadow** | **Breeding wader habitat** | **Winter Bird Food** | **Pollen and Nectar** | |
| **Number of pilot Agreements** | 11 | 14 (13)* | 15 | 11 | **34 (some have both options)** |
| **Number of fields/plots** | 19 | 22 (20)* | 18 | 11 | |
| **Total area under agreement (ha)** | 35.35 | 153.25 (137.52) | 25.14 | 16.94 | **230.68 (214.95)** |

Table 2. Summary of pilot agreements.*One agreement holder left the pilot after the first year.

The participating farms represent a broadly typical cross-section of farms for their respective areas. The average size of the grassland farms is 84ha, ranging from 5-286ha, whereas the arable average is 288ha, ranging from 77-703ha. The farm types are a varied mix of large commercial farms, small farms, farms with a long history of involvement with AES (for the arable existing AES membership is a prerequisite) and some who have never previously participated. The majority of participants have been in farming for more than 20 years, with a small number of more recent entrants.

**Training and guidance to support results delivery and results self-assessment**

Farmers were provided with extensive advice on how to achieve the best environmental outcomes. This was achieved through a range of guidance materials, 1:1 farm visits, farm walks and training events. The guidance documents included both detailed descriptions of the scoring methodology and scorecards and extensive good practice guidance on potential management interventions to support the delivery of the biodiversity targets. These materials have been published separately.

The majority of farmers attended the training events. These have been very well received and have also provided a valuable opportunity for participants to meet and share their experience with one another. This 'peer-to-peer' learning is a valuable aspect of a results-based approach, where farmers can share knowledge of how to achieve the best scores, and which has limited value in a prescriptive approach because of the inherent inflexibility in choice and timing of management interventions. The 1:1 advice, especially supporting the baseline result assessment process, and the provision of bespoke management advice based on these assessments was also highly valued and this is reflected in the higher proportion of participants who identified that they were quite or very confident about undertaking the self-assessments at the end of the project.

**Dissemination and communication**

The project has generated a considerable amount of interest and has been presented at conferences in England, Wales, Scotland, Belgium and Ireland by the project partners. The project website[1] was updated during the project and an annual project newsletter was produced. Regular meetings were held with local groups and stakeholders in each pilot area and with national stakeholders via an existing group. The project has hosted numerous visits from organisations interested to find out more and many articles and interviews have been published or presented in local and national press/media to promote results-based schemes. Experience from the pilot has fed into the development of post-Brexit environmental land management policy in England, and Defra has agreed to continue funding the project for a further 2 years to enable further testing of the approach to inform future policy development.

**Biodiversity Results**

The environmental performance of all the results-based measures was better than their equivalent control sites. The winter bird food plots managed with a results based approach significantly outperformed conventional scheme control plots during both years of the pilot (43% higher scores). Pollen and nectar plots exhibited somewhat less difference but still performed better than the control sites (15% higher scores). The species rich meadow sites exhibited an average 24% increase in quality score over the 2 years with improvements on all but 2 sites. Quality scores for the breeding wader habitat declined by 13% on average over the 2 years but this was still slightly better than on comparable control sites (-17%). In the case of both hay meadows and winter bird food the difference in performance between RBAPS and controls was statistically significant (P0.05).

Farmers have been motivated to carry out different management practices to improve the biodiversity results. Grassland participants responded to the results-based approach by carrying out around 4 new practices each such as reduced fertiliser, changes to grazing management and adding wildflower seed. Arable farmers have made different management decisions for their plots even compared to their conventional AES plots. These include seed bed preparation, choice of seed mix, fertiliser and plant protection product applications. In short they are paying greater attention to their result-based plots and carefully considering how to produce results and secure a higher payment rate. The short duration of the project means that it has not been possible to test whether the initial motivation wanes as participants develop experience of the approach (and are successful or otherwise).

This illustrates that the approach was effective at motivating the participants to deliver changes in management which translated into improvements to their quality scores, even within the very short timeframe over which the farmer contracts operated. However, developing and using simplified result/quality measures means that there is a risk of divergence between the desired outcome, as represented by the simplified result measure, and more sophisticated outcome assessments. The short duration of the project and limited resources means that comprehensive validation of the simplified result measures with more detailed assessments of the results has not been a priority. For example, a full bird survey and chick productivity assessment would be required to fully understand if the management undertaken by the farmers was having a positive effect on breeding wader numbers and importantly, the number of chicks that are reared to fledging age.

The development of result measures which rely on intermediate/proxy results has highlighted particular challenges with this approach. For example, when developing the results criteria for winter bird food, seed

[1] https://www.gov.uk/government/publications/results-based-agri-environment-payment-scheme-rbaps-pilot-study-in-england

production was the focus. As the results show the farmers have delivered well even during the exceptionally dry, hot season in 2018. However, what has become apparent is that focusing on seed production has resulted in some very tall dense plots that are difficult to assess and potentially may not be ideal for the birds to feed. Defining and measuring a good plot is not as simple as the amount of seed produced, other elements such as plot structure and habitat provision need to be considered further if this approach is to be adopted more widely.

Significant variations in weather conditions during the project have provided valuable testing of the approach under these circumstances and have highlighted that extreme weather events, outside normal fluctuations, can unfairly expose farmers to risk beyond their control.

**Accuracy of self-assessment and verification of biodiversity scores**

In terms of measurement of results, farmers have picked up survey skills rapidly and their results show a good correlation with the adviser's. For winter bird food provision, pollen and nectar provision and hay meadows the majority of adviser and self-assessments over the two years resulted in the same payment tier (67%, 68%, 66% respectively). The results for breeding wader habitat were significantly less consistent with only 36% of assessments agreeing on payment tier. Overall only a very small proportion of assessments resulted in more than a +/- 1 tier difference in result (predominantly for the breeding wader habitat). The results have shown that farmers have grown in confidence and ability with surveying techniques and plant identification. Assessment results which showed most differences were typically caused by:

- Species misidentification (both grassland and arable),
- Purposeful or unintended deviation from the fixed transect (Hay meadows),
- Interpretation of the 'representative stops' methodology (Arable),
- Measures based on assessments such as percentage cover were also found to be more subjective (Breeding wader habitat and Pollen and nectar provision).

**Farmer attitudes towards the results-based approach**

Farmer attitudes towards the results-based approach, based on responses to questionnaire surveys, were almost universally positive. Farmers like the freedom to use their own local knowledge and expertise to manage without being 'told what to do'. A strong theme of equity emerged with widespread recognition that the approach fairly rewards knowledge, skills and effort rather than a flat rate payment regardless of results. The approach has also generated better understanding of the biodiversity outcomes. For example, grassland participants highlighted the value of learning about the national and international importance of the habitats and species on their farms and the role they play in protecting them.

Depending on a participant's attitude to risk, a pure results-based approach provides a positive motivation and/or a negative exposure to risk. The pure results-based approach and consequent £0 payment rate created much discussion, primarily in the arable element of the project where the objectives are delivered through annual measures with significant potential exposure to risk each year, unlike an established habitat. At the start of the project there was concern about the level of risk it exposed a farmer to; although it could be argued that all commercial crops are also subject to failure and so this is little different. However, the pilot has shown that none of the arable plots, even in the challenging weather of 2018, were anywhere near the £0 payment tier so this concern may be unsubstantiated in the longer-term. However, it might act as a significant barrier to initial scheme uptake, especially for those with lower levels of confidence/experience.

**Administrative costs and scheme payments of RBAPS compared with management-based schemes**

A full comparison of cost-effectiveness isn't possible without taking into account all the delivery costs, payments and environmental performance of both result-based and management-based approaches, which has not been possible. However, the estimates suggest that in terms of delivery costs the administrative simplicity of the RBAPS approach, which negates the need for the selection and tailoring to individual sites of multiple management based options and prescriptions, offsets the additional resource required to manage and support the ongoing implementation of RBAPS agreements in terms of advice.

In most other respects the processes involved in scheme delivery, eg expert baseline assessments, payment of claims, compliance monitoring, and environmental monitoring are the same so costs for these elements wouldn't be expected to differ significantly between approaches.

In terms of overall scheme payments the higher scheme payments associated with high levels of results delivery under a result-based approach may be offset against lower payments for under-performance/sites at the lower end of the payment range (which would have received a higher fixed rate payment under a management based approach), so the total value of payments is not necessarily higher for an equivalent area under management. Where payment rates under a result-based approach are somewhat higher on average than those on control sites under management-based agreements (for example the winter bird food and pollen and nectar payments were on average approximately 20% higher under the result-based approach) this corresponds to environmental performance improvements (scores increased by 43% and 15% respectively), which suggests that the additional benefits are likely to be at least proportionate to the higher scheme payments.

**Conclusions**

The England pilot has built on the available evidence and developed and tested result scoring assessments and tiered results based payments for four biodiversity objectives. A pure results-based approach provides an important motivation, and also a value-for-money safeguard to ensure payments are only made for performance above a defined minimum level. It is clear that the results-based approach has considerable potential to improve the performance of agri-environmental measures. Early indications suggest that delivery costs and scheme payments are unlikely to be significantly different to those of management-based measures, suggesting that the approach could deliver some efficiency gains. It is also clear that the approach could be applied to a wide range of biodiversity objectives and many other environmental objectives associated with land management practices.

In relation to the design and implementation of results-based measures the following conclusions emerge:

- Proxy indicators need to be extensively tested in the field to identify any potential unforeseen/perverse outcomes.
- Result measures require ongoing validation, comparing result scores with traditional habitat condition assessment methodologies/other direct measures using longer time series, to confirm that simplified measures are good proxies for their objectives and that there is no divergence over time.
- To limit the use of result indicators reliant on more subjective assessments, such as percentage of cover, and to recognise the greater variability in scoring that may result if they are adopted (eg by using fewer payment tiers, accepting that this may reduce the incentive effect).
- Weather is a significant factor that affects both agricultural and environmental results. Successful delivery of many biodiversity outcomes is closely linked to characteristics, such as wetness, which are affected by the weather. Result indicators which are very sensitive to weather conditions should only be used where potential management interventions are available to directly influence these characteristics. Provided that this is the case it is not unreasonable to expect farmers to make more interventions in some years to deliver optimum results (or accept a lower level of results, which would be no different to agricultural production affected by weather).
- The need for clear safeguards to apply if truly 'exceptional weather' is experienced so that land managers are not unfairly exposed to risk beyond their control and are aware of this when they enter an agreement. The pilot has explored a number of potential options for this and different approaches may be more suitable for different outcomes.
- Defined assessment windows are important to ensure any independent verification takes place as close to the self-assessment survey date as possible.
- Developing single result measures for species with different habitat requirements is challenging. This has been highlighted in the development of the breeding wader measure where 3 of the target species have broadly similar habitat requirements whereas the 4$^{th}$ (Lapwing) shares many similar requirements but also has some significant differences. This highlights the challenge of defining

simple habitat condition objectives that can simultaneously satisfy the requirements of multiple target species.

**Further work and Mainstreaming**

A number of priorities for further work to support future design and implementation, have emerged, specifically:

- A greater understanding of how farmer confidence and expectations develop over time as they engage with the approach. Especially whether their initial motivation wanes as participants develop experience of the approach (and are successful or otherwise), especially for those environmental objectives, such as habitat condition, that are typically very slow to respond to changes in management. Specifically for the pollen and nectar resource provision, which is a multi-annual sown mix and prone to deteriorate in quality over time, whether the RBAPS approach will encourage proactive management actions to be taken to maintain a certain quality/payment level.
- Testing how the number of payment tiers and the use of non-linear spacing of tiers affects farmer attitudes to risk and reward and their engagement with the approach.
- There are opportunities to explore the use of technology, especially to support the process of result assessment undertaken by farmers/land managers. Overall, technology may have two specific uses in this context. First, to support more accurate assessments of results by land managers at the field/farm-level. Here it is important that there is scope for real-time or rapid feedback from such tools to inform management decisions. Second is the potential for remote sensing to support effective targeting of site verification visits, recognising that independent verification of results will only be possible for a small proportion of sites.
- There is a need to develop a better understanding of the impact of annual weather differences, especially in the context of increasing variability driven by climate change, on indicator species visibility/counts through longer time series data.

Five particular challenges to mainstreaming the approach have been identified.

1. Concerns that the time associated with undertaking self-assessment of results by participants on a larger number of plots/fields, across a wider range of environmental objectives, at a whole farm scale, could be considerable. The scheme payments include an element for the time required to undertake the assessments so the time itself need not be a barrier, however, if the timing of assessments for different outcomes were coincident and/or the timing of assessments were coincident with peaks of agricultural activities this could be a particular challenge. It would be anticipated that the time spent by participants on self-assessment would reduce as they develop the skills and confidence to undertake the assessments, and there is some evidence from the pilot of this happening. However, this clearly needs further consideration in the context of an overall scheme design although it might be possible to reduce the frequency of some assessments or to reduce the number of stops per plot, subject to further testing of the repeatability of different survey methodologies.

2. The need for extensive training and advice, especially in the early stages of implementation to support the self-assessment process. The approach is a big culture change for farmers, changing the scheme risk from non-compliance with prescriptions to non-delivery of results. Experience from the pilot shows the potential need for high levels of support in the early stages of adopting the results-based approach as farmers develop the necessary skills and confidence. This would be especially true across a scheme with a wider range of result based objectives. However, indications from the pilot suggest that farmers have developed the necessary skills and grown in confidence quickly and that this would predominantly be a temporary requirement in the initial stages of implementation.

3. The resource required to verify results. The pilot has necessarily employed 100% independent assessment of results annually. Translating such an approach into a mainstream scheme is unlikely to be feasible because of the volume of assessments required. However, the pilot has demonstrated a high level of accuracy of self-assessment results for most measures which indicates that such a level of verification is probably not necessary. For some measures less frequent independent assessments may be sufficient eg at end of agreement (which would also provide a new baseline for any future agreement), in other cases a risk-based approach focused on independently sampling a small proportion of sites each year could be adopted. Selection could be informed by factors such as significant changes in self-assessed scores, evidence from remote-sensed data suggesting a discrepancy between a self-assessed score and actual condition on the ground, or random.

4. Budget management. The potential variability in performance and consequent fluctuations in expenditure raises a potential concern for Managing Authorities. However, for most measures, such as habitat condition, it should be possible to accurately anticipate expenditure based on baseline condition assessments and assumed average rates of habitat quality improvement. Annual measures, such as the arable measures tested here, are potentially more prone to fluctuation but their performance has been broadly consistent across the pilot (even in a challenging growing season affected by drought) which suggests that average performance levels would emerge which could be used for budget planning purposes.

5. The development and testing of a much wider range of result measures. The pilot has only developed and tested result measures for 4 biodiversity objectives and following experience and testing some further development of these measures is still required. This is potentially a significant process which requires considerable technical expertise and extensive time for testing, especially for outcomes where the approach hasn't be tested before. Even for outcomes where there may be more experience to draw on, tailoring of proven approaches to specific local circumstances is still likely to be required. However, unlike management-based schemes which tend to develop multiple management options and prescriptions designed to address specific situations, a significant advantage of a results-based approach is that a tiered approach to payments can accommodate a wide-range of baseline starting conditions within a single measure and also subsume a range of payment supplements and supporting capital investments. A tiered approach could therefore potentially result in a very significant simplification of the potential number of measures required compared to a management-based scheme.

Clearly there is some further work that is required before the approach could be fully mainstreamed. However, experience from the pilot is very positive and suggests that the approach has considerable potential to improve the delivery of outcomes in the future.

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# Background

There is widespread interest in the potential for results-based/payment by results (RBAP) approaches to be adopted more widely in agri-environment schemes (AES) to help address some of the limitations of conventional action-based approaches. This report presents the findings from a 3 year pilot project in England testing the RBAPS approach in the delivery of 4 environmental objectives: species rich hay meadows, habitat for breeding waders, provision of winter bird food and provision of pollen and nectar resources for pollinators.

An interest in results-based approaches for agri-environment schemes has existed for many years in Europe, for example see Klimek *et al* 2008. Specifically in England, the Peak District National Park Authority ran a project for hay meadows briefly during the 1980s (Buckingham, 1998) and the UK Conservation Agency network commissioned a study on the approach in 2008 (Schwarz *et al* 2008). However, despite this longstanding interest the RBAPS approach has not been adopted in England, although in recent years there have been an increasing number of examples of the approach operating elsewhere in Europe (Hasund 2013, Fleury *et al* 2015, Russi *et al* 2016, Birge *et al* 2017).

The conventional approach to AES delivery defines specific management actions, often referred to as prescriptions, which are expected to result in a desired environmental outcome. While there is evidence for the effectiveness of this approach in some circumstances, especially where schemes have been highly targeted (for example see Peach *et al* 2001, Wood *et al* 2015), there have also been longstanding questions about the overall effectiveness of action-based approaches and the associated limitations of a 'one-size fits all' set of management prescriptions/payments (Klein and Sutherland 2003, Reed *et al* 2014, Batáry *et al* 2015).

In addition the European Court of Auditors (ECA) concerns about the controllability of management actions (ECA 2011) have resulted in major changes in the control framework for the 2014-2020 Rural Development Programme period. This means additional evidence and record keeping requirements for scheme participants to demonstrate that prescriptions have been delivered in order to avoid the risk of payment reductions and penalties. Together these factors have contributed to a renewed focus on RBAPS approaches. This is also reflected in the context of future changes in the Common Agricultural Policy which envisage an increased focus on performance and results (European Commission 2018).

The key characteristic of a RBAPS approach is that the value of the payment is directly linked to the level of environmental outcomes achieved, not to the management inputs/actions undertaken. This in turn means that there is no need for evidence that prescriptions have been met as the level of payment is variable and based on the results not inputs/actions (although the calculation of the payments is typically based on the income foregone and additional costs methodology to ensure consistency with the WTO green box requirements).

Reflecting these dual concerns of effectiveness and controllability the European Commission (EC) commissioned a review of the RBAPS approach (Allen *et al* 2014) and subsequently launched a funding scheme for pilot projects to test and develop RBAPS approaches for biodiversity. Natural England (NE), with the Yorkshire Dales National Park Authority (YDNPA) as a partner, led a successful bid in late 2015 securing 70% funding for a 3 year pilot project. The pilot is one of three EC funded projects, the others are in Ireland/Spain and Romania. The pilot tested the delivery of 4 environmental objectives: species rich hay meadow, habitat for breeding waders, provision of winter bird food and provision of pollen and nectar for pollinators.

RBAPS approaches have a number of inherent strengths:

- The link between payment and result focuses farmers on owning and understanding the results, rather than simply following prescriptions, promoting behaviour change (Burton and Paragahawewa 2011, Burton and Schwarz 2013). There is widespread evidence of a lack of

understanding of the scheme objectives in England and low quality of delivery of many management options (Mountford and Cooke 2013). There is also evidence that shows there is scope for significant improvements in performance, for example research has shown that the best wild bird seed mixes yield six times more seed than the worst – following prescriptions doesn't guarantee the results (Hinsley *et al* 2010b).

- Farmers can manage as they see fit to achieve outcomes in their specific location. Allowing them the freedom to use their own local knowledge and expertise. The lack of prescriptions provides flexibility at the field, farm, local, regional level – rather than a national 'one-size fits all' set of prescriptions. This can bridge the gap between the delivery efficiencies of a national scheme and local flexibility.
- The onus is on the farmer to seek advice and to improve their skills, and knowledge to enable them to deliver the results.
- An opportunity to greatly simplify schemes focused around objectives. There is no need for separate supplements and capital items as these become embedded as tools supporting the delivery of the objective rather than separate payment items; and it removes the need for evidence that lots of individual prescriptions have been met as payment is based on results not inputs/actions.
- Payment is only made when results are delivered, improving the cost-effectiveness of schemes. Matzdorf and Lorenz (2010) reported a positive impact on cost-effectiveness compared to a conventional approach for a results-based scheme in Germany. If payments are structured effectively farmers may be motivated to achieve higher environmental outcomes to secure higher payment rates (Schroeder *et al* 2013).

The overall aims of the pilot are:

- To set up agreements in 2 geographical locations looking at 2 environmental outcomes (broadly equivalent to conventional scheme 'options') in upland grassland and lowland arable farming systems.
- To assess the environmental performance of habitats under RBAPS agreements.
- To compare the RBAPS approach to control sites within the pilot boundary.
- To test the accuracy of farmer self-assessment of results.
- To test the cost effectiveness of the RBAPS approach.
- To explore agreement holder and stakeholder attitudes to RBAPS.

## Biodiversity Objectives

### *Arable Farming Systems*

Despite the recent growth of RBAPS approaches their application has been largely confined to grassland farming systems (Allen *et al* 2014). Arable farming systems have not been the subject of RBAPS approaches despite their importance for the delivery of environmental objectives such as farmland bird populations and wild pollinator populations. The only reference to an arable based RBAPS scheme is from Germany where a project with the objective to increase the population of arable weed species and the populations of associated insect species and their predators ran for two years in 2008 and 2009 but was then discontinued. A particular challenge of applying the approach to mobile species such as birds and pollinators is their limited suitability as reliable result indicators, especially for self-assessment by farmers. Accordingly it was decided that proxy measures of habitat quality would be more reliable result measures and that there is good evidence that links increased populations of both birds and pollinators to improvements in habitat quality.

*Farmland Bird Populations*

The latest farmland bird trends published by the Department of Food Environment and Rural Affairs (Defra) show that in 2016 the England farmland bird index was less than half its 1970 value. The majority of this decline occurred between the late 1970s and early 1980s and was largely due to the impact of rapid changes in many farmland management practices during this period. More recently the smoothed index decreased 8% between 2010 and 2015 (Figure 1).

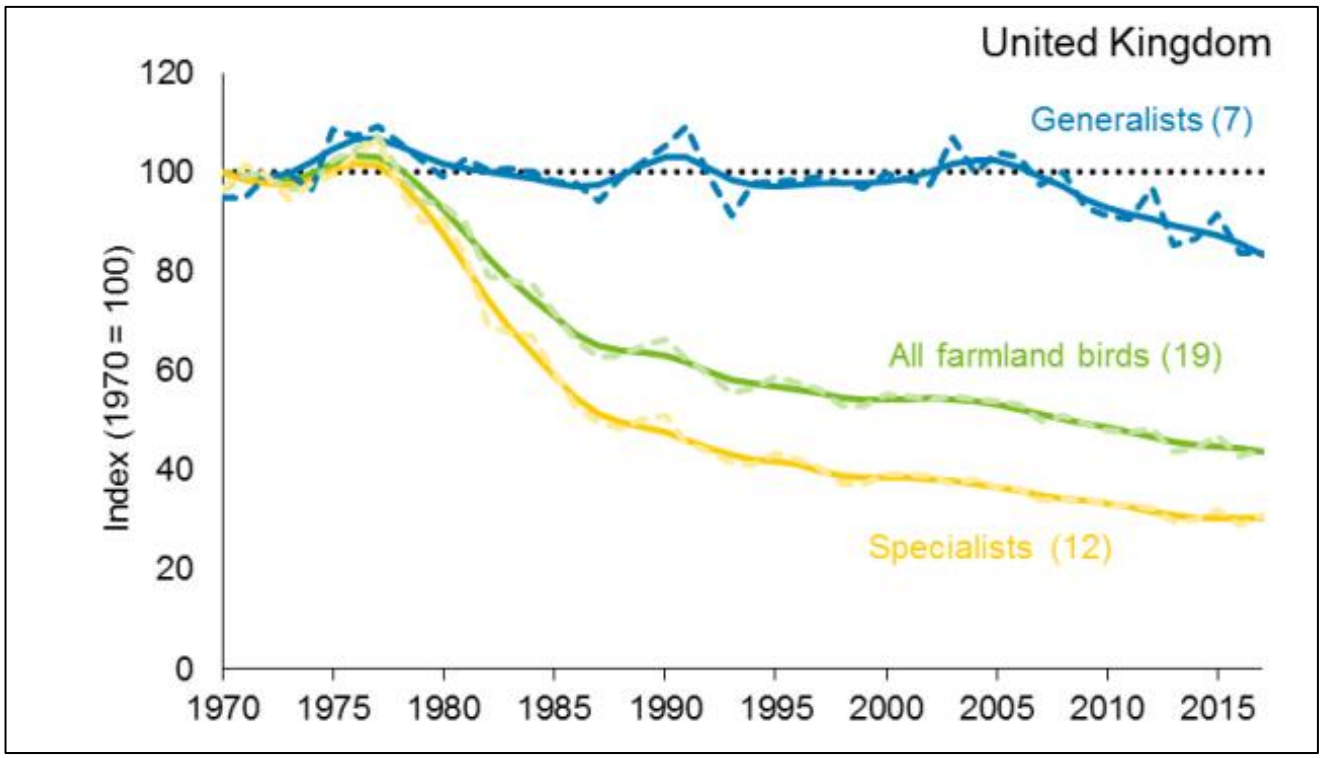


Figure 1. Breeding farmland birds in England, 1970 to 2016 i) figures in brackets show the number of species, ii) graph shows unsmoothed trends (dashed lines) and smoothed trends (solid lines)(Defra, 2018).

The Farmland Bird Index (FBI) is comprised of 19 species. The long-term decline of farmland birds in England has been driven mainly by the decline of those species that are restricted to, or highly dependent on, farmland habitats (the 'specialists'). Between 1970 and 2016, farmland specialists index declined by 73% and farmland generalists declined by only 4%. The smoothed trend shows a decline of 73% for specialists and a 6% decline for generalists.

The large declines in the abundance of many farmland birds have many known and potential causes. For a large part, declines have been caused by the changes in farming practices that have taken place since the 1950s and 60s, such as the loss of mixed farming, a move from spring to autumn sowing of arable crops, changes in grassland management (e.g. a switch from hay to silage production), increased pesticide and fertiliser use, and the removal of non-cropped features such as hedgerows. The rate of these changes, which resulted in the loss of suitable nesting and suitable feeding habitats, and a reduction in available food, was greatest during the late 1970s and early 1980s, the period during which many farmland bird populations declined most rapidly.

The continued fall in the FBI is being largely driven by ongoing declines in the farmland 'specialist' bird species, most of which are granivorous (i.e. are predominantly seed-eaters for most of the year). There is a raft of evidence linking the declines in these seed-eating birds to reduced rates of overwinter survival (as summarised by Siriwardena *et al*. 2000), with the most likely driver being reduced seed availability on farmland during the non-breeding season. There are several reasons for this, including the increased use of agrochemicals and more

efficient harvesting methods, but the main cause has been the widespread switch from spring to autumn-sowing of cereal crops and the consequent loss of seed-rich overwinter stubbles. As a consequence, a range of agri-environment measures have been developed which seek to increase the provision of seed-food on farmland during the non-breeding season for declining granivorous birds, including Winter Bird Seed Mixes (WBSMs).

WBSMs were initially developed out of game cover crops put in place to provide cover and food for pheasants, and Game and Wildlife Conservation Trust (GWCT) were the first to see their potential for a wider range of native farmland birds. They trialled a range of different crop mixtures and studied their use by different species (see Stoate *et al.* 2004 for history of early development). WBSMs were first trialled within an AES as part of the Arable Stewardship Pilot Scheme (from 1998) and were then rolled-out as part of mainstream AES from 2002. A range of studies have looked at seed delivery and bird use of winter bird food delivered as part of AES (e.g. Davey *et al* 2010, Hinsley *et al* 2010b, Field *et al* 2011). They have noted widespread use by the target, declining seed-eaters (and also by certain insectivorous species as well) but also concluded that both seed delivery and bird-use is heavily dependent on how well the plots are established and managed, which is also linked to the extent/quality of advice (Lobley *et al* 2013).

There is good evidence that provision of winter bird food (WBF) can enhance bird abundance at farm and landscape scales. Redhead *et al* (2018) showed significant effects of winter options (mostly) on local seed-eater populations, and the work by Baker *et al* (2012) found that the extent of WBF (and stubble) options delivered by AES were significantly positively linked to the population trends of a number of target species at the 1km-square, 9km-square and 25km-square (i.e. landscape) scales - i.e. the more WBF you had in a Breeding Bird Survey square (and the surrounding squares), the more favourable the population trends of the species most likely to benefit from the option.

Options to provide winter bird food occur in current mainstream agri-environment schemes in England: Environmental Stewardship (ES) and Countryside Stewardship (CS). Options are managed according to a set of prescriptions and a payment is made on the basis of providing the option area and complying with the prescriptions. For example, the Winter Bird Food prescriptions (option code AB9) which are used in the current Countryside Stewardship Scheme are shown below:

- P217 Blocks and/or strips must be at least 6 m wide and a minimum of 0.4ha in size. The maximum individual plot size is 5ha.
- P218 Where the chosen mixture fails to establish, you must re-establish it using one of the re-establishment mixtures specified in the option guidance.
- P1237 Establish a seed mix of cereals, brassicas and other plants producing small edible seeds between 1 March and 15 June to meet the autumn, winter and spring food needs of the following farmland birds if they are targeted in your area: grey partridge, tree sparrow, corn bunting, turtle dove, cirl bunting.
- P1242 To maintain seed production, re-establish every year for annual mixtures and every two years where mixtures include plants that deliver feed over two winters.

Achieving the policy objective to address the decline in farmland birds relies heavily on the successful uptake and management of these scheme options. However, significant variability in the performance of these management options in agri-environment schemes has been documented. The Hillesden experiment showed that if all patches had performed at the maximum, yield would have increased by about 64% and there was a positive relationship between bird counts and seed yield (Hinsley *et al* 2010a). At a farm-scale, winter bird abundance was significantly greater (granivorous species + 415%) when patches were available. Follow up 'aftercare' visits by Natural England (NE) advisers and compliance inspection visits have also highlighted this variability. The study also showed that different farmland birds had a preference for specific seed from different crops. This was also shown in another study carried out by the Game Conservancy Trust (Boatman and Stoate, 2002) illustrated in Table 1.

| | IN ORDER OF PREFERENCE (1-5) | | | | |
|---|---|---|---|---|---|
| **Species** | **1** | **2** | **3** | **4** | **5** |
| Blackbird | Kale (2) | Kale (1) | Quinoa | Cereals | Rape |
| Bullfinch | Kale (2) | Quinoa | Millet | Linseed | Mustard |
| Chaffinch | Kale (2) | Cereals | Quinoa | Linseed | Millet |
| Corn Bunting | Quinoa | Cereals | Mustard | Linseed | Millet |
| Dunnock | Kale (2) | Kale (1) | Quinoa | Cereals | Linseed |
| Goldfinch | Teasel | Linseed | Kale (2) | Quinoa | Rape |
| Greenfinch | Sunflower | Kale (2) | Quinoa | Linseed | Rape/Mustard/Borage* |
| Grey Partridge | Cereals | Kale (2) | Rape | Millet | Quinoa |
| Linnet | Kale (2) | Linseed | Mustard | Rape | Quinoa |
| Reed Bunting | Kale (2) | Millet | Quinoa | Rape | Sunflower |
| Skylark | Linseed | Millet | Kale (1) | Kale (2) | Cereals |
| Song Thrush | Kale (2) | Kale (1) | Quinoa | Rape | Cereals/Millet* |
| Tree Sparrow | Kale (2) | Cereals | Quinoa | Rape | Millet |
| Yellowhammer** | Cereals | Millet | Linseed | Rape | Kale (2) |
| * All of equal importance<br>**As a permanent crop – Yellowhammers show a strong preference for Canary Grass<br>(1) = 1st year kale<br>(2) = 2nd year kale | | | | | |

Table 1: Farmland bird species seed preference (Source: Game Conservancy Trust)

The reasons for this variation in performance can be due to a wide range of factors, e.g. geographic location, seed choice, soil type, soil fertility, establishment techniques, shape and size of plots, seed bed conditions, sowing depth, sowing date, weather conditions, pest and weed pressure, farmer commitment and subsequent management. Most of these factors are within the control of the agreement holder and one way to improve the outcomes would be to increase the standard of crop management. If the level of husbandry and crop management could be improved to match the level on commercial crops elsewhere on the farm, there is likely to be a significant increase in the seed yield of winter bird food plots. This in turn would offer marked benefits to farmland birds, particularly if improvements could be translated at a national scale.

This is the major reason why a winter bird food option appeared suitable for a results based approach. To a large extent, it was assumed that changing from a '*management by prescriptions*' to a '*results based*' approach would inevitably lead to a raising of standards as agreement holders strive to maximise the payments they receive for their winter bird food plots just as they do when growing commercial crops. Whilst this would probably improve the overall standard of crop management, it was important to determine which specific aspects of winter bird food plots needed to be improved in order to increase seed production.

It was agreed that the objective for winter bird food plots under a results based approach would be to reward:

*Plots which have a good cover of seed producing crops that shed their seeds at different times to ensure a plentiful supply of seeds for farmland bird for as long as possible over winter;*

*Plots which included a diverse range of crops that can meet the dietary needs of farmland birds.*

To achieve these objectives it was important to optimise crop cover (to maximize yield potential of sown seed-producing crops) and diversity (to ensure a range of seeds exhibiting different nutritional qualities are sown).

*Wild Pollinator Populations*

Biodiversity loss around the UK has been attributed, in part, to the intensification of agriculture. This has had a detrimental effect on wild pollinators since increased use of pesticides and loss of key landscape features such as hedgerows and floral resources has reduced nesting and foraging sites. Analysis of volunteer collected data has shown a marked decline of rare bees (especially bumblebees) since 1960. The Joint Nature Conservation Committee (Joint Nature Conservation Committee, 2018) estimate that over 34% of pollinator species have declined in the UK since 1987 (Figure 2). This resulted in 7 bumblebee species and 13 other bee species being prioritised for conservation under the UK Biodiversity Action Plan.

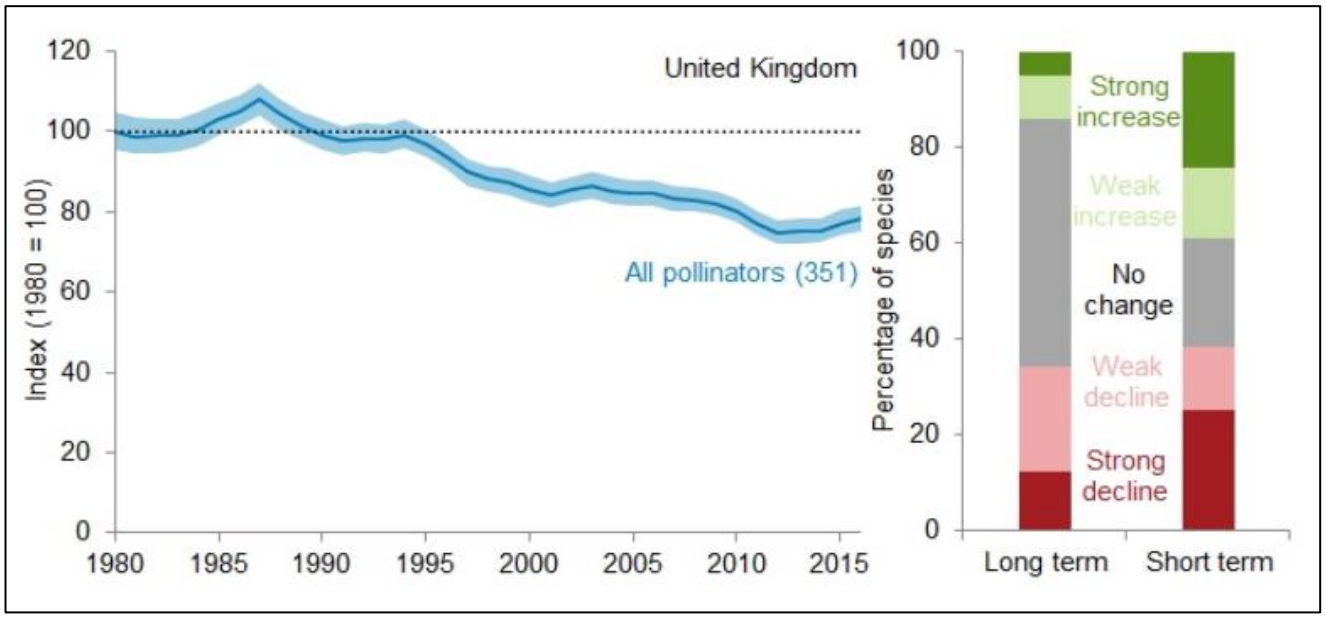


Figure 2: Change in UK pollinator distribution between 1980 and 2016. The line represents the unsmoothed trend based on 351 wild bee and hoverfly species and the shaded area shows the 90% confidence intervals. Source: JNCC, 2018.

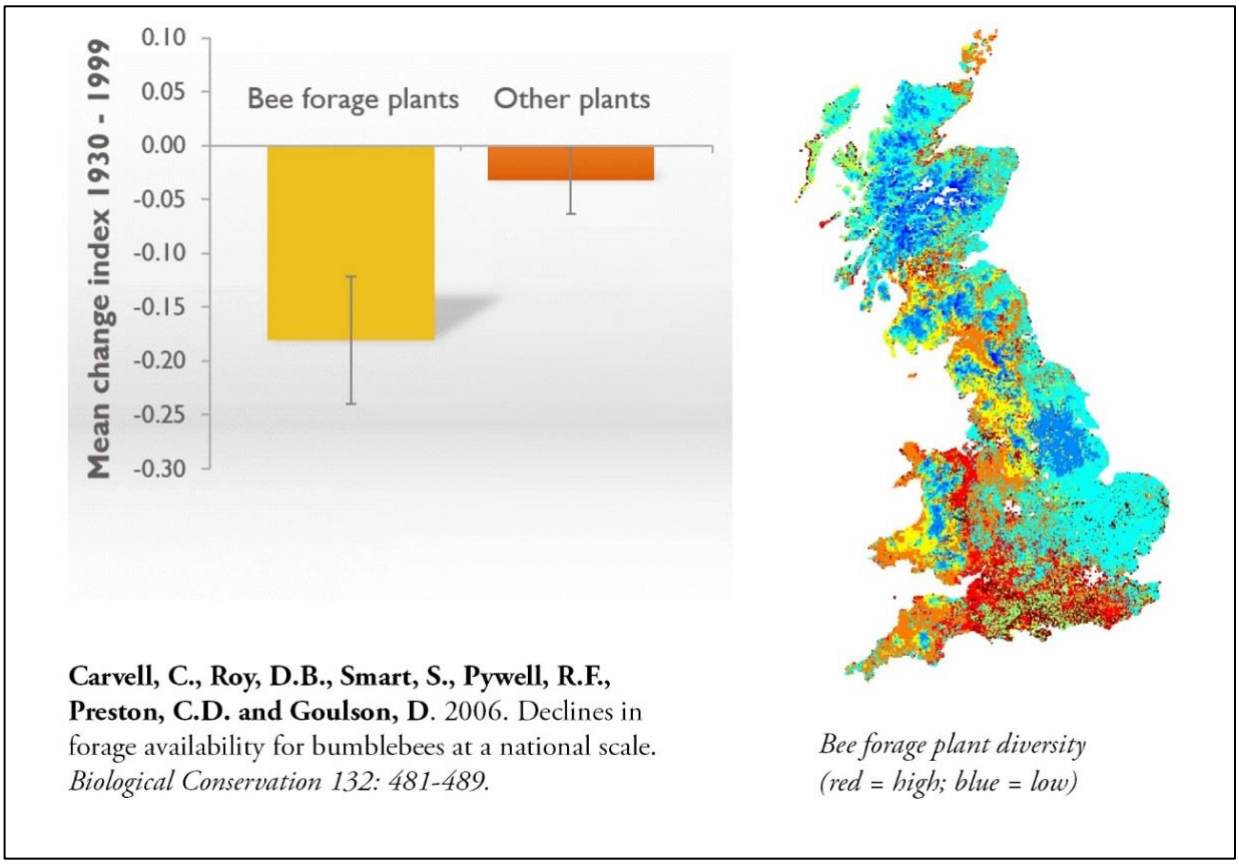


Figure 3**:** Declines in forage availability for bumblebees at a national scale (Carvell *et al* 2006).

One of the main reasons for these population declines is declines in forage availability. With 76% of bee forage plants shown to have declined since 1930 (Carvell *et al* 2006). Pollinator abundance is also highly associated with structural complexity of the surrounding landscape (Redhead *et al* 2016).

Bees have adapted to use a variety of flower types, for example the common carder bee is one of the most frequently seen species of bumblebee in agricultural areas. It is a polylactic feeder meaning it forages on many different types of flowers, however its long tongue means it is specially adapted to feed on flowers which have long corollae such as red clover so shows a preference for flowers in the families Fabaceae and Scrophulariacae (Wood *et al* 2015). Research by Carvell *et al* (2007) concluded that that bumblebee survival is dependent on high quality habitat, particularly semi-natural vegetation and flower cover. Wood *et al* (2015) demonstrated that more flower species is positively associated with more bee species, really good evidence that wildflowers are important for supporting the solitary bee community too. Work by Carvell *et al* (2011) and Redhead *et al* (2016) demonstrated that newly created pollinator habitats delivered greater benefits to bees in intensively farmed areas than diverse landscapes where other foraging habitats exist. Bumblebees forage closer to their nests in farmland with higher proportions of flower rich habitats.

The research detailed in the previous section has been integral to the development of mainstream agri-environment measures to create habitats in the farmed landscape containing bee forage plants. This has included using a range of reliable, commercially available plant species, including red clover, knapweed and birds-foot trefoil, to form the core of the new agri-environment prescriptions for insect pollinators. Both Environmental Stewardship (ES) and Countryside Stewardship (CS) have options which provide pollen and nectar for pollinators. For example, less intensive management of hedges and cultivated margins can provide pollen and nectar in early spring. During the summer, pollen and nectar on arable farms is typically provided by floristically enhanced grass buffer strips or through nectar flower plots. The former tends to be longer lived habitat whilst the pollen and nectar plots are relatively simple mixes containing agricultural cultivars of herbaceous legumes and flowering perennials and may only last 3-5 years. These options are managed according to a set of prescriptions and a payment is made on the basis of providing the option area and complying with the prescriptions. The Nectar Flower Mix (Option AB1) prescriptions which are used in CS are shown below:

- P149 Establish a mixture of at least four nectar-rich plants and at least two perennials from the list in the "How to carry out this option" section. Establish in blocks and/or strips between 15 March and 30 April or 15 July and 30 August.
- P152 Rotationally cut 50% of the plot area each year between 15 April and 31 May. Do not cut the same area in successive years.
- P154 Cut the whole area between 15 September and 30 March, removing or shredding cuttings to avoid patches of dead material developing.
- P155 Do not graze between 15 March and 31 August.
- P706 Keep a monthly record of stock numbers grazing on parcels in this option. Make the record available on request.

Agri-environment schemes have been shown to increase pollinator abundance and richness in arable areas (Wood *et al* 2015) as they are effective at improving the heterogeneity of the landscape and provide foraging resources. However, significant variability in the performance of EF4/HF4 plots within ES agreements has been observed (Hinsley *et al* 2010b, Mountford and Cooke, 2013). In addition, aftercare visits by NE advisers and compliance inspection visits have highlighted significant variability in the condition of nectar flower mixes plots with some producing very little pollen and nectar.

The reasons for this variation can be due to a wide range of factors, e.g. site selection, seed choice, soil type, establishment techniques, plot shape and size, pest and weed pressure, excess soil fertility, seed bed quality, sowing depth, sowing date, weather conditions, farmer commitment and subsequent management in the first 12-24

months after sowing (when high populations of competitive arable weeds can dominate to the expense of the sown flower species). However, the two main issues tend to be:

- A decline in sown flower species from year 3/4 onwards largely as a result of weed ingress and short persistence of some flower species (e.g. agricultural cultivars of red and alsike clover);
- Deteriorating plots are not re-established frequently enough. This is particularly the case in Higher Level Stewardship (HLS) agreements which are 10 years in duration and where plots often perform well for the first 4-5 years and then decline rapidly thereafter (in terms of pollen and nectar provision) if they are not re-sown.

To a large extent these issues are within the agreement holder's control and can be overcome through better establishment and subsequent management. For instance, where agreement holders select seed mixtures containing a number of flower species that can persist within swards for longer (e.g. common knapweed, yarrow, musk mallow and wild carrot), it is possible to deliver nectar flower mix plots that continue to deliver pollen and nectar when pollinators require it over an extended period of time (i.e. >5 years). In addition, choosing sunny south-facing plots with low fertility and weed pressure can also increase the establishment success and long-term performance of nectar flower mix plots.

This potential uplift in plot performance could be achieved by several means such as providing better and more intensive advice and/or implementing more inspection visits where agreement holders are penalised for sub-standard plots. Alternatively, a results based approach may achieve the same objective aligning the management of nectar flower plots with conventional crops. It is assumed that introducing a competitive element as well as linking payments to the outcomes is likely to raise standards and produce better nectar flower plots which benefit pollinators.

Research has shown that different pollinators; bees and wasps (Hymenoptera), flies (Diptera), butterflies and moths (Lepidoptera) and beetles (Coleoptera) require a wide range of pollen and nectar sources (Wood *et al*, 2015). In addition, different species within the same group have specific food plant preferences. For instance, the Buzz Project showed that 5 species of bumble bees visited a wide range of plant species and each of the 5 species had different preferences. Therefore, it was agreed the objectives for a payments by results approach on pollen and nectar plots would be to incentivise:

*Plots which had good crop cover of flowering plants minimising the amount of bare ground and grasses.*

*Plots with a wide range of different flowering species which produced pollen and nectar attractive to a wide range of pollinators at different times of year.*

By making these two key objectives fundamental to a payments by result approach and making payments based on the quality of the plots, it was hoped that agronomic management would improve accordingly.

### *Grassland Farming Systems*

Hay meadows and breeding waders were selected as the focus for the pilot in grassland due to their conservation status, strong presence within the pilot area and vulnerability to changes in agricultural management. For both objectives a set of key attributes were identified to describe good condition in either habitat restoration or maintenance situations. The attributes were identified and refined following a literature review and consultation with farmers and stakeholders. They formed the basis for setting an over-arching objective for each habitat which described in a simple way the desired outcome and was meaningful for the farmer; this was seen as important because it removed ambiguity and presented a clear statement.

*Breeding waders - background*

At present, 10% of European bird species are considered to be of global conservation concern, and are listed as Threatened or Near Threatened on the IUCN Red List (EC 2018). This includes the Eurasian Curlew and the Northern Lapwing – both classified as Near Threatened. Common Redshank and Common Snipe are both Amber listed species for the UK. Population declines of Eurasian curlew, common snipe, Northern lapwing and common redshank are well documented in the United Kingdom (UK) (Table 2). However, a recent report into the wild bird population trends within the Yorkshire Dales National Park (YDNP) appear to show these species are stable, and for Northern lapwing, increasing – bucking the national trend (de Palacio, Court & Harris 2018). This is replicated within other adjacent parts of the northern uplands of England making it one of the most important areas for breeding waders within the England.

| BOCC species | IUCN status | UK status | % decline over past 25 years | Dependent on upland habitats for breeding | Selected as RBAPs target |
|---|---|---|---|---|---|
| Eurasian curlew *Numenius arquata* | Near Threatened | Red | 46 | Y | Y |
| Northern lapwing *Vanellus vanellus* | Near Threatened | Red | 57 | Y | Y |
| Common redshank *Tringa totanus* | Least Concern | Amber | 44 | Y | Y |
| Common snipe *Gallinago gallinago* | Least Concern | Amber | 31 | Y | Y |

Table 2: Status of upland breeding waders (Eaton *et al* 2015)

'Biological resource use', and 'agriculture and aquaculture' are listed as the top threats (according to the IUCN Threats Classification Scheme) to European bird species, including those on the European Red List (threatened)(Figure 4). Agricultural threats relate to changes in land-use practices, including both intensification of agriculture and land abandonment, which are behind the dramatic declines in farmland bird species observed since the 1970s (Donald *et al* 2001, Stoate *et al* 2009) and continue to pose an important threat today..

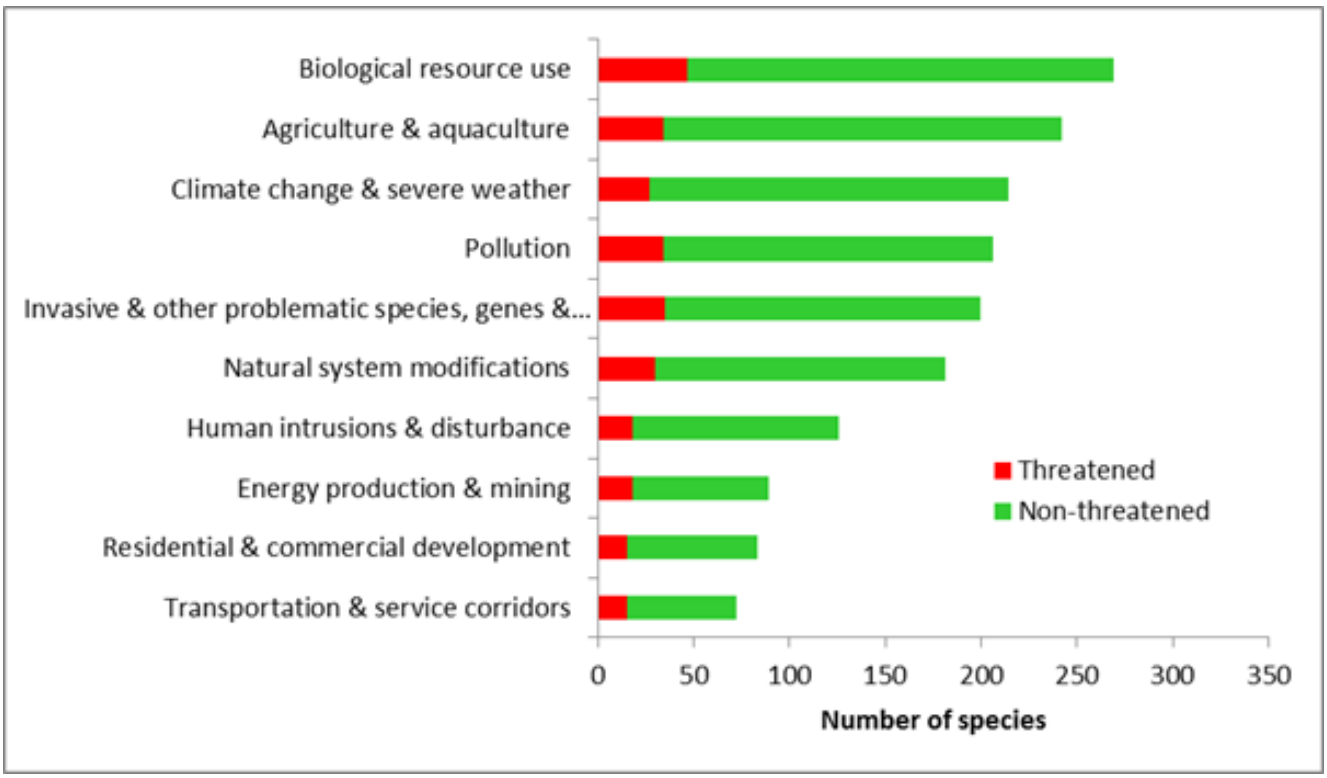


Figure 4: Summary of the relative importance of the different threats recorded for birds in Europe (After Birdlife International, 2015 p25).

The in-bye or moorland fringe of the uplands is an important area for these four breeding wader species. The moorland fringe is a transitional area, resulting in a mosaic of habitats. It contains the majority of the breeding wader population due to its diverse habitat and structure of rush pasture, rough acidic allotments, species rich grassland and improved grassland. The fringe acts as a natural extension of the upland moorland habitats. The waders utilise the moorland fringe in spring and summer for breeding and rearing offspring. Their breeding success relies on a number of factors including weather conditions, impact of predators and crucially, farming practices. The management of the moorland fringe by farmers is therefore instrumental in creating a connected mosaic of habitat types that the four bird species require – from semi improved grass pastures through to acidic rough grazing pastures.

For breeding waders, the biodiversity goal of the project was to encourage results that would support continued stability in the breeding populations of Eurasian curlew, Northern lapwing, common snipe and common redshank. The objective for breeding waders was:

*'To provide suitable and sufficient feeding, nesting and chick rearing habitat for the four key breeding waders in the uplands (Eurasian curlew, Northern lapwing, common snipe and common redshank).'*

To achieve the objective the land management needed to focus on providing the right habitat conditions for breeding waders throughout the entire breeding season. This ensured the sites are suitable for returning adults – both for feeding and breeding as well as being suitable for rearing and fledging chicks. By fulfilling all habitat requirements over the duration of the breeding season higher numbers of chicks would be reared to the fledged stage, therefore increasing or stabilising the wader population.

*Hay meadows*

For hay meadows the focus was on encouraging both the maintenance of species-rich meadows and restoration of meadows to a more species-rich condition. The objective for species rich meadows was:

*'To maintain or enhance the diversity of plant species within hay meadows through sustainable agricultural management'.*

The objective sought to halt the decline of species rich meadows and encourage maintenance and restoration. Encouraging the retention, restoration and enhancement of meadows is likely to improve linkages between the existing species rich resource, de-intensify grassland management and provide knock-on environmental benefits e.g. for pollinators and reduced nutrient flows to water courses. At the core of the objective is the reference to species diversity, as the key indicator for species rich grasslands such as upland hay meadows is the range of species which they contain. The objective was designed to ensure species diversity was retained and / or enhanced, depending on the initial (baseline) quality of the grassland at the beginning of the project.

To achieve this objective the land management needed to focus on creating the optimum conditions for the plant species which are indicative of upland hay meadows to flourish. This would include consideration of all aspects of the seasonal use of the meadow, taking into account soil indices, nutrient inputs, livestock carrying capacity, weed control, methods of harvesting and potential species introduction.

# Locations

The following section provides background and context for the locations selected for the pilot project.

### *Arable - East Anglia, Norfolk and Suffolk*

The original proposal was to focus the pilot area within three National Character Areas[2](NCAs) – Central North Norfolk (78), Mid Norfolk (84), and South Norfolk & High Suffolk Claylands (83) illustrated on Figure 55. These form a cohesive geographical unit covering parts of Norfolk and Suffolk in East Anglia.

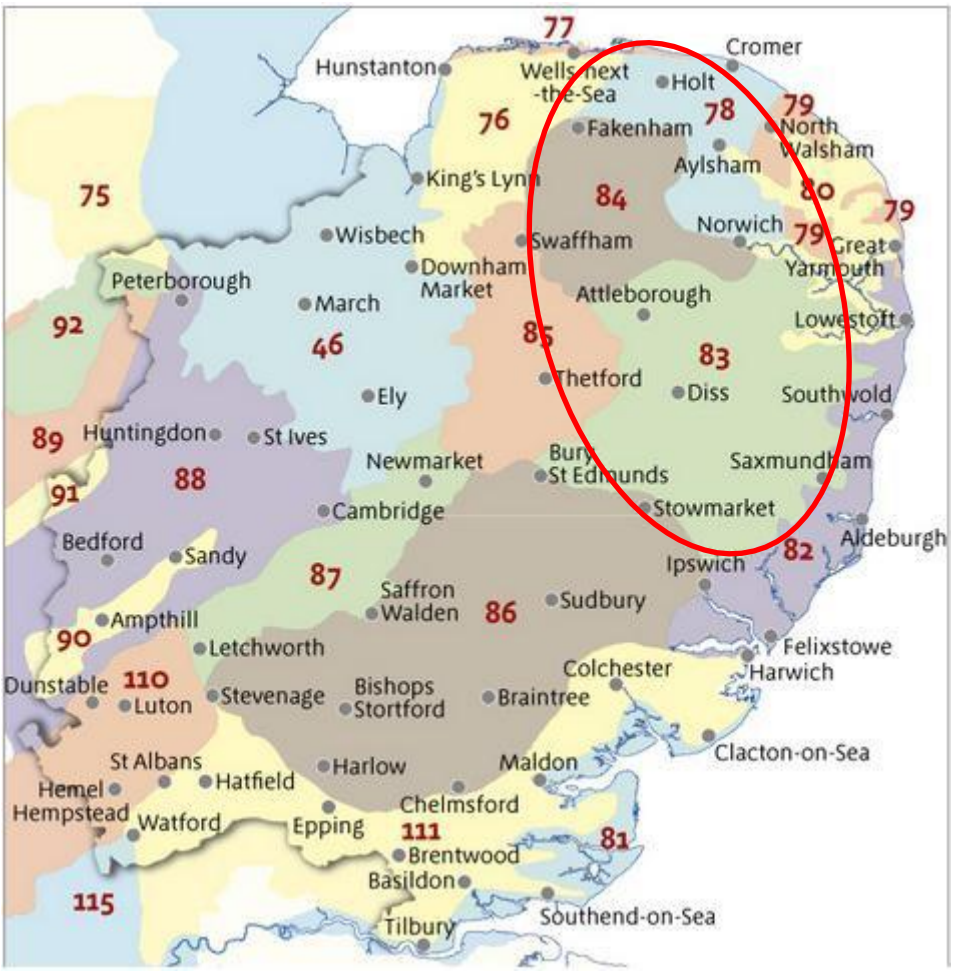


Figure 5. Proposed pilot boundary and NCA landscape character areas in the East of England region.

However, following further refinement and reflecting the budget available for the project it was decided to offer agreements within a slightly smaller area as shown in 6.

[2] Full character area profiles for these three areas can be found at https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles#ncas-in-the-east-of-england


Figure 6. Final boundary of arable pilot.

This area predominately sits within the South Norfolk and High Suffolk Claylands (NCA 83) with a small area of (NCA 84 and 85 – The Brecks). The South Norfolk & High Suffolk Claylands is contiguous with the Mid Norfolk NCA and forms part of the East Anglian Plain. It has a relatively flat topography, dissected by streams and river valley corridors. Soil type is variable but is dominated by boulder clay. This can be very productive but also difficult to work. The area is largely agricultural with arable cropping forming the main activity. Cereals, oilseed rape and other combinable crops are the main cropping enterprises with lower amounts of sugar beet on the lighter land. Mid Norfolk and The Brecks share many landscape characteristics and features and are closely linked. Land cover in both NCAs is predominantly agricultural with extensive arable land and some grassland along the valley floors. Cereals dominate the cropping with break crops of sugar beet, oilseed rape, pulses and localised areas of potatoes. The soil type across both NCAs varies from light loamy sands to heavier sandy clay loams.

The intensive nature of the arable cropping in the area is potentially one factor for the loss of habitat for both farmland birds and wild pollinators. Therefore the successful establishment and management of wild bird seed and nectar plots are essential for the survival of farmland birds and wild pollinators.

There are numerous Natura 2000 (N2K)/Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protected Areas (SPA) and RAMSARs in all three NCAs. The pilot area is a national 'hot spot' for both important farmland bird species and wild pollinators. Target farmland bird species present include corn bunting, grey partridge, tree sparrow, turtle dove and yellow wagtail. The area also contains at least 7 of the 12 target pollinator species. Existing AES agreements in the area contain considerable areas of scheme management options targeting farmland bird and pollinator objectives as follows:

| **Environmental Stewardship Scheme National Landscape Character Areas (NCAs)** | **Pollen and Nectar Flower Mix (ha)** | **Winter Bird Food (ha)** |
|---|---|---|
| Central North Norfolk (78),<br>Mid Norfolk (84)<br>South Norfolk & High Suffolk Claylands (83) | 641 | 1,311 |

Table 3: Uptake of Pollen and nectar flower mix and winter bird food management options in Environmental Stewardship (Source: Natural England 2016).

There has been extensive monitoring, particularly of farmland bird population responses to agri-environment scheme agreements including winter bird food options, for example a study between 2008 and 2014 looked at 3 regions, one of which included the pilot area, and reported positive responses to scheme management for some species (Bright *et al* 2015, Walker *et al* 2018). Positive responses to scheme management for some pollinator species have also been reported, for example see Wood *et al* 2015, although not from studies in this area.

### *Grassland – Wensleydale, North Yorkshire*

The Yorkshire Dales National Park (YDNP) situated in the Pennine uplands of England, is a landscape of high, exposed moorland dissected by sheltered valleys or dales containing intricate patterns of walled fields, meadows, scattered stone field barns, areas of sparse woodlands and limestone karst features.

The National Park area contains multiple Global, European and National habitat designations. In particular it contains part of the North Pennines Special Protection Area designated to protect the range of moorland birds found in the area and part of the North Pennines Special Area of Conservation for northern upland hay meadows. It has 19% of England's upland hay meadows and is an important breeding ground for Eurasian curlew (*Numenius arquata*) and Northern lapwing (*Vanellus vanellus*).

Within the YDNP, the area for the pilot on grassland habitats was narrowed down to Wensleydale as it is typically representative of the National Park. The pilot area encompassed the catchment of the River Ure within the YDNPA (Figure 7). Farmers within Wensleydale have participated in high numbers with management based agri-environment schemes since 1987 when the first Environmentally Sensitive Area (ESA) scheme was launched in the Pennine Dales. The area contains significant proportions of habitats and species of high conservation value which have traditionally been targeted by agri-environment schemes in England – in particular upland and lowland hay meadow and breeding waders as it is one of the most important areas of the National Park for these birds.

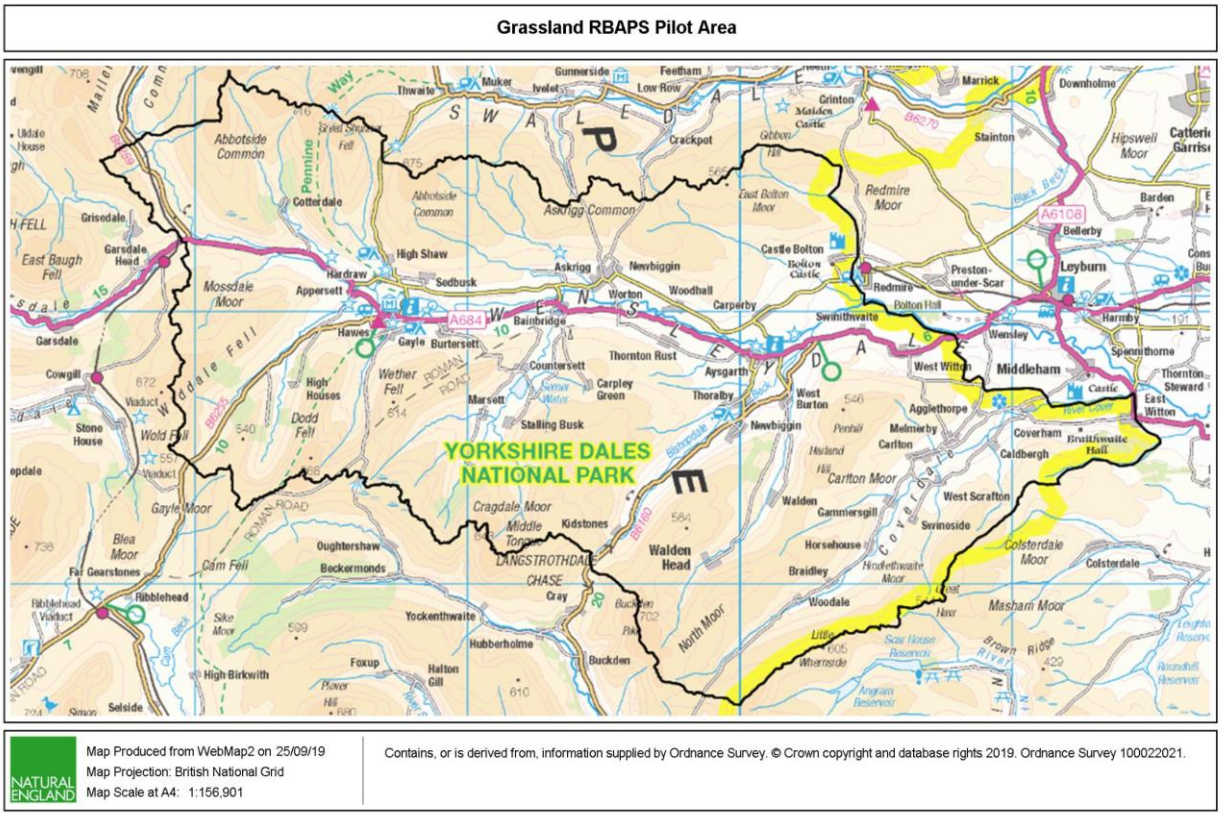


Figure 7: Grassland RBAPS Pilot Area

Wensleydale extends to 506km² and contains approximately 330 registered farmers. The pilot area is predominantly upland classified by Defra as Less Favoured Area (LFA) and either as Disadvantaged in the valley bottom or as Severely Disadvantaged on the steeper valley sides and higher unenclosed moorland. There is a mix of livestock farming within the upper dale, ranging from sheep and beef to sheep and dairy. Further downstream within Wensleydale, dairy farming and small pockets of mixed arable farming take place. The area is closely associated with dairy farming with a history dating back for many centuries. Today the dairy industry continues largely due to the success of the Hawes Creamery which produces Protected Geographical Indication (PGI) status Wensleydale Cheese; it is this cheese production from milk sourced within Wensleydale and the surrounding area that has ensured the survival of dairy farming within this part of the National Park.

A traditional hill farm in the Yorkshire Dales will use pastures near the farmstead (the 'in-bye') and enclosed rough grazing allotments of the moorland fringe to provide seasonal grazing for livestock being moved up and down the hill in spring and autumn. The adjacent moor is used for grazing during the summer. The enclosed rough grazing will be grazed by both beef cows (or drying off dairy cows) and 'hardy' sheep of hill breeds such as Swaledales.

The in-bye is an essential part of the hill farm system and is possibly the area under the most pressure from changes to traditional grazing practices. Within Wensleydale there has been a slow intensification on some of the more accessible grasslands compared to those in other dales within the National Park due to the more favourable topography. Productive silage fields with high fertiliser inputs and multiple cuts have replaced traditional hay meadows which has led to fragmentation of species rich grasslands and a loss of species diversity (Pinches *et al* 2013).

Between the 1950s and 1970s, much of the enclosed rough grazing land was drained to try and increase production in a post-war Britain. Coupled with increases in sheep numbers during the 1980s and a gradual decline in cattle numbers, particularly post Foot and Mouth Disease in 2001, there has been a steady decline in

biodiversity of the wet moorland fringe habitat (Krebs *et al* 1999, Stoate *et al* 2009). Between 1990 and 1998 the uplands of England and Wales exhibited greater levels of land-use change than lowland zones (Haines-Young *et al* 2003). Agricultural land management resulted in a 7% increase in the area of improved grassland, indicating a continuation of agricultural intensification in the uplands.

*Habitats and Species*

The Wensleydale area contains three important areas of Annex 1 designated habitats and features as defined by the European Union Habitats and Species Directive. Figure 8 shows the distribution and type of designation. Of most significance is the North Pennine Moors SPA/SAC covering 5,688 ha of the pilot area. This area equates to 5.5% of the SAC/SPA designation.

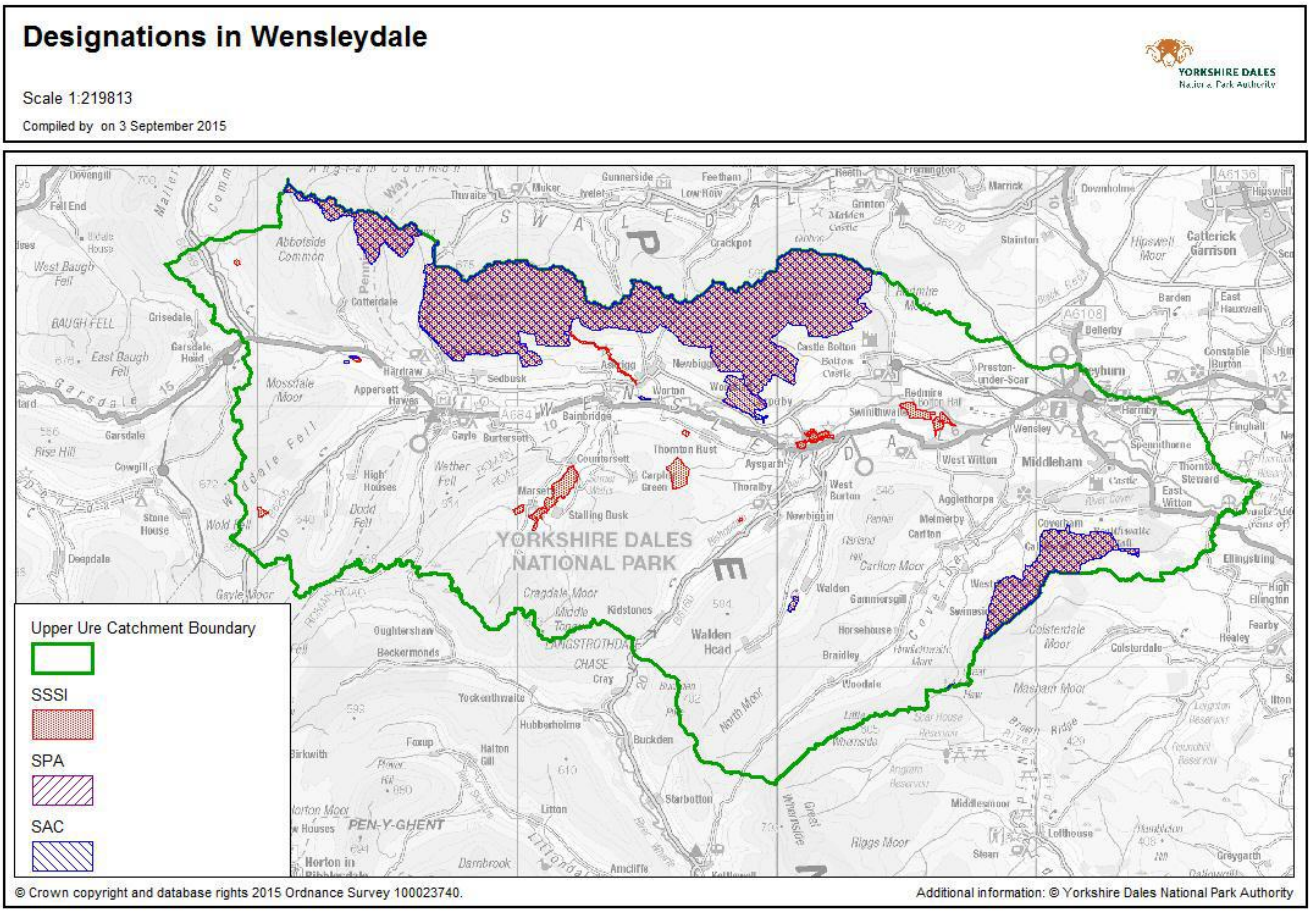

Figure 8: Key environmental designations in Wensleydale.

A recent assessment of biological data gathered from local and national sources found the area to be home to 21 UK priority species, including Eurasian Curlew and Northern lapwing. Survey work has shown that the YDNP supports nationally important numbers of breeding Northern lapwing and Eurasian curlew: up to 2,900 pairs of Northern lapwing and 2,500 pairs of Eurasian curlew were recorded on moorland areas during the early 1990s and up to 1,500 pairs of Northern lapwing and 1,500 pairs of Eurasian curlew were found on enclosed grassland in 2000 (Shepherd 2000). Seventeen UK priority habitats including northern upland hay meadows, blanket bog and upland calcareous grassland are also present in the area – see Table 4.

| UK Priority Habitat[1] | Local datasets[2] | | YDNP resource (Ha) | Proportion of YDNP resource in project area (>29% = significant[3]) |
|---|---|---|---|---|
| | Project area resource (Ha unless stated) | % Project Area | | |
| Blanket bog (M06) | 8547 | 16.8 | 35029 | 24 |
| Calaminarian grassland (G10) | 36 | 0.1 | 370 | 10 |
| Inland rock outcrops & scree - Limestone (M07a) | 43 | 0.1 | 433 | 10 |
| Inland rock outcrops & scree - Acidic (M07b) | 8.5 | 0.0 | 183 | 5 |
| Limestone Pavement (L01) | 10.5 | 0.0 | 2051 | 1 |
| Calcareous grassland - lowland (G04) | 95 | 0.2 | 379 | 25 |
| Calcareous grassland - upland (G08) | 1277 | 2.5 | 8666 | 15 |
| Fens (W04) | 22 | 0.0 | 130 | 17 |
| Hay Meadows - Lowland meadows (G06) [4] | 511.6 | 1.0 | 1121 | 46 |
| Hay Meadows - Upland Meadows (G09)[4] | 195 | 0.4 | 970 | 20 |
| Lowland Raised Bog (W05) | 0 | 0.0 | 38 | 0 |
| Mesotrophic Lakes (W06) | 25 | 0.0 | 91 | 27 |
| Native Woodland (T11, T12, T13) | 203.5 | 0.4 | 1371 | 15 |
| Ponds (W07) | 3.4 | 0.0 | 20 | 17 |
| Upland flushes, fens and swamps (M08a & M08b) | 1068 | 2.1 | 2562 | 42 |
| Purple moor-grass & rush pasture (G07) | 11.3 | 0.0 | 178 | 6 |
| Upland Heathland (M04) | 2142 | 4.2 | 11018 | 19.4 |
| Rivers & Streams (km) [5] | 1231.9 | - | 2969 | 41 |
| Hedgerows (km) | 57.4 | - | 110.7 | 52 |
| Ponds[6] | 12.4 | 0.02 | 54 | 23 |

| Other habitat | Project area resource (Ha) | % Project Area | YDNP resource (Ha) | Proportion of YDNP resource in project area (Over 29% is significant) |
|---|---|---|---|---|
| Ancient Woodland Inventory | 332.9 | 0.7 | 2102 | 16 |
| Montane [7] | 1499.2 | 3.0 | 7316 | 20 |

**Notes:**

[1] Including mosaics

[2] Consisting of YDNPA, NT and YWT data

[3] Project area as a proportion of YDNP is 29%

[4] Consisting of meadows and pastures. When G06 and G09 are combined the totals are as follows: Project resource 706.6 Ha, Percentage of project area 1.4%, YDNPA resource 2091 Ha and proportion of YDNP resource in project area 34%

[5] Based on Water Framework Directive definition

[6] Based on size criteria for BAP only ≤2Ha (data regarding condition not currently available)

[7] Montane habitat - Climate Change Adaptation Manual definition used as follows: Q OS contours >=600m. (Verified by the presence of BSBI records for *Carex bigelowii* and *Salix herbacea* records)

Table 4: UK priority habitats within the Wensleydale pilot area (Source: Yorkshire Dales Rivers Trust and YDNPA, 2015).

There are approximately 661 ha of species rich hay meadow within the pilot area incorporating both lowland and upland types (Yorkshire Dales Rivers Trust and YDNPA, 2015). This represents an important proportion of the total hay meadow resource within the YDNP, 46% of the lowland hay meadow habitat and 20% of the upland hay meadow network. Figure 9 shows the distribution of hay meadows within the Wensleydale Project area.

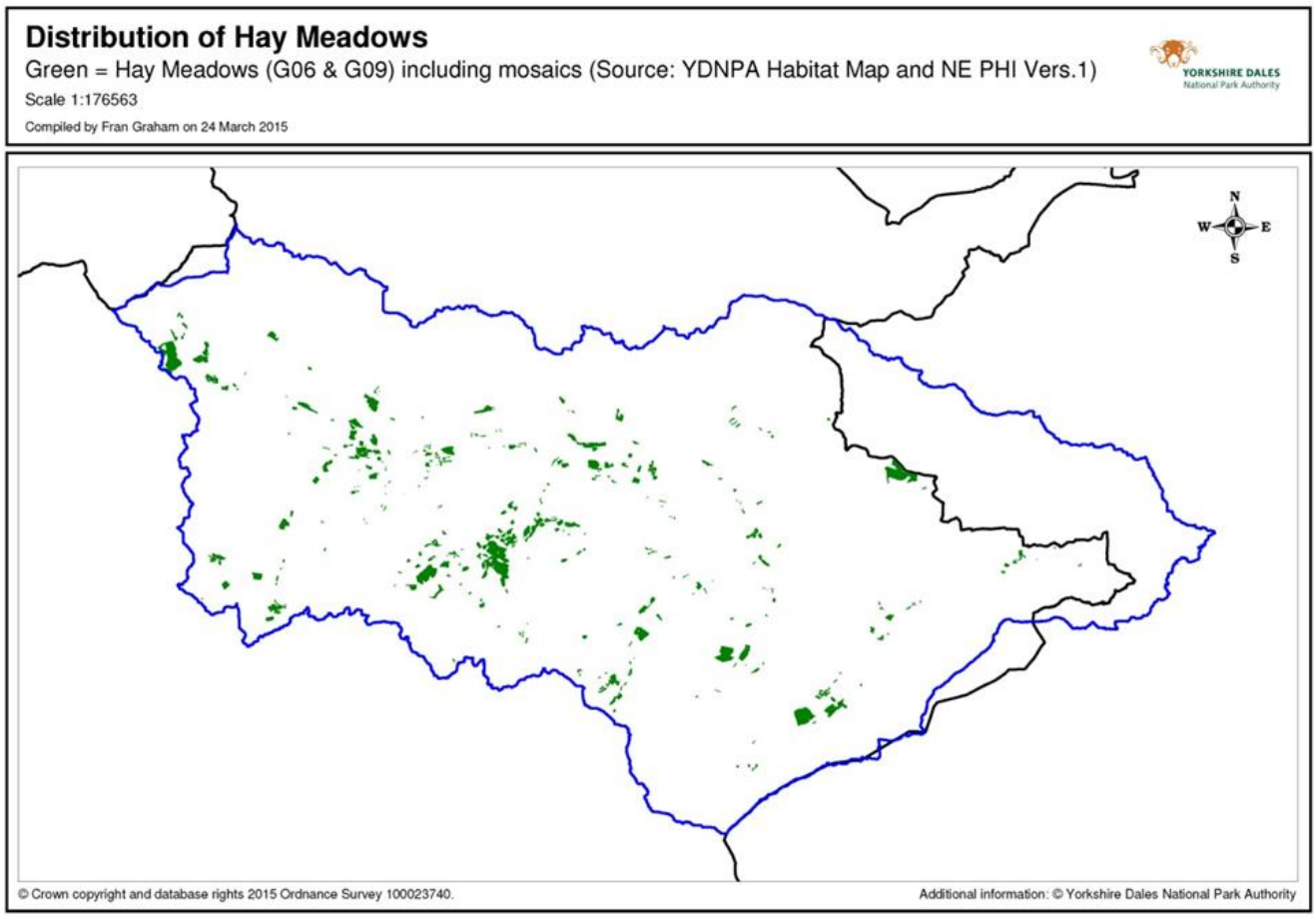


Figure 9. Distribution of Lowland hay meadows (G06) and Upland hay meadows (G09) recorded in baseline surveys for ES and CS applications within the RBAPS grassland pilot area.

The terms “upland” and “lowland” hay meadows are not exact in their definitions. In Wensleydale some meadows incorporate both types. In addition meadows which lie over bands of calcareous soils support plants not normally associated with meadows such as Salad burnet (*Sanguisorba minor)*, Orchids and Bedstraws. The best examples can contain over 30 species per square metre and some have up to 120 species per field.

Upland or northern hay meadows (National Vegetation Classification community MG3, *Anthoxanthum odoratum – Geranium sylvaticum* grassland) are an Annex 1 habitat under the EU Habitats Directive (1992) and are one of the rarest grassland types in the UK. Recent estimates indicate that there are 900ha of the habitat remaining in the UK (North Pennines AONB 2018). Upland hay meadows are characterised by a suite of species including sweet vernal-grass (*Anthoxanthum odoratum*), wood crane’s-bill (*Geranium sylvaticum*), pignut (*Conopodium majus*), great burnet (*Sanguisorba officinalis)* and lady`s mantles (*Alchemilla spp.)*. They also provide an important feeding habitat for a wide range of bird and insect life. They are confined to areas with a history of non-intensive hay-meadow management at 200-400m altitude in the upland valleys of northern England and Scotland (YDMT 2012).

Hay meadows are precious not only in biodiversity terms but because they provide an important link to the socio-economic and cultural past of the area. They are a semi-natural habitat, having evolved as a by-product of a farming system that relies on management by people year-in, year-out. Every hay meadow has a unique management history which depends upon its location relative to the farmstead, its aspect and altitude. These

differences mean that each hay field will have been cut at a different time each year – fields closer to the farm will have tended to have been cut earlier, those at a higher altitude later. Fields closer to the farm would also be more likely to receive inputs such as farmyard manure and lime than those further away. Diaries held by farmers within Swaledale that go back more than 50 years illustrate the full range of dates these activities occurred on, which were principally guided by the weather conditions in Spring and Summer. Over the generations, these slight differences in management will have resulted in fields with subtly different suites of species, each representing a unique 'fingerprint' of the field's management history. The persistence of traditional management practices in the area, coupled with the presence of national agri-environment schemes since the 1990s have undoubtedly prevented the complete loss of hay meadows that has occurred in other parts of the country as a result of ploughing, re-seeding, fertilisation and drainage.

Nonetheless, the hay meadow resource in the area is declining in quality and extent, albeit at a slower rate than nationally. Surveys undertaken by the North Pennines Area of Outstanding Natural Beauty (AONB) Partnership since 2006 indicate that many formerly species-rich meadows have lost their key indicator species such as wood crane's-bill. Wetter meadows are tending to be dominated by one species, marsh marigold. In addition rush cover is on the increase and soils are becoming more acidic – potentially from atmospheric deposition of nitrate which adds nutrients, affecting species diversity. Old field drains are collapsing due to age and the use of modern farming machinery and a wetter climate has led to problems with soil husbandry and nutrient leaching (Starr-Keddle, 2014).

*Agri-environment Schemes (AES)*

Since 1987 with the introduction of the Pennine Dales Environmentally Sensitive Area (ESA) agri-environment scheme (AES), biodiversity within Wensleydale has been a priority for AES focussed on prescribing specific management regimes and providing separate grants for capital works. The ESA was the first of its kind, developed to conserve the important features of a particular landscape – within the Pennine Dales this was upland hay meadows, field barns, dry stone walls, in-bye pastures and rough grazing ('allotments'). Subsequent AES have continued to support conservation management of the in-bye through incentivising changes in management regimes and encouraging retention of cattle. This has largely had a positive effect on habitat quality and biodiversity but also, in some cases has led to a reduction in habitat quality due to under-grazing.

Uptake of AES options that benefit breeding waders and species rich meadows has been high within Wensleydale, particularly under the Environmental Stewardship (ES) scheme (2005 – 2015). During the RBAPS project, the Royal Society for the Protection of Birds (RSPB) and British Trust for Ornithology (BTO) have undertaken a survey of breeding wader populations of in-bye farmland. Results show a positive association between AES options for grazing and habitat restoration and breeding wader numbers – particularly Eurasian curlew (de Palacio *et al* 2018).

A review of RDP funded AES in 2015 found that 80% of the registered farmers within Wensleydale had some form of AES (predominantly Environmental Stewardship). The scale of agreement coverage within the pilot area was high at 70% of the total utilisable agricultural area (UAA) area as agreements could cover the whole farm (although not all the farm would necessarily be under a management option). The Environmental Stewardship (ES) scheme closed to new applicants in 2015 and as agreements last either 5 years (Entry Level Stewardship) or 10 years (Higher Level Stewardship) the area under ES is declining as agreements expire. Of the 264 ES agreements live in 2015 within Wensleydale, 132 (50%) would end by 2018. Table 5 shows the number of expiring Entry Level Stewardship (ELS) and Higher Level Stewardship (HLS) agreements each year.

| | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** |
|---|---|---|---|---|---|---|---|---|---|---|
| ELS | 60 | 24 | 47 | 18 | 5 | 0 | 0 | 0 | 0 | 0 |
| ELS/HLS | 0 | 0 | 1 | 2 | 0 | 13 | 20 | 21 | 8 | 45 |

Table 5: Number of expiring Environmental Stewardship agri-environment agreements in Wensleydale (Source: Magic website 2016)

Countryside Stewardship (CS) replaced ES after 2015. CS is more targeted and is not intended to have the same level of uptake as ES both in terms of numbers of agreements or area as it is not a whole farm scheme. However uptake has been lower than anticipated. The resulting picture is that after nearly 30 years of significant farmer participation, Wensleydale is experiencing a substantial drop in AES coverage. For example, of the 84 AES agreements that came to an end in Wensleydale between 2015 and 2016, only 11 renewed into a new agreement. This reduction in mainstream scheme coverage provides an opportunity for piloting RBAPS in this area which would previously have been extremely difficult.

# Design and Implementation

This section details the overall experimental design, detailed design of the arable and grassland results measures and associated payment rates and aspects related to the implementation of the project. The design proposals were subject to independent peer review and adjusted accordingly.

## Arable Design

### *Exploration*

Due to the timing of the development stage of the pilot, at a peak of fieldwork for arable farmers, there was limited opportunity to run workshops for farmer engagement. However, the personnel working on the pilot for Natural England collectively had over 80 years of experience of arable farming systems so felt well placed to make initial suggestions for design.

These initial suggestions were then tested with stakeholders. A workshop was held to discuss the results criteria attended by representatives from the seed industry and those involved in on farm advice supporting the delivery of the two pilot objectives. The agenda covered:

- What does payment by results look like
- Background to project and arable pilot
- Measuring results including controls
- Payment steps – how many, how big a step

Discussions focused on establishing the minimum performance level required and the need to link performance of a plot to the outcome i.e. increase in bird numbers. The importance of training and advice was highlighted and how this could be delivered e.g. peer to peer and online. There was a strong desire to keep it simple and not spend so much time monitoring that the delivery aspect was lost. Following the meeting feedback was sought individually from those attending on the structuring of the payment rates, eligibility criteria and assessment criteria. Feedback from the external peer review led to further refinement of the proposals.

### *Development and Testing of Results Metrics*

*Winter Bird Food*

Under the current Environmental Stewardship (ES) and Countryside Stewardship (CS) schemes, the prescriptions stipulate what can and cannot be sown. However, this approach still results in variable winter bird food (WBF) plots and still permits the use of certain crop species even if their seed value is not proven. Some species (e.g. chicory, dwarf sorghum or Japanese reed millet) can also become very dominant to the detriment of desirable seed-producing crops such as gold of pleasure, linseed, mustard, quinoa and white millet. At low levels these taller, more competitive structural crops may be useful to farmland birds as they can provide cover over winter, perch points for some species such as the corn bunting, and help support weaker standing plants such as red millet. A problem can arise when these structural crops are included at too high a rate.

When developing the results it was agreed there needed to be a way of avoiding specific lower value crops and the initial idea was to define a list of eligible seed species and negative species. Feedback following the independent review resulted in an approach focused solely on positive result measures on the basis that achieving positive results would necessitate low levels or absence of negative species. A revised approach was

developed listing the eligible crops in the results criteria so that only these crops would 'score' and be used to calculate the payment rate. There would be nothing to prevent agreement holders from including 'non-scoring' crops which may have a low seed value for farmland birds but in doing so they would run the risk of getting a lower score and thence reduced payment rate. The final choice of eligible crops was based on the crops permitted under the current ES and CS schemes along with the research papers referenced in the Background section. The major exception from the list is kale which is a biennial and only flowers and sets seed in its second year. The main reason for this exclusion was the perceived difficulty in assessing second year WBF plots dominated by kale. Such plots often contain few or no other crops and can be very variable in terms of plant population. Some plots can be dominated by very few but very large kale plants whilst other plots can be covered in high numbers of small plants and sometimes the kale is lodged (fallen over) on the ground. This makes plot assessments very difficult and would necessitate a different approach to the annual mixes as well as further research into the optimum plant population required to maximize seed yield. It was also felt that as the project was limited to two years of field assessments more data would be gathered by requiring agreement holders to sow two one year mixes rather than a plot just being sown the once. In view of all these factors, kale was not included as an eligible crop but this would have to be addressed in the future due to its value for farmland birds.

Initially, buckwheat was not included as an eligible crop principally because it is thought to be of low value to farmland birds. However, it has the ability to be sown very late (Mid-July to early August) and still flower and set seed (within 100 days) before the winter. This can be very useful where plots have to be re-sown in late summer if a plot fails due to drought conditions or has been eaten by pests or out-competed by weeds etc. In order to give the farmers every opportunity to produce a good plot an addendum to the Manual was issued in March of year 1 allowing the use of buckwheat. Given its feed value is probably less than the other crops this was reflected clearly in the guidance, stating 'its inclusion should only be considered where there has been a crop failure and you need to re-establish something from mid-late June onwards'. At the same time, naked oats was also added as an eligible cereal in addition to wheat, barley and triticale. Oats are a common constituent of supplementary feeding mixes and certain birds (e.g. corn bunting and yellowhammer) are known to eat oats (Personal communication, Game and Wildlife Conservation Trust GWCT).

In addition to encouraging the right crop species to be sown, it was clear there needed to be a way of measuring the seed value of the winter bird food plots. This meant developing a scoring process which could subsequently be related to a payment rate. It was agreed that there had to be a quantitative element to the measurement process and that making subjective assessments as to the value of a plot would not work. Whilst it may be easy visually to tell the difference between a good and bad plot, a way of converting any differences into a quantitative measurement was required. As noted one of the basic objectives of a winter bird food plot is to provide '*a plentiful supply of bird food for as long as possible over winter*'. This meant ensuring a good plant population or crop cover of sown seed producing plants and minimising the amount of bare ground, undesirable weeds or structural crops, all of which reduce the seed value of a plot.

At first it was proposed to measure crop cover of the winter bird food plots in addition to the number of crops present. This would help address the objective of wanting to ensure an adequate crop cover or plant population and to avoid open patchy crops. The assumption was made that a higher crop cover of sown plants would produce more seed compared to a thin open plot with a higher proportion of bare soil or weeds etc. A higher crop cover of eligible crops would result in a higher payment. However, it became apparent very early on that measuring crop cover of winter bird food plots was going to be very difficult; assessing a crop cover of a plot or quadrat was subjective, particularly where bare ground is present or the assessor has to subtract non-eligible plants such as fat hen or redshank from the eligible crop cover value. There are various smartphone 'apps'

which can measure crop covers or leaf area indices but, from our knowledge, none can differentiate between different crop or weed species and so would be unable to differentiate between eligible and non-eligible crops.

Feedback from the independent review and field research into the practical application of the WBF results criteria resulted in the removal of subjective or prescriptive assessments. This reduced the risk of disparity between the agreement holder and the adviser and ensured the farmers were the decision makers in how to achieve the optimum results criteria. On further consideration, it was also felt that there was no positive correlation between crop cover and seed yield. For instance a tall relatively slender quinoa plant could produce significant amounts of seed but its crop cover would be very low due to its upright growth habitat. Conversely, a multi branched fodder radish plant would have a high crop cover value but probably produce a lower quantity of seed. Consequently an assessment process which was largely quantitative and would reflect the yield potential of a winter bird food plot was required. In view of these requirements it was felt that measuring plants or seed-heads using a quadrat was a more appropriate methodology.

Adopting this approach necessitated a decision on the optimum number of seed-heads or seed producing plants per quadrat taking into consideration a variety of crops can be sown in one mix. For every commercial crop, where only one crop species is sown, there are various formulas which calculate the optimum seed rate to give the highest economic yield. This is typically based on the thousand grain weight, target plant population and likely establishment percentage. All this information is readily available for a wide range of commercial crops and is based on many years of trials work. Unfortunately, the same information is less available when it comes to crops sown for winter bird food. It is further complicated by the fact that most winter bird food plots are sown as mixes with potentially five plus crops in one mix. This results in inter-crop competition where taller, quicker growing crops out-compete other less competitive crops leading to partial failure of some crops and/or smaller plants which produce less seed. Weed competition can also result in the same effect and the presence of fat hen and redshank can completely smother out the sown species leading to either a low plant population or sometimes complete crop failure. The use of herbicides to reduce this risk is often not possible as it is very difficult to find herbicide which is effective on the target weeds, safe to all of the sown crops and has label recommendation to be used on winter bird food plots.

In spite of the above difficulties, thresholds were calculated using the thousand grain weights for the various seed producing crops, assuming an establishment rate of 30% or less. This was cross referenced against the seed rates used by seed merchants when supplying winter bird food mixes. The final quadrat thresholds are shown in Table 6, some measurements are based on seed-heads and others on how many seed producing plants are present. The reason for this difference is purely practical. For instance it would be very time consuming and very difficult to count seed-heads on a fodder radish, linseed, mustard or oilseed rape plant where one plant produce a multitude of branches and seed pods. Similarly, counting cereal plants in a winter bird food plot is much more difficult and less relevant compared to counting cereal heads.

| Crop | Threshold per Quadrat |
|---|---|
| Triticale, wheat, oats or barley | 25 seed heads |
| Red millet | 4 seed heads |
| White millet | 4 seed heads |
| Quinoa | 2 seed producing plants |
| Fodder radish | 1 seed producing plant |
| Dwarf sunflowers | 1 seed producing plant |
| Linseed | 5 seed producing plants |
| Mustard | 2 seed producing plant |
| Gold of pleasure | 5 seed producing plants |
| Spring oilseed rape | 1 seed producing plant |
| Buckwheat | 4 seed producing plants |

Table 6 Winter bird food plant and seed-head thresholds.

*Pollen and Nectar*

When developing the specific results criteria and target flower species for pollen and nectar (PN) plots, a slightly different approach was taken compared to winter bird food. With the latter it was decided to list the crops in the results criteria, only these crops would 'score' and be used to calculate the payment rate. For PN plots the project wanted to see what mixes the agreement holders would choose. This would give more flexibility in terms of seed mix selection but could result in agreement holders sowing seed mixes that were cheap to buy and/or relatively simple to manage. A scoring sheet of typical flowering species, based on commercial PN mixes was developed. An additional consideration was whether to allow plants to count towards the results that may naturally occur from the seed bank or be a contaminant in the seed mix. This opened up a debate on the value of these types of plants over what are traditionally considered weeds, but have a nectar value e.g. creeping or spear thistle. Although we recognize that a number do provide a valuable nectar source we wanted to keep the assessment methodology simple, therefore it was decided to only count only sown species.

As with the winter bird food plots, it was agreed that there had to be a quantitative element to the measurement process and that making subjective assessments as to the value of a plot would not work. A plot which produces lot of different flowering species is clearly better than one with few flowering species which is dominated by grasses, injurious weeds and bare ground. However, there has to be some level of quantitative measurements if one plot is compared to another and payments are based on a performance level.

Initially it was proposed that each year we would measure the plant cover and flowering diversity of each plot. Points would be awarded accordingly and maximum points could be achieved by producing a plot with good plant cover and a range of flowering plants. However, one of the most important factors in producing successful pollen and nectar plots is how they are established and managed in the first year. The need to cut the newly established plots in year 1 is essential in order to suppress competitive annual and perennial arable weeds. Without this cutting, typically 2-4 times in the first year, the sown pollen and nectar plants can easily be outcompeted and smothered by arable weeds leading to a poor establishment. Therefore, measuring plant cover in year 1, particularly with spring sown plots, could lead to unmanaged plots as agreement holders sought to maximise ground cover. There is also little correlation between cover of flowering plants in year 1 and their cover in subsequent years. As long as the pollen and nectar plants are well established and present in year one, even if they are very small plants, they will typically develop into large plants giving good cover in year 2.

For year 1 the resulting assessment process was based on a presence or absence approach. The size of the individual plants was not important, neither was crop cover. This made assessments relatively easy and straight forward, although it did depend on agreement holders and advisers being able to identify different species when they could be very small and not flowering. To help with this identification process, identification guides were produced by Natural England for the common pollen and nectar plants that agreement holders would typically encounter. Pictures were provided along with distinguishing features which helped with their identification at different development stages.

In year 2 crop cover values were seen as a valuable element in addition to species diversity. From year 2 onwards the various flowering plants will usually be fully established and ensuring good crop cover should result in high levels of pollen and nectar. Whilst measuring cover was not seen as a viable approach for winter bird food plots due to the lack of correlation between crop cover and seed production and also the difficulty in assessing cover in winter bird food plots, it was felt a crop cover approach could be feasible with pollen and nectar plots. Largely, because the flowering plants tend to be a uniform height and in years 2-3, the amount of bare soil or unwanted weeds tends to be small or easily measureable.

A short assessment was undertaken to see if different advisers could agree on the crop cover value of already established pollen and nectar plots. A similar trial was carried out at the farmer training meetings. The results were encouraging as although it was rare to agree on the same crop percentage cover value, they were usually similar. It only became more difficult where grasses or injurious weeds (e.g. creeping thistle) were present because of the need to estimate and subtract the non-eligible crop cover.

### *Results Assessment Methodology*

*Winter bird food*

As described the result indicator for the winter bird food assessment is the number of eligible sown seed species present, based on count thresholds for each species. The next step was how to convert this information into a scoring system which could be associated with a payment rate. The decision was made that 10 $1m^2$ quadrat assessments would be carried out across a plot. This related back to the fact seed rates are typically calculated using kilogrammes per ha and so using plants or seed-heads per square metre was a logical choice. In addition, using a quadrat larger than a square metre would be too big and unwieldly to use but using a smaller quadrat was virtually impossible, given some plant thresholds are set at 1 seed producing plant per square metre. The figure '10' was chosen on the basis that there needed to be enough stops to be representative but not too many as to be impractical and time consuming to undertake. In order to keep things simple, it was also decided to keep the number of sampling points fixed regardless of the plot size. In practice plots sizes did not vary much within the agreement and ranged between 0.5 ha and 3.25 ha with most plots around 1.0 ha in size. For each sown seed species, if an agreement holder reached the required threshold in a quadrat, it was recorded as 'present'.

The final step in the assessment process was when to count a particular crop as being present and representative across the whole of the plot; if the threshold for fodder radish or any other crop was only achieved in one quadrat out of ten, it is unlikely to be present across the whole plot. Equally, given the random nature of the sowing where several crops are sown together it is unreasonable to expect any one crop to be present in all 10 quadrats. It was agreed that to count as present at plot level a sown species had to be present in at least 5 out of 10 quadrats.

*Pollen and Nectar*

In order to be consistent across both the winter bird food plots and the pollen and nectar plots, the decision was made that 10 assessments using a 1 square metre quadrat would be carried out across these plots as well.

The final step in the assessment process was when to score a particular crop as being present in the plot. For the reasons outlined above, one of the primary objectives of a pollen and nectar plot is to establish a diverse range of species which will supply pollen and nectar throughout the summer into early autumn. Research has shown it is important to provide pollen and nectar from a variety of sources and over as long a period of time as possible. Clearly if a plant listed in the table is only recorded in one quadrat out of ten, it is unlikely to be widely present across the whole plot. Equally, given the random nature of the sowing and sampling where several crops are sown together it is unrealistic to expect any one plant to be present in all 10 quadrats.

The final decision was that presence in 5 quadrats should be the target threshold. This matched the threshold set for the winter bird food plot and seemed a reasonable compromise. In order to achieve this target and so get the highest payment rate, it was felt that agreement holders would probably sow more than 5 different species and so the final number of pollen and nectar plants in a plot could easily be more (e.g. 6 or 7). However, setting a target of more than 5 different pollen and nectar species could lead to even more species being included with expensive mixes containing high numbers of different species which out-compete each other and fail to establish. The threshold also had to be measureable and achievable using a square metre quadrat. This sized quadrat was chosen as the assessment area as anything bigger would be unwieldly to use but anything smaller would necessitate choosing a lower plant target threshold. However, as a results based approach has never been attempted on a pollen and nectar before, there are no previous results to draw on.

In year 2 an additional crop cover measurement had to be made. There are applications available to measure ground cover digitally but these are unable to distinguish between the species of plant contributing to the cover. Given the lack of suitable technological approaches to support measurement it was accepted that the agreement holder had to make a subjective measurement of cover in 10% bands. However, there may be scope to develop these approaches in future, and a separate project funded by the Department of Environment, Food and Rural Affairs (Defra) explored the use of image recognition in this context using photographs taken during the project (August and Logie 2018) – see case study at Appendix 8.

### *Payment Rates and Results Tiers*

*Payment Rates*

The full calculations for the PN and WBF payment rates followed the standard income foregone (IF) approach used for mainstream rural development programme funded AES. This partial budget method has been used to calculate annual payment rates for all previous AES. The calculations take into account income gained and costs saved set against income lost and management costs incurred. This gives a final net IF figure which provides the maximum payment rate.

The basic assumptions such as seed and fertiliser prices, operational costs, crop yields, market prices etc. were the same as those used for calculating payment rates for the current Countryside Stewardship scheme. However, with the results based approach there were additional costs which needed to be taken into account. Table 7 and Table 8 show the extra costs including the time taken by agreement holders to attend training on how to get the best out of their plots and how to undertake crop assessments (one full day and an annual farm walk). Also included was the time taken for agreement holders to carry out their plot assessments. The payment rate is considerably higher than the equivalent CS option due to these extra activities (and is artificially inflated

as some costs (such as PN seed mix and cultivations) are spread over the two year agreements rather than the normal five year CS agreements).

| Establishment costs | Management Costs | Training/workshop attendance | Plot assessment |
|---|---|---|---|
| Plough & press | Topping prior to re-establishment | Training and RBAPS workshop attendance | Labour costs |
| Min-till | Fertiliser application - one pass | Face-to-face farmer plot assessment training - year 1 | Quad bike |
| Spring Tine | Nitrogen @ 1.14 p/kg - 34.5% ammonium nitrate | Travelling Costs | |
| Power harrow | Herbicide spot treatment - ATV incl. labour | | |
| Drill | Herbicide spot treatment | | |
| Cambridge roll | Switch to spring cropping at end of year 2 | | |
| Basic Annual Seed Mix | | | |

Table 7: Winter Bird Food payment calculation costs.

| Establishment costs | Management Costs | Training/workshop attendance | Plot assessment |
|---|---|---|---|
| Plough & press | Topping | Training and RBAPS workshop attendance | Labour costs |
| Min-til | Flailing & mulching | Face-to-face farmer plot assessment training - year 1 | Quad bike |
| Power harrow | | Travelling Costs | |
| Cambridge roll | | | |
| Drill | | | |
| Pollen and Nectar Seed mix | | | |

Table 8: Pollen and Nectar payment calculation costs.

*Payment Tiers*

With a management based approach, the income foregone and additional costs incurred calculation for the action is taken as the payment rate (additionally transaction costs up to 30% of the overall agreement value may be added). Current EU rules do not allow for an incentive element to be added. With a results based approach any payment rate needs to reflect the quality of the outcome and so the payment has to vary accordingly. The challenge is how to reflect the assessment scores of the PN and WBF plots with an appropriate payment rate. Various methods were looked at. One approach considered was to have a bigger difference in the payment rate for the top tier compared to the lower tiers. It was thought this would incentivise agreement holders to reach the top tier and deliver better environmental outcomes.

Another question posed was around a zero payment rate. Would this be viewed as unfair and penalise agreement holders who may have a plot failure through (possibly) no fault of their own? Would agreement holders consider this too high a risk to undertake? Alternatively should there be a base payment so that agreement holders always received some payment to offset some of the costs incurred? The objective of the project was to try and show if a results based approach could work. Therefore it was felt if a result was not achieved there should be no payment. This also provided the opportunity to test farmer attitudes to this.

Winter Bird Food

The final step in the process is to take the results from the plot assessments showing how many eligible crops have reached the necessary threshold and to convert it into a score which determines the payment rate. Whilst some winter bird food mixes are sown specifically to provide seed for one particular bird species (e.g. tree sparrow or corn bunting), most winter bird food plots are designed to feed a range of different species. This means providing a wide range of crops so that the widest range of farmland birds are catered for. The prescriptions for ES Winter Bird Food (option code EF2) stipulate at least 3 small seed bearing crops should be sown. A similar approach is taken with CS Winter Bird Food (option code AB9) where it is required to sow '*a seed mix of cereals, brassicas and other plants producing small edible seeds*….'. Following a similar approach but to raise standards even further; a target of 5 sown eligible species in order to achieve the maximum payment rate was set. Consultations with partners and stakeholders agreed this was achievable but the pilot would confirm if that it was the case. It was felt that it would be easier to reduce the target of 5 sown eligible crops if it proved difficult compared to increasing it.

Having a target of 5 sown eligible crops resulted in 6 payment tiers as shown in Table 9. In order to incentivise agreement holders, as well as to keep it simple and straightforward, it was decided to have a zero payment rate (Tier 1) with equal gaps between the 6 payment rates (Tiers 1-6). The payment rates would increase or decrease in a linear fashion according to plot performance between £0/ha and £842/ha. The fewer number of species recorded in the plot would result in a lower payment whilst achieving 5 or more different eligible crops would receive the maximum payment rate. It was felt this approach gave a transparent and fair way of rewarding agreement holders for producing the best winter bird food plots.

| **Number of Established Sown Species Producing Seed*** | **Payments rate where 50% or more of plot assessments reach the required plant or seed head threshold** |
|---|---|
| 5+ | Tier 6 (£842) |
| 4 | Tier 5 (£674) |
| 3 | Tier 4 (£505) |
| 2 | Tier 3 (£337) |
| 1 | Tier 2 (£168) |
| 0 | Tier 1 (£0) |

Table 9: Winter bird food payment tiers.

Pollen and Nectar

As with the WBF option it was felt there should be a zero payment with the payment rates increasing or decreasing in a linear fashion according to plot performance between £0 and £705/ha. The one major difference was that there would be ten payment rates (with smaller payment gaps between individual performance tiers) for the PN option compared to six for the WBF option. The main reason for doing this was because the assessment methodology included estimates of cover which could be more subjective, so having ten payment rates would ensure that where plots fell into a lower performance tier it did not unfairly result in a large financial penalty (compared to the WBF option where the gap between each payment rate is much greater) thus penalising agreement holders for plots that have narrowly missed securing a higher performance tier. This may also avoid the situation where agreement holders overestimate the crop cover value in order to reach a higher payment tier.

As described previously, in year 1 the agreement holder records whether a pollen and nectar plant is present in at least 5 out of 10 assessment points. This determines how many flowering species can be counted as present. This figure is then referenced against the column headed 'Number of sown flowering species present' in the payment table (Table 10: Pollen and nectar payment tiers.). The agreement holder reads across to the final column (90 – 100%) in the table to show the final payment rate. For example if the assessment recorded 4 different flowering species, the payment rate would be £635 or Tier 9.

In year 2 the same approach is used but the additional crop cover measurement is applicable. As in year 1, the number of flowering species found is matched to the relevant number in the first column of the payment table. In addition, the agreement holder calculates the average crop cover value across the 10 quadrats. Using the average crop cover and the number of flowering plants found, this is used to determine the relevant tier and payment rate. For example if the agreement holder found 4 flowering species and the crop cover was 95%, the payment rate would be £635/ha or Tier 9. Similarly if the crop cover value was only 54%, the payment rate would be £353/ha or Tier 5.

As can be seen in the payment table, the crop cover values are split into 6 levels but with a greater weighting for crop covers above 50%. Initially the crop cover values were split evenly from 0-100% but it was felt this approach would over-reward poor performing plots. Ensuring a high cover of flowering plants is one of the prime objectives of the measure and therefore paying for plots with less than 50% crop cover did not seem appropriate.

Similarly, payment rates were reduced where there may be good cover but only one or two flowering species. Clearly there is still an environmental benefit if a plot contains just one or two flowering species but one of the two prime objectives is to produce a plot containing a wide range of flowering species producing pollen and nectar for a long period. Therefore the payments were developed so that agreement holders would receive the highest payments for providing both a wide range of flowering species and high ground cover values. This should incentivise agreement holders to produce high quality plots.

| **Number of sown flowering species present** | **Percentage cover of flowering sown species*** | | | | | |
|---|---|---|---|---|---|---|
| | **0-49** | **50-59** | **60-69** | **70-79** | **80-89** | **90-100 Yr1** |
| 5+ | Tier 1 (£0) | Tier 6 (£423) | Tier 7 (£494) | Tier 8 (£564) | Tier 9 (£635) | Tier 10 (£705) |
| 4 | Tier 1 (£0) | Tier 5 (£353) | Tier 6 (£423) | Tier 7 (£494) | Tier 8 (£564) | Tier 9 (£635) |
| 3 | Tier 1 (£0) | Tier 4 (£282) | Tier 5 (£353) | Tier 6 (£423) | Tier 7 (£494) | Tier 8 (£564) |
| 2 | Tier 1 (£0) | Tier 3 (£212) | Tier 4 (£282) | Tier 5 (£353) | Tier 6 (£423) | Tier 7 (£494) |
| 1 | Tier 1 (£0) | Tier 2 (£141) | Tier 3 (£212) | Tier 4 (£282) | Tier 5 (£353) | Tier 6 (£423) |
| 0 | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) |

Table 10: Pollen and nectar payment tiers.

## Grassland Design

The design of the results based approach for grasslands in Wensleydale followed the recommended steps defined in the Results Based Payments for Biodiversity Handbook produced in 2014 by the Institute for European Environmental Policy (IEEP) for the European Commission (Keenleyside *et al* 2014).

In summary this included:

- A review of how the high nature value farmland in the Yorkshire Dales, (specifically species rich hay meadows and habitat for breeding waders) has been shaped by agricultural practices during the last 100 years, and what impact contemporary agriculture is having on its biodiversity value; identifying the drivers, timescale and expected impact of future changes in agricultural land use and management, and any consequent threats to high conservation value farmland now and over the next five to seven years;
- Clearly understanding and defining what constitutes the highest quality habitat e.g. species composition, vegetation structure, farming practice etc, which then leads to defining biodiversity objectives for the habitats
- Determining which result indicators should be used, with guidance from the farming community on its development.
- Field testing across a wide geographical area and within the pilot area

In addition, the results indicators had to be within the management control of the farmer.

### *Exploration*

It was important to engage farmers from the start of the design process to ensure their skills and understanding of land management fed into the development of the criteria and methodology which would be used to measure results. It also provided opportunities for them to air current management issues and discuss solutions.

An existing group, the Northern Upland Chain (NUC) Higher Nature Value Farming (HNVF) working group, provided a vehicle to engage with farmers and stakeholders. This group is made up of representatives from the 5 protected landscapes of the northern English uplands who have experience of working with farmers and agri-environment schemes. It also includes representatives from the farming community of the 5 areas, Natural England, Royal Society for the Protection of Birds and the National Farmers Union. Work had already been undertaken in the wider NUC area prior to the project and during late 2015 and early 2016 five farmer meetings were held, to increase awareness of the project and ensure that as many farmers as possible were able to offer opinions on the design of the indicators, even if they were outside the formal pilot area. The aims of the meetings were to:

- Bring everyone up to the same level of understanding of the results based payment approach
- Agree what poor and excellent habitat looks like and the management requirements needed.
- Agree the results we are seeking to deliver in the target habitats and agree how their delivery can be measured by the farmer and/or adviser.
- Discuss a payment structure
- Agree an approach for an additional payment for discrete capital works e.g. should this be a separate payment or built into the scoring process? What 'actions' should be included e.g. wall restoration, adding wildflower seed or creating wet areas?

In total 75 farmers attended the meetings – representing all parts of the NUC. All were hill livestock farmers with enterprises of varying scales. The meetings were informal with opportunities to comment and ask

questions throughout. The presentation at each meeting described the current agri-environment situation, the RBAPS development process and how such a scheme would work. The following is a summary of key feedback from attendees:

- Including farmer knowledge within the process of decision making and scheme design was viewed very positively;
- They expressed a preference for such a scheme to be locally delivered by people with a good working knowledge of the area and its farming systems. They felt that this would facilitate a high degree of trust to be developed between all parties, helping to ensure the scheme is a success;
- It was considered necessary to have a capital grant element to enable certain works to be carried out that would support improvements to habitat quality and subsequent annual payments;
- There was a preference for the duration of an agreement to be 10 years;
- Annual meetings between participants of the scheme was considered to be a good way of sharing knowledge, rather than through attendance at formal training events;
- The risk of taking on more responsibility for delivery of outcomes: how this might affect the payment each year and who has the final say – the farmer, the adviser or the inspecting authority?
- That the scheme could be negatively influenced and/or restricted in its flexibility by Natural England, Rural Payments Authority and Defra.
- That extenuating circumstances like bad weather would affect final score for that year.
- That the scheme may become very expensive and difficult to budget for if every farmer is trying to get the highest score.

*Habitat for breeding waders*

Substantial research into breeding wader ecology has confirmed the range of habitat and physiological attributes needed for species survival and to enable successful breeding. It is clear that wader species require sufficient good quality habitat to feed, nest, rear and fledge young. At a landscape scale, their breeding success is also dependent upon many other factors that tend to be beyond the farmers control – for example afforestation causing fragmentation and deterioration of habitat quality (Amar *et al* 2011).

This extensive evidence base was drawn upon to define the key environmental attributes or indicators which are considered to constitute good breeding wader habitat. As wader habitat requirements differ between wader species it is difficult to define generic optimal habitat on a field by field basis. Furthermore, waders tend to move their young between habitats across a relatively wide area, so features are needed at different spatial scales.

A generic set of attributes for good breeding wader habitat were defined as follows:

- Openness and aspect - open site within a mosaic of grassland and moorland habitats - as opposed to sites which are enclosed, hemmed in or have woodland at a boundary.
- Slope - the potential for nesting birds is greatly increased on flatter ground. Sites which are generally flat or have only a shallow slope or terraces can hold high numbers of breeding waders. The following measure is a guide:
    - more than 50% of the field is flat (0-8°) = good potential,
    - 26-49% of the field is flat = medium potential;
    - 0-25%= poor potential. NB depends on size of field, so for example, 25% of a 20ha field = 5ha of flat ground.
- Damp grassland containing wet features like flushes, open drains and scrapes, over at least 10% of the field area.
- Rush cover (particularly soft rush) up to a maximum cover of 30% of the field – scattered

- Varied sward height and changes to vegetation structure and tussock density where there are significant areas (up to 75% of the field) of relatively short grassland (<5cm).
- Site is grazed by cattle and sheep to maintain sward structure
- Permanent grassland containing a range of plants and invertebrates and features such as mole hills, hoof prints, farm yard manure
- The habitat may or may not be used by breeding waders, but it is within 5km of known wader sites

The next step was to distil these into criteria that could be measured to assess habitat quality (results) in an outcome-focussed payment scheme. Using the principles and guidelines in the Results Based Payments for Biodiversity Handbook a set of results criteria, assessment methodology and scoring system were drawn up to grade wader habitats within the pilot scheme.

*Species rich hay meadows*

Using Natural England Common Standards Monitoring for lowland grassland (NE, 2013), standard plant community descriptions (Rodwell *et al* 1992) and the UK terrestrial biodiversity surveillance strategy (JNCC 2008) a definition of the attributes of an optimally managed habitat was produced. Excellent examples of typical hay meadows tend to have the following characteristics:

- High diversity and quantity of flowering plants and grasses
- Ratio of flowering plants to grasses in excess of 50:50
- Plants are able to flower and set seed annually
- A varied sward structure
- Site is grazed by sheep and cattle
- Grass crop is removed each year via mowing (for hay meadows)
- Weeds and dominant grasses are absent or very low in cover
- Occurrence of bare soil is minimal
- Soils contain low levels of nutrients and in particular extractable P and K

As the key attribute for species rich grasslands is the range of plant species, an assessment and scoring system was developed that allowed hay meadows within the pilot area to be graded largely by type, range and frequency of indicator species; more detail is provided in the following section.

### *Development and Testing of Results Metrics*

*Habitat for Breeding Waders*

The habitat for breeding wader result indicators were devised from the set of 8 key attributes described previously. Four of the key attributes – openness, slope, permanent grassland and use by breeding wader species were considered to be elements that could be included as eligibility criteria for fields entering agreement. The management by mixed grazing was considered as part of the guidance material to suggest ways of improving habitat diversity and therefore its score. The key attributes that could be directly affected by changes in management and therefore under the control of the farmer were rush cover, diversity of sward height and wetness of soil. These 3 main indicators were therefore used to develop the methodology for assessment of the habitat.

Consideration was given to a presence / absence of bird species element, but was discounted as there are many external factors that affect the numbers of birds returning each year to the uplands and even the presence of birds within an individual field is not a reliable indication of breeding success unless the observations are made

repeatedly throughout the season. This is outside the control of the farmer and thus could put them at risk of failing the indicator through no fault of the management of the habitat. Nevertheless the collection of presence/absence of bird data along with bird number as a non-scoring indicator was considered to be useful for increasing the farmers understanding about the habitat they are managing and why the range of wader species are using the habitat.

A scoring system was then designed based on individual scores for each result element and the total score then used to assign the field to a payment rate (see Appendix 2 for score sheet). Within each result element, the farmer/land manager identified from a range of descriptive statements one which most closely reflected the habitat condition within that particular field. Different scores were assigned to the various conditions to differentiate between good and poor condition. Through this process the farmer was able to identify immediately if the habitat was in sub-optimal condition and what good looks like. In addition to the three principle elements, an additional element was included to discourage damage to habitat, with accumulation of negative points correlated to the degree of damage.

Vegetation height and tussock coverage

Waders require variety in sward structure. Taller areas provide cover for concealing nests and chicks while shorter areas are favoured for feeding. A lack of structural diversity can also result in little invertebrate diversity (Ausden *et al* 2001) and increases the likelihood of predation from mammals and corvids. Different bird species also have different requirements with respect to sward heights. Lapwings select fields with a short sward and scattered tussocks that will conceal their nests and chicks, while leaving their all-round view uninhibited. At the other extreme, the snipe prefers a higher level of concealment in taller vegetation. Redshank accept a broad range of tussock frequencies and swards with a varied structure. Most species prefer swards with tussocks to those that lack them, the maintenance of grazing regimes which promote the development of swards rich in tussocks has been shown to be beneficial (Milsom *et al* 2002).

Farmers have complete control over this indicator which is (ideally) delivered using a mixed stocking regime. For RBAPS scoring the farmer was required to assess the sward at one point during the breeding season (initially May, then later expanded to one point between March and May). It was measured against a simple range of sward heights and cover, reflecting varying levels of sward heterogeneity – see Table 11. Whilst there was no stocking rate requirement as part of this indicator example stocking regimes were provided within the guidance, along with explanations for why this is important e.g. risk of nest trampling from certain stock types.

| | |
|---|---|
| Mixed sward height where between 25 - 75% of the field is short and the rest varied, grass tussocks frequently seen and well distributed | 10 |
| Over 75% long. Short swards confined to very small parts of fields (e.g. gateways, sup feed sites only) Grass tussocks indistinguishable from other tall vegetation | 5 |
| Over 75% short with little to no variation in height. Grass tussocks rare or absent | 5 |
| No difference in height – either all short, or all long with no variation | 1 |

Table 11: Scoring table for vegetation height. (Short = below ankle height (<5cm); Long = over 15cm).

Cover of rush

Fields prone to rush infestation are often damp, and as such have good potential habitat for breeding waders. In fields with little plant diversity, rushes may be the only taller vegetation present, making them an important feature of the habitat. Rushes can provide tussocks that are useful for cover, but if they become too dense the field will lack the shorter areas that are useful for feeding. If rushes take up more than one-third of a field's area

then grazing management, which is essential to maintaining the grassland for breeding waders, is made more difficult, the site loses its open aspect and quality of habitat is reduced (RSPB 2008).

The scoring criteria (Table 12) was informed by the 30% threshold from research which shows that wader numbers using rough grazing sites declined once rush cover exceeded this level (Eglington 2009). Farmers are able to manipulate rush cover through implementing a regular mowing regime - in some cases accompanied by chemical treatment; this can enable progress from a poor habitat category to a good one within a relatively short space of time.

| | |
|---|---|
| 10 – 30% cover, well scattered with local areas of dense rush | 10 |
| Sparse rush cover 5 – 10% | 5 |
| >30% rush cover, large areas of dense rush and tall vegetation | 5 |
| <5% rush cover | 1 |

Table 12: Scoring table for cover of rush.

Wet features

The extent of wet features is an extremely important factor in attracting adult breeding waders and subsequently ensuring they are able to successfully rear their young. These wet features support a wide variety of aquatic, terrestrial and aerial invertebrates, such as beetles, bugs and molluscs.

Farmers are able to influence the assessment of this indicator by creating more wet areas within the field and/or managing existing ones to improve the habitat within a year. One significant issue however, is that the extent of wet features is affected by factors both within a farmers' control (e.g. management of field drains) and also, most notably, the weather which is outside the farmer's control. So while wet features are a key attribute of habitat for breeding waders, it proved difficult to develop results criteria which fully met the recommendations laid out in the RBAPS Handbook 2014 of being within the farmer's control.

Another complication was that definitions of the optimal scale of wetness vary. Natural England (2005) suggests good wader habitat is wet across more than 10% of the area. RSPB have calculated that chicks need 150m/ha of foot drains to provide enough invertebrate food to successfully fledge. For scrapes a minimum of 60m² per ha has been suggested (RSPB 2010). Transferring this level of technical information into the scoring criteria whilst retaining a level of simplicity for the end user was challenging; Table 13 shows the scoring system which was used during the project.

| | |
|---|---|
| Field is damp across the majority of the area with a number of wet features scattered across the field | 10 |
| Damp areas are contained to approximately 10% of the field, e.g. springs, remainder of field is dry | 5 |
| Damp areas are rarely seen | 1 |

Table 13: Scoring table for extent of wet features across field.

The quality of the wet feature is as important as its scale. A combination of areas of open water, waterlogged ground, good areas of exposed mud with a proportion of rush cover provides ideal conditions for a range of waders. Quality was taken into account using the scoring parameters shown in Table 14.

| | |
|---|---|
| Wet features contain a mix of shallow pools and wet vegetation, gently sloping edges, 50% of the edge is mud with less than 25% rush or tall vegetation | 10 |
| A number of wet features on the site but not meeting all criteria above | 5 |
| Steep sided, no muddy edge, dense rush cover, inaccessible to birds | 1 |

Table 14: Scoring table for quality of wet features.

The RSPB consider that the location of wet features has a direct effect on breeding success. Proximity to predator posts, overhead wires and woodland has detrimental effects on chick numbers. However rather than accommodate these elements into the scoring criteria it was decided that guidance would cover likely negative impacts of these physical landscape features and/or unsuitable sites would be screened out through the application process.

Damaging operations

Damaging activities that affected the integrity of the habitat attracted a negative score - the level of which depended on the extent of the damage. Where damage occurred over more than 25% of the field area this received the severest penalty - no payment (irrespective of the quality of the habitat over the remainder of the field). At a level of damage between 10% and 25% a negative score was attributed, resulting in the total score being at least one step lower than it would be had no damage occurred.

Damaging operations included:

- excessive use and poor management of supplementary feeders causing damage to vegetation and soil
- use of machinery during the bird nesting season
- intensification of fertiliser use identified through soil test results
- damage to historic environment features

Presence and diversity of birds

This was a non-scoring element of the assessment process but a simple species count was included as it assisted with project monitoring, but more importantly was expected to improve the land managers' observational skills and understanding of which species were using their fields. It was hoped that by completing this assessment, the farmers might be able to make a connection between the quality of the habitat produced by their management and the birds using it. However the observations would not count towards the score as the presence or absence of waders on an individual field were likely to be subject to outside influences beyond the land manager's control, for example the management of surrounding land outside the RBAPS pilot.

Bird observations were made during June in the baseline year and the behaviour of the majority of birds indicated they had nested, had young nearby or were displaying for a mate. Most observations in year 1 were made in early to mid-May after the bulk of lambing had finished and when farmers had slightly more time. Assessments in year 2 were typically made slightly later, from mid-May to early June.

Additional observations

Farmers were keen to provide further information on the type of breeding season they had observed – weather conditions, temperature, whether waders failed or were successful with rearing broods etc. A free text box was included in the self-assessment form so they could record any comments they felt were helpful, including how they had managed the habitat. This information could be used to advise future projects or management recommendations.

*Species Rich Hay Meadows*

The development of scoring criteria for hay meadows went through two iterations. The first proposal included subjective assessments such as percentage cover of wildflowers and weed species that would be typically used in ecological surveys. In addition there were abundance and number of species criteria. After peer review and further research, it was agreed to remove the majority of the subjective assessments as they were potentially confusing to the farmer, difficult to decide between categories and importantly, their removal would minimise the risk of disparity between the agreement holder and managing authority.

The second iteration focused purely on species composition of the sward. A record was also made of any damaging activities within the field. These attracted a negative score of -10 or -20 points depending on the extent of the damage as a proportion of the field area. A total meadow score was then derived by summing the total scores for each species and subtracting any negative points from damaging activities.

The total meadow score can be used to grade the overall health of the meadow at a point in time but also monitor changes in condition over time and thus the success of any management initiatives which aim to enhance the range and abundance of positive indicators within the sward. If the management objective is to restore a degraded site to good condition, the meadow score would be expected to increase over time as positive indicator species are retained, re-introduced and/or become more abundant, and negative indicator species die out or become less abundant. Even though absolute abundance isn't measured, the scoring system provides a measure of number and frequency of species leading to the most diverse and species rich meadows having the highest scores. It can also provide a reference point for management considerations and restoration proposals, for example identifying key indicator species that could be re-introduced by sowing native seed.

The number and frequency of positive indicator species within a grassland sward is closely related to the intensity of agricultural management and nutrient status in particular. Many plants characteristic of species rich hay meadows are very sensitive to high nutrient inputs - for example Globeflower, Wood Crane's Bill and species of Orchid - so their presence or absence can be used as a barometer of health for the meadow. Thus for meadows, the most important attribute to defining the 'condition' of species rich grassland is the number and frequency of flowering plants and grasses indicative of that habitat.

Using the key indicators of the National Vegetation Classification MG3 and MG8 communities (encompassing upland/northern and lowland hay meadow habitats), survey work undertaken by the Hay Time Project (Perry and Gamble 2012) the Peak District Hay Meadows Project (Buckingham, 1998) and research undertaken in Upper Teesdale (Starr-Keddle 2014), a definitive list for recording the presence of 42 species along the transect was developed that related to hay meadows found within a broad geographical area from Forest of Bowland to the North Pennines. The list included rarities as well as more common plants found within this habitat and included plants that favour acid, calcareous or damp grasslands.

To reduce the complexity of the list, and risk of misidentification by the farmers of some similar looking plants, a decision was made to group a number of species together e.g. hawkbits and catsear, cranesbills, scabious and sedges. In addition, only two species of grass were included within the positive indicator species, again to reduce complexity. The grasses included were indicative species of old meadows – sweet vernal grass and quaking grass. A number of the more commonly found meadow species were not included in the list including common sorrel, meadow buttercup, black medic and germander speedwell. The inclusion of these widely found species would not have provided diagnostic information about the condition of the meadow.

The list also included undesirable species such as weeds and rushes as they typically indicate the habitat is in a sub-optimal condition. The Hay Time Project (2012) and the study undertaken by Starr-Keddle (2014) used negative scores for undesirable species in order to assess changes to the condition and richness of the hay

meadows. These 'negative indicators' initially included cow parsley, soft brome, soft rush, creeping buttercup, bracken and the main weed species – creeping thistle, nettle, dock, spear thistle and ragwort (Starr-Keddle, 2014). Bracken and creeping buttercup were removed from the list because it can be difficult for the untrained eye to differentiate creeping and meadow buttercup and there is low occurrence of bracken within the meadows within the pilot area.

The impact of negative scores gave the farmer a clear indicator of what management actions would improve the score and payment. Treatment of weeds and reduction in fertiliser will reduce weed frequency in most cases, with the exception of soft brome. As soft brome is an annual, the quickest and most effective method for controlling it in hay meadows is to mow the meadow before the soft brome flowers and sets seed. This would require an earlier cut than normal, leading to a loss of hay crop and consequently a reduced volume of winter forage for the farmer. An early cut could also affect the hay meadow score in subsequent years if it was undertaken before the full range of plants had flowered and set seed, particularly annuals like yellow rattle (Rhinanthus minor). Since the agreements within the project only had a duration of two years it was decided that soft brome should be tolerated and it was removed from the negative species list.

Each species was given a points value according to their rarity or undesirability (Table 15). A score for each species could then be calculated by multiplying the points score for the species by the number of times the species was recorded across the 10 stops.

| |
|---|
| +4 positive indicator species: very special or rare species such as melancholy thistle and greater burnet |
| +3 positive indicator species: species only found in better meadows such as scabious sp. and burnet saxifrage |
| +2 positive indicator species: typical hay meadow species such as hawkbits, sweet vernal grass and meadowsweet |
| -1 negative indicator species: troublesome weeds such as cow parsley and rush |
| -2 negative indicator species: weed species such as common dock and creeping thistle that indicate high nutrient status or agricultural improvement, poaching or neglect. |

Table 15: Hay meadow indicator species scoring.

The species list approach was tested using survey data from existing 'reference sites'. A desk based assessment was undertaken using hay meadow survey data taken from three different hay meadows within the Yorkshire Dales. One meadow formed part of the Yockenthwaite SSSI series, Northern Hay Meadow SAC and was species rich, the other two meadows were less species rich to varying degrees. The SSSI meadow obtained the highest score of the three while the others fell within the mid and lower range of scores. The testing concluded that the species list approach did reflect the condition of the meadows.

Damaging Activities

Damaging activities that affect the integrity of the habitat were represented as a negative 'score' - the severity of which depended on the extent of the damage. Where damage occurred over more than 25% of the field area, this received the severest penalty - no payment. Between 10% and 25% a negative score would be applied that ensured the total score was reduced by enough points to lower the payment compared to what it would have been had no damage occurred. Damaging activities included:

- excessive use and poor management of supplementary feeders causing damage to vegetation and soil
- use of machinery during the bird nesting season on fields used by breeding waders
- Intensification of fertiliser use.

Additional observations

In addition to the formal assessment a short form was included with the methodology that the farmer would complete to describe that year's management. The form included details on the following:

- Grazing regime: including livestock type, numbers, timing of grazing, use of supplementary feeding
- Mowing practice: methods used (production of hay, haylage or silage), approx. range of cutting dates, spring and aftermath grazing
- Use of surface applications: [3]lime, compound fertiliser, farm yard manure. Include timings of applications and rates
- Other management practices – chain harrowing, rolling, weed control measures
- Other wildlife that use the fields – e.g. breeding waders
- Historic features present – note condition with adviser.

### *Results Assessment Methodology*

*Habitat for breeding Waders*

The assessment methodology for the habitat for breeding wader is a whole parcel assessment, as outlined above. The key consideration in this context is timing of the assessment. Breeding waders return to the English uplands from late March and stay until late June. During that time, they are looking for suitable feeding and nesting sites and will begin to pair up in April and settle on nesting sites within the same month. Chicks will hatch during late April into May and the adults will then move them into other areas of the field or neighbouring fields to feed and find shelter. In order to make the process simple, the farmers were initially asked to undertake a single assessment visit in May. This enabled a more accurate count for the breeding waders as well as being able to assess the habitat at the same time. The visit timing also took into consideration the farmers' activities at that time of year – lambing of the sheep flock would be over and checks on livestock moved to the breeding wader fields would be frequent. In the second agreement year (2017) the time frame for the visit was expanded to include March and April and the farmers were encouraged to undertake two visits. The first could be early in March to undertake a habitat assessment before the breeding waders returned and the second would be in May once the birds had settled and were rearing young.

*Species rich hay meadows*

A literature review was undertaken to look at different survey techniques for identifying plant species within meadows and identify the most appropriate one for use by non-professionals as some assessments would be undertaken by participating farmers with no prior experience of botanical survey. The survey method had to meet two key criteria:

- Be simple to undertake.
- Provide accurate, repeatable results.

In most ecological surveys a 'W' shaped transect is used in order to gain a representative sample of species from a field. This standard 'W' walk survey line was trialled alongside a simpler linear transect approach developed and tested as part of a local project focused on meadow restoration (Perry and Gamble 2012). Farmers were concerned that the simpler approach might not capture as many species. However, the results showed that the "W" survey technique did not capture any additional species compared to a linear transect and in fact generally captured more species (probably because, unlike the 'W' walk method which deploys quadrats for sampling,

[3] At the start of the RBAPs meadow agreement, each meadow was soil tested to review the pH and Phosphate index. Information was then used to inform any management change

the RBAPS sampling was based on species visible at each stop which captures more species). As the 10 stop, linear transect approach was the simpler method, and easier to repeat, this method was selected for assessing species rich grasslands within the RBAPS pilot.

The field parcels under agreement were mapped and a single transect line chosen which gave a good representative sample of the meadow and which started and finished at predetermined points. Figure 10 shows an example Agreement Map where both the land under Agreement and transect line are identified. As the field parcels ranged in size the length of the transect lines was also variable. In each field parcel the results were measured at 10 equi-distant stops along the transect line. At each stop the selected species within a 1 metre radius were recorded.

By standardising the survey route it was anticipated that any repeat survey would give similar results if undertaken at the same time of year i.e. using a mapped transect line would enhance the repeatability of the approach. This was an essential consideration both for the ongoing annual farmer surveys and for auditing purposes. Repeatability was also enhanced by stipulating that surveys must be carried out at a particular time of year: before the hay was cut and once the majority of plant species are in flower - this is usually between late June and late July.

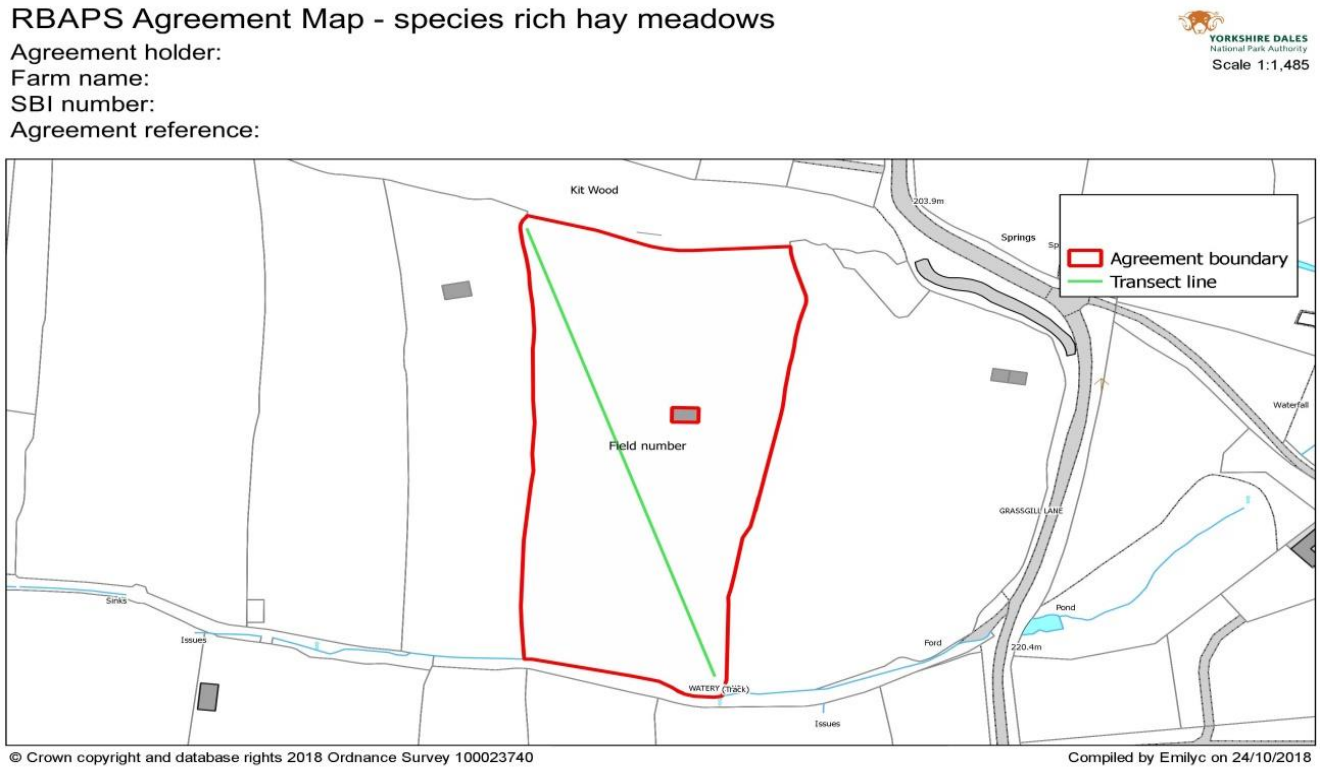

Figure 10: Example Agreement Map showing meadow survey transect line.

The repeatability of the assessment methodology was checked in 2016 by Natural England staff outside the core project team. They independently completed assessments using the same methodology on 2 wader fields and 3 meadows. Unfortunately the assessments on the wader sites were not able to be carried out until August, after the survey window and later than the YDNPA had carried out the initial baseline surveys; however it still provided an opportunity for the methodology to be tested by others and provide constructive feedback.

*Innovative approaches to verification and monitoring*

No approaches were directly applied during this project as there was limited time and budget to develop a strategy. However various innovative techniques such as remote sensing technology were discussed and the efficacy and accuracy of using remote sensing to measure results in habitat for breeding waders is being explored by Natural England in other ongoing work.

### *Payment Rates and Results Tiers*

Payment rates in the RBAPS project were based on the income foregone and additional costs which a typical participant within Wensleydale would be expected to incur when delivering optimum results. The calculations take into account income gained and costs saved set against income lost and management costs incurred. This partial budget method is well-established as it is used in conventional AES within Rural Development Plans (RDPs). However, unlike conventional agri-environment schemes, the RBAPS options did not contain prescriptions so the costings were based on assumed management regimes capable of producing optimum results for each of the objectives. The calculations were based on information about current farming practices within the Yorkshire Dales and are therefore only deemed to be applicable to the Wensleydale area. Margin and cost data was derived from a range of agricultural budget management publications (ABC 2015, AHDB 2016 and Andersons 2011).

For species rich grasslands, the calculations were based on an assumed switch from silage to hay making in meadows, with the relative savings, income change and additional costs which that incurs. An additional cost was also included to reflect the cost of the farmer's time to survey the meadow each year and the additional costs of carrying out more targeted weed control by spot treatment.

Two income foregone calculations were undertaken for habitat for breeding waders to cover the wide range of field sizes which were likely to be in the pilot scheme; the final income foregone figure was taken to be the average of the two. Within the wader fields it was assumed that under an RBAPS management regime both fertiliser inputs and stocking levels would be lower, leading to reduced income from livestock, additional costs (agistment for cattle) and savings (reduced fertiliser) and additional efforts and costs associated with managing weeds, scrub, rushes and wet features to provide the optimum habitat for breeding birds.

For both options it was assumed participants would complete an attitudinal survey each year, attend an annual training event on carrying out their self-assessment survey, plus other meetings for the RBAPS project team to provide updates on the pilot and gather feedback from participants.

The total income foregone figure became the maximum payment rate for each option as it was based on the scenarios under which optimum environmental results would be expected. It should be noted that while the maximum payment rates in the RBAPS project were considerably higher than the equivalent mainstream AES options, this was largely due to the additional activities which RBAPS participants were expected to undertake which are not included within current mainstream schemes, principally the self-assessment survey and attendance at meetings. Due to the relatively small areas under each RBAPS agreement these option level costs translated into significant amounts per hectare, especially for the hay meadow option where the typical area under agreement was estimated to be 2.25ha (actual average was 1.87ha).

A review of other grassland results based schemes across Europe (including: Burren Programme, Ireland; MEKA programme, Baden-Württemberg and other states in Germany) indicated that having a number of payment tier levels which are set according to the condition of the habitat is a positive method of encouraging farmers to do more for the habitat and therefore improve their payment. It also fairly rewards the farmers based on the condition of the habitat but provides enough incentive to further improve the condition should they want. It

recognises and makes the highest payment to farmers with the best habitat condition. Farmers have appreciated this approach which has also instigated a certain level of healthy competition between participants in the various projects. Arguably, it has also put the importance of managing the environment on an equal footing to managing livestock, as payment for both is based on the quality of the output.

A stepped payment approach is particularly suitable when dealing with habitats that are in sub-optimal condition and require a period of restoration. It provides incentive and reward for changes to management that improve the condition of the habitat – which is the key goal. A similar approach was adopted and the payment tiers were calculated using a simple linear progression.

For breeding wader habitat the payment rate generated from the income foregone calculations was based on the management of optimal condition habitat and so would score the maximum number of points (40). The highest score would be achieved by gaining 10 points for each assessed attribute, except for damaging operations where a 0 is considered the best score. This payment was then divided by 5 to produce the value by which each of the 5 payment tiers would be separated, producing a 5 tier system of equal tiers – see Table 16.

| Score /Total points | Payment Tier | £/ha |
|---|---|---|
| <9 points | 1 | 35 |
| 10-19 points | 2 | 69 |
| 20 – 29 points | 3 | 104 |
| 30 – 39 points | 4 | 139 |
| 40 points | 5 | 174 |

Table 16: Payment table for habitat for breeding waders.

For species rich meadows the payment rate was again based on the costs and income foregone of managing a species rich grassland under a traditional hay meadow regime. In the first iteration of the methodology, the payments were divided into 10 equal payment tiers. After testing the approach prior to launch, the 10 tiers were deemed to be too sensitive to seasonal and annual variations in species composition of the meadows. Therefore it was agreed to reduce the number of tiers to 5 which also increased the width of each tier.

The payment value for each was linked to the total meadow score (Table 17) as this reflected the number and frequency of indicator species identified on the transect line within the land parcel. Each payment tier was linked to a range of scores of equal size (39 points) which reflected the range of possible meadow scores that could be recorded by the survey.

| Score /Total points | Payment Tier | £/ha |
|---|---|---|
| 40 -79 points | 1 | 112 |
| 80-119 points | 2 | 186 |
| 120-159 points | 3 | 260 |
| 160-199 points | 4 | 334 |
| 200+ points | 5 | 371 |

Table 17: Payment table for species rich hay meadow.

# Experimental design

### *Adviser and self-assessment*

A core element of the design of the pilot was 100% self-assessment and independent verification of the results. A NE/YDNPA adviser and the farmer independently assessed the participating plots/fields using the same methodology, within a 10 working day timeframe. In addition to this a further 10% of participating plots/fields were subject to an independent assessment to test any variability in adviser scores.

### *Control Sites*

A set of control sites within the pilot areas were also identified and surveyed. These were paired individually, or in clusters with participant sites, according to key characteristics. For example in the case of the species rich hay meadows control sites all exhibited similar baseline species richness scores and were all under mainstream scheme management, for the arable sites these were all equivalent conventional AES options of the same age. The control sites were surveyed using the relevant assessment methodology at the same time as the RBAPS plots. Soil samples were also taken from the control sites to enable a comparison on soils for all the plot types to check whether this had a bearing on the results. Incorporating well selected control sites into the pilot was important, in order to explore if environmental changes observed within the pilot agreements were a consequence of the particular incentive and advice framework provided by the pilot. Comparing results from the RBAPS sites against equivalent habitats in management-based schemes tested whether there was any difference in environmental performance under the two approaches, isolating common factors such as the weather.

*Arable*

The control sites were selected from within the pilot boundary and consideration was given to the variables that were likely to impact on the performance of the RBAPS plots which would need to be accounted for when selecting the control sites. Given the range of soil types the pilot plots covered the conclusion was that the differences centred on the management decisions made by the farmer. However, it was recognised that the age of the pollen and nectar plots and whether the winter bird food plots were annual or 2 year mixes would be also be significant variables. Selection of controls therefore focused on Countryside Stewardship (England's current mainstream agri-environment scheme) agreements with either PN or WBF options that had been established in the same year as the RBAPS agreements. A list was produced and the farmers were contacted to see if they would be happy to be a control and to establish the characteristics of their plots. Overall 26 suitable control sites were identified, 13 each of WBF and PN.

*Grassland*

Control sites were randomly selected from data sets of sites that closely matched the habitat and attributes of the pilot sites and were being managed in a live AES agreement for the same objectives as the RBAPS pilot. The data were derived from the latest AES information held by Natural England and the YDNPA Habitat Survey for Wensleydale (2015 and 2016).

To provide a reliable control it was important that control sites were matched as far as possible to the baseline conditions of the RBAPS pilot sites. The following criteria were used:

- Within pilot area;
- Size;
- Altitude;
- Aspect;
- Soil and vegetation type.

Permission was sought from the farmers who had suitable control sites to ask if they would be willing to be involved in the pilot. Overall 9 suitable hay meadow control sites and 10 habitat for breeding wader control sites were identified. Unfortunately the timing of the selection of control sites in the first year of the project meant that it wasn't possible to undertake baseline habitat assessments until 2017 (year 1), coincident with the first re-assessments of the pilot participant sites. However, for the meadow sites data from the YDNPA Habitat surveys (2015 and 2016) and data from AES baseline assessments (2011-2013) was available. These sources identified a range and frequency of species for the sites, allowing an equivalent RBAPS score to be generated. However, the original survey methodology wasn't identical to that developed for the pilot and in some cases the survey data pre-dated the baseline year by several years so this baseline data needs to be caveated accordingly. For the habitat for breeding waders control sites there was insufficient existing data to make an accurate assessment of the baseline condition. Therefore assessments of the habitat on control sites started in spring 2017 (year 1) to coincide with the first year of RBAPS Agreement assessments.

### *Participant and Stakeholder Surveys*

Two participant surveys were carried out (See Appendix 4 for details). The first was completed in early summer 2017 (year 1) before participants had completed their first year assessments. The second attitudinal survey was done in late 2018 (year 2) after the farmers had completed their second year's assessment. The timing was intended to complement the first survey which was timed before the majority had done any assessments to capture the 'before' and 'after' views and how these may have changed. The approach to developing the questions was to gain an understanding of the background of the participants and farm structural characteristics followed by their reasons for being interested in the pilot. Additional questions were grouped around their views of an RBAPS approach and specific questions on the habitats they were managing in the pilot. In the second year a number of questions were repeated to see if views had changed and some additional questions were added focused on the role of advice and support. In addition in depth interviews were conducted with four of the farmers which can be found at Appendix 7.

Stakeholder input was coordinated via the Agri-Environment Stakeholder Group (AESG) which is a national advisory group convened to support the delivery of AES in England. It comprises representatives from a wide range of government and non-government organisations with an interest in AES delivery and development (Membership list at Appendix 5). The RBAPS project presented the draft methodology to the group in Spring 2016 to gauge opinion, feedback and suggestions for alterations. A structured online survey was created for AESG stakeholders to complete to gain an understanding of their views on RBAPS approach (at Appendix 4). The approach to developing the online questions was to gain an understanding of the stakeholders experience and views of existing management based agri-environment as well as an RBAPS approach, enabling a comparison between the two. In addition to this attendees at the two final dissemination conferences were asked about their views on including RBAPS approaches in future AES.

### *Delivery cost and cost-effectiveness analysis*

Staff time recording of the process steps undertaken to deliver the pilot was completed to enable comparison to equivalent data from mainstream AES delivery.

## Implementation

### *Eligibility Criteria*

Eligibility criteria were developed to ensure there was no incompatibility with existing agri-environment schemes or designations (incompatibility to include dual funding and/or other obligations on the land that could influence the results). The eligibility criteria are detailed in the RBAPS Manuals (published separately) and summarized as follows:

- The Agreement Land itself must not be managed under any other agri-environment scheme option for the duration of the RBAPS Agreement. Land within an existing RDP funded AES agreement is eligible for the Pilot Scheme providing it does not have a paid scheme management option on it.
- Applicants must have control of all the Agreement Land and all the activities needed to meet the Pilot Scheme requirements for the full duration of the Agreement.
- The Agreement Land must be registered on the Rural Land Register to the Agreement Holders SBI (Single Business Identifier).
- Agreement Land must not be in receipt of any other funding other than the Basic Payment Scheme (BPS) (double funding risk).
- Agreement Land must not be used as Ecological Focus Areas (EFAs) (double funding risk).
- Eligibility was checked on application and before payment of claims. For simplicity it was also decided not to allow designated sites to be included in the pilot e.g. Sites of Special Scientific Interest (SSSIs) or Special Areas of Conservation (SACs).
- Agreement Land must not be under any other grant or management obligation such as Inheritance Tax Exemption (double funding risk).
- Common land and shared grazing is not eligible
- Agreement Land must not be designated a Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) or Special Area of Conservation (SAC)(These were excluded as certain management activities are prohibited therefore preventing a participant having freedom to manage).
- For grassland - Habitats had to reach the minimum baseline score for a payment to be eligible to enter the scheme.
- For arable - In order to maximise the comparison of the results based approach with the conventional action-based approach an additional criterion was applied. Applicants had to have an area of existing winter bird food or pollen and nectar on their farm that was part of an existing mainstream agri-environment scheme. This could be either Environmental Stewardship (ES) or Countryside Stewardship (CS). This enabled a 'baseline' survey to be completed (which would not normally be possible for these arable habitats as they are created on cultivated ground). This differed from the grassland element where the baseline survey was carried out on the field being entered into the scheme.

### *Scheme Manuals*

The RBAPS Arable/Grassland Manuals covered all aspects of the pilot that a potential applicant would need to know before applying. The intention being to have everything in one place for an applicant and subsequent agreement holder. This included: selection criteria, appeals processes (agreement, and payment)/dispute resolution, contracts, double funding cross-checks, payments process and guidance (published separately).

### *Recruitment of Participants*

The application process mirrored the existing mainstream agri-environment scheme process. Application windows were agreed and differed between the two geographical areas. An earlier window closing on 31st July was needed for the arable to allow for the sowing of the pollen and nectar plots in late summer, the grassland application window closed 8th August 2016.

For the arable area reports were run to produce a list of all holdings in the pilot boundary that had the relevant management options present in existing AES agreements. This produced a list of just over 250 farms. A flier was produced and posted to all the farmers inviting them to express an interest. Following an initial expression of interest potential applicants were checked against the eligibility criteria in the final handbook during a pre application visit and, subject to eligibility, provided with an application form.

For the grassland area reports were run using existing data to produce a list of all holdings (approximately 300) in the pilot boundary. Following an initial expression of interest potential applicants were checked against the eligibility criteria in the final handbook during a pre application visit and, subject to eligibility, provided with an application form. Thirty five farmers responded to the letter and each was visited by YDNPA advisers in June 2016 to explain the approach and to assess the eligibility of their land. All farmers who responded were keen to take part but many were already in a current AES on the land parcels they wanted to include in an RBAPS Agreement and this excluded them from applying. Three farmers did not meet the eligibility criteria for the hay meadow option due to low species diversity (using the assessment methodology they scored less than the minimum required to attract a payment). Nineteen farmers were encouraged to submit applications on eligible land and the fields identified for inclusion were surveyed by a YDNPA adviser using the standard methodology. This survey was undertaken with the farmer present to introduce them to the assessment methodology and to set the initial 'baseline score' for the habitats prior to entering an RBAPS Agreement.

Promotion of the project was challenged by two periods of Purdah; one for English local elections and one for the UK EU Exit Referendum. This, coupled with the immediate level of response received, meant that a decision was made not to do further publicity through for example local land agents/stakeholders.

### *Agreement Offers*

Budget checks were completed once all the grassland and arable applications had been received to ensure that there was sufficient budget based on the assumption that all would achieve the top level of performance.

### *Participants*

In total 34 farmers were recruited to participate with a total of 230.68 hectares of land enrolled in 2 year agreements (2016/17 and 2017/18) (Table 18).

| | Grassland | | Arable | | TOTAL |
|---|---|---|---|---|---|
| **Farms** | **19** | | **15** | | **34** |
| | **Species rich hay meadow** | **Habitat for breeding waders** | **Winter Bird Food** | **Pollen and Nectar** | |
| **Number of pilot Agreements** | 11 | 14(13)* | 15 | 11 | **34 (some have both options)** |
| **Number of fields/plots** | 19 | 22(20)* | 18 | 11 | |
| **Total area under agreement (ha)** | 35.35 | 153.25 (137.52) | 25.14 | 16.94 | **230.68 (214.95)** |

Table 18. Summary of pilot agreements.

*One agreement holder left the pilot after the first year.

The areas under RBAPS agreement for wading birds were registered as 22 separate field parcels but 3 pairs of fields were managed as single units so effectively there were 19 units of habitat for breeding waders.

*Arable*

36 farmers responded and registered an interest in the pilot. All those who responded were contacted by telephone to discuss their interest and whether they would be able to fulfil the requirements. 16 were then visited to discuss the scheme. The remaining either did not respond when follow up contact was made or on further discussion decided they were not able to apply. The main reason for this was lack of available land for the RBAPS options in addition to their existing AES options. However, many of those who were not able to apply were keen to be kept up to date with the progress of the project.

*Grassland*

Of the 30 farmers who responded to the project call, eleven farmers did not meet the eligibility criteria regarding double funding on existing agri-environment scheme land and could not apply. Nineteen meadows sites (totalling 35.53ha) and 22 wader sites (totalling 153.25ha) across 19 farm holdings were chosen to go forward into the pilot. The locations were spread evenly across the pilot area and varied in size, altitude, vegetation and soil type providing a good representative sample of upland hay meadows and breeding wader sites within Wensleydale. The breeding wader sites fell into two distinct categories: four were relatively improved flood plain pastures in the valley bottom while the remaining fields contained rough grazing on higher "allotment" land. This presented an issue as the scoring system for vegetation height and rush cover had been developed to reward the more varied sward structure favoured by three of the target bird species - Eurasian curlew, common redshank and common snipe. But the flood plain pastures had good potential for Northern lapwing which prefer to nest within shorter and more uniform swards; indeed three in particular were favoured by Northern lapwing.

Participant Characteristics

The headline characteristics of the participants and their businesses are as follows:

- The average size of the participating grassland farms is 84ha, ranging from 5-286ha, whereas the arable average is 288ha, ranging from 77-703ha,
- The majority considered farming their main business, although a significant minority of the grassland element did not,
- The majority of participants have been in farming for more than 20 years, with a small number of more recent entrants,
- There is an even split between those with and without a confirmed successor,
- The majority (11/14) of the grassland participants have previous agri-environment experience (for the arable existing scheme membership is a prerequisite),
- Of the arable participants, 11 of the farmers are over 45 years old and all bar one are owner occupiers; some with additional rented land. Six have a mixed farm including livestock of which 2 are dairy, the remainder are arable farms,
- The farm types are a varied mix of large commercial farms, small farms, farms with a long history of involvement with agri-environment schemes and some which have never previously participated.

### *Grant Claims and budget management*

Participants were required to submit a claim form each year to Natural England where they recorded their self-assessment score in each land parcel and answered a series of questions relating to eligibility requirements. The claim deadlines were mid-November for the arable and mid-December for the grassland in year 1 and mid-December and end of October for both in year 2 to allow for analysis of the results.

On receipt of claims a checklist was completed in order to confirm the eligibility of the options and to ensure double funding was not a risk a series of checks were undertaken against data held on the two IT systems that support the existing RDPE AES in England. The only check that we were unable to verify using these systems was whether the arable plots had been claimed as Ecological Focus Areas in the Basic Payment Scheme; for this the claimants made a self-declaration on the claim form. In order to process the payments Natural England's financial system was used. This entailed setting up each agreement holder as a supplier, raising a purchase order for the work and then receipting it once the claim form had been received and checks satisfactorily completed. A summary of the total payments to participants is provided at Appendix 3.

*Arable*

In instances where there was one payment tier's difference between the adviser assessment and the farmer self-assessment payment was made on the higher tier recorded (whether adviser or farmer). This recognised the sensitivities in the 'pilot' assessment methodology. If the difference was two, or more, payment tiers e.g. Tier 4 and 6, the payment was on the difference between the two, so in this example it would be Tier 5. The farmers were contacted to inform them of the situation. In situations where the farmer recorded a higher tier a second adviser visit was undertaken to verify the results before applying the principles above. All results presented are the original adviser and self-assessment tiers.

*Grassland*

An approach was developed for cases where the farmer's and adviser's scores fell into different payment tiers. In this situation the YDNPA adviser contacted the farmer to discuss the survey results and compare the outcomes together. A discussion took place about how each party reached their score including their survey

technique and identification skills. From these discussions a decision was made on the final score which was agreed by both parties. The adviser then completed a 'Score Confirmation Note' for the farmer to sign to confirm their acceptance and include with their claim form. Payment was then made according to the agreed final score. This proved to be a simple method for settling score discrepancies for participating farmers but required additional input from YNDPA.

All results presented are based on the original adviser and self-assessment scores rather than any adjusted scores used for payments. Further details on the frequency of differences between adviser and self-assessment surveys, causal factors and outcomes from the discussions are provided in the Monitoring and evaluation section.

### *Provision of guidance and training*

*Arable*

The project team have many years of experience planning and running events for farmers. The advisers also discussed with the participating farmers what they would require. An initial programme was developed for year 1 (Table 19).

| Date | Title | Type | External Resource |
|---|---|---|---|
| February | Getting the Best Out of Your Plots | All day meeting and farm walk | Game and Wildlife Conservation Trust/Wildlife Farming Company |
| June | Management of Your Plots | Farm walk | N/A |
| Nov/Dec | Annual Meeting – to update on scheme/project developments | Evening meeting | N/A |

Table 19: Training and Advice Provision.

Getting the Best Out of Your Plots

All 15 agreements were represented by one or two people. At the start of the day we asked the farmers to list the top two things they wanted covered by the day. For Winter Bird Food (WBF) the results were weed control and establishment, for Pollen and Nectar (PN) weed control and pest control. The two speakers from the Wildlife Farming Company and Game and Wildlife Conservation Trust who are nationally respected experts in their field covered establishment and management of the options before we went and looked at some established plots on the host farm (not in the pilot).

Feedback was very positive with the event answering the majority of the questions they had. Some farmers wanted us to provide WBF seed mixes for them but we deliberately didn't cover this to avoid everyone putting in the same mix and removing the need for the farmer to consider this for themselves. At the event we gauged the interest in a follow up farm walk in early summer to look at some newly sown plots. There was enthusiasm for this from the farmers and they all indicated they would like a farm walk.

Management of Your Plots

This farm walk in June was principally to introduce the farmers to the assessment methodology, do some plant identification and discuss management issues at a key time for both options. The host farmer is participating in the pilot with both winter bird food and pollen and nectar options. The walk provided an excellent opportunity to share the challenges he was facing and discuss some practical options that could be taken. In addition to the management the team demonstrated the assessment methodology for pollen and nectar. The farmers were

then split into groups of three; each led by an adviser to run through the methodology and complete some plant identification using the photo guides the team produced (published separately).

This was well attended although some farmers were unable to make it due to other pressures (silaging) at this time of year. This event highlighted the need for training in identification and the methodology as the farmers were not confident at the beginning of the walk, but their confidence increased after completing a number of quadrats.

End of year 1 Annual Meeting

The annual meeting to share and discuss the year 1 results was postponed from the end of February 2018 due to snow to the end of March. This was well received with 11 of the 14 farmers attending. The meeting was combined with an all team project meeting so the grassland team were able to meet the arable farmers. YDNPA presented the grassland results before a presentation of the arable. The feedback was incredibly positive with the farmers really enjoying learning about the grassland element of the pilot. A lively discussion took place over aspects of the arable with a focus on each of the objectives covering a range of topics the arable team had identified. These included assessment methodology, plot management and guidance.

Plot Assessment Refresher June 2018

A farm walk was held in June to discuss plot management in a very different climatic year to year 1 and run a refresher on the assessment methodology. Hosted by a farmer with both winter bird food and pollen and nectar enabled a full discussion amongst the 11 farmer attendees and pilot team. During the farm walk the farmers were split into smaller groups each led by an NE adviser to complete an assessment of the pollen and nectar plot. This provided a timely refresher on identification. The dry spring resulted in a useful discussion about establishment of winter bird food plots, the host farmer had allowed his plot to self-seed and then direct drilled into it which was an interesting talking point.

In addition to the group events the advisers have provided one to one support and advice. The amount varied between the farmers and advisers. Most farmers received support on the assessment methodology and plant identification in both years. Method and duration of advice and support was adapted according to the needs of individual farmers, including, office based, field based, telephone calls and emails (as well as at farm walks and RBAPS meetings).

*Grassland*

Training was discussed at the pre-project stakeholder meetings and was forecast to be a major element of the pilot as farmers would be asked to undertake new areas of work, of which most would not have had any previous experience. Comments from stakeholders and NUC farmer groups also raised skills training as an important aspect.

Self-assessment was highlighted as the major concern for all the participant farmers. The issue was widely raised at the pre-project stakeholder meetings and the participant inception meeting. Training was discussed at length with participant farmers before the first surveys were undertaken and most of the discussion was focussed on the process of self-assessment. In response, bespoke training was provided for both project options as each option assessment required different surveying techniques. Some farmers had land in both options which meant they received training for both. In addition to group training all farmers were offered individual advice and guidance.

Some initial training on the assessment methodology was undertaken during the pre-application visits with the applicants. For the habitat for breeding waders option the farmers were asked to consider the descriptive

criteria on the score sheet and identify (with help from the adviser if necessary) the ones that most closely matched the conditions within the field. Farmers were 'tested' as the first assessment was undertaken, in order to see if they understood the descriptions and approach overall. This approach was applied to the meadow option as well with farmers observing the methods used, learning about plant identification and undertaking their own assessment on the last stops along the transect line. The farmer accompanied the adviser during the baseline assessment of the meadows. The assessment was done together and this was a valuable lesson for all as it gave the farmer the opportunity to observe the survey methods and gave the adviser the chance to assess the farmers' capabilities and identify areas which would need further guidance. Agricultural management of the fields was also noted, including the approximate dates when livestock was usually removed to allow the sward to grow for hay (the "shut up" date), and the hay cut, average number of bales produced, livestock management and fertiliser regime. Feedback from this initial field testing of the methodology allowed for slight tweaks to the format and scoring bands (see setting thresholds section).

RBAPS grassland agreements commenced on 15th September 2016 and in November 2016 the first agreement holder meeting was held. The aim of the meeting was to bring participating farmers up to date with the project developments, increase understanding of the results-based approach, discuss hay meadow and breeding wader restoration methods, agree the training needs and discuss the content of technical guidance. After discussion with agreement holders it was clear their main issue and concern was with the identification of plant species for the hay meadow assessment and that they would need in depth support and guidance before they were confident to self-assess. Farmers were more confident in their ability to self-assess the habitat for breeding waders although some were very keen to have training in bird identification.

The farmers asked to have annual meetings in addition to specific training events. It was agreed to develop a training program that included group sessions on farm, looking at good quality habitats with the farmer who managed them, one to one or one to many training on the scoring sheet methodology, plant species identification and training on hay meadow restoration techniques. This program was initiated in year 1 (2017) and reviewed at the second annual meeting in November 2017.

Group training

At the project inception meeting in November 2016 an information pack was provided to each farmer which collated technical guidance from a wide variety of existing resources. The packs included best practice guides on rush management, scrape creation, soil management, hay meadow restoration and ID cards for hay meadow species and breeding waders. As part of the meeting a workshop was undertaken with separate groups looking at both options to identify areas of concern and to establish individual farmers' abilities to undertake the self-assessment and to formulate a training plan.

After consultation with farmers at the inception meeting a series of training events were organised, the first two of which were indoor sessions arranged before the survey season. All were well attended by participating farmers, often with members of their close family who would be helping with the self-assessments.

Hay meadow restoration – March 2017

The project utilised the technical expertise of the local Hay Time Project Officer from the Yorkshire Dales Millennium Project, who provided an informative talk on the techniques of hay meadow restoration, covering the basics from seed collecting, through to full scale sward enhancement using green hay. Farmers were encouraged to carry out the work themselves and feel confident in being successful with the restoration work. Nine agreement holders (out of 11 that have meadows under RBAPs) attended. Feedback was extremely positive with the average score on feedback forms being 4 out of 4.

Breeding waders – March 2017

Technical expertise from the YDNPA Wildlife Officer was provided to seven agreement holders (out of 14 that have habitat for breeding waders under RBAPs). The event covered the typical traits of the 4 key species, identification of eggs, chicks and habitat requirements for the different periods when the adults are in the uplands. Techniques for habitat restoration were explained, including rush management and scrape / wetland creation. Similarly, feedback was extremely positive with the average score on feedback forms being 3.8 out of 4.

Meadow species identification and survey techniques – June 2017

This event was held at one of the most diverse meadows in the National Park, the Coronation Site of Special Scientific Interest (SSSI) meadows in Muker, Swaledale. This meadow was chosen to show farmers a high quality meadow and which also served as a survey training exercise. The farmer was on hand to describe his management techniques and project staff provided help on identification of typical meadow plant species. Some farmers had already undertaken their meadow self-assessment surveys so it was agreed to arrange future events earlier in the season.

Meadow species identification and survey techniques – June 2018

In the second year a field training event was held a RBAPs control farm in Wensleydale. A number of meadows were looked at as they contained different combinations of species, and survey techniques were practised. It was noted that the main difficulty was in identifying grasses. It was also acknowledged that in order to identify early flowering species such as Pignut an additional earlier survey may be needed.

Individual training

Farmers varied in their survey abilities and identification skills. In 2017, the first survey season, some farmers were happy to “get on with it” whilst others were less confident and keen to have extra adviser support. Some farmers sent in photos of plants they were unsure of or could not identify. Farmers seemed more confident during the second survey season in 2018. Other advice requests from farmers in addition to the training program related to capital works which some were undertaking to improve their score – particularly on rush management, scrape creation or ditch modification, wildflower seed addition, timing of shut up dates and hay cut. YDNPA advisers provided this advice by email, site visit or phone call. Farmers were made aware that they could contact a YDNPA adviser at any time for technical support or guidance on any aspect of the pilot.

# Monitoring and evaluation of the measures and biodiversity targets

## Results

The following sections detail the environmental performance of each of the habitats according to their result measures, payment tiers and respective to the control sites.

### *Winter Bird Food*

*Sown Species*

The number of crops per plot was measured to define the payment tier with five crops achieving the maximum payment rate. The approach was used to measure and compare results in:

- "RBAPS" plots - within RBAPS agreements for the pilot;
- "baseline" plots - on the same farms as the RBAPS plots but in equivalent mainstream AES management (Environmental Stewardship, ES);
- "control" plots - also under ES but on different farms in the pilot area.

The minimum requirement for ES plots is 3 small seed bearing crops. Fifteen baseline plots were surveyed in year 1 and 14 in year 2. The control plots are all in Countryside Stewardship (CS), which does not define a minimum number of crops, but specifies that a mix of cereals, brassicas and other crops should be sown. Thirteen control plots with a one year mix were surveyed each year.

The RBAPS plots have consistently contained more established seed crops than both the baseline and control plots. Figure 11 illustrates that the RBAPS plots had an average of 4.9 crops compared to 2.9 for the baseline and 2.7 for the controls, although the average was slightly higher in year 1 for the RBAPS plots (5.3) compared to year 2 (4.5) a pattern which was replicated in the baseline plots (2.9 and 2.6 respectively). Conversely the average for the control increased between these years from 2.5 to 3.0.

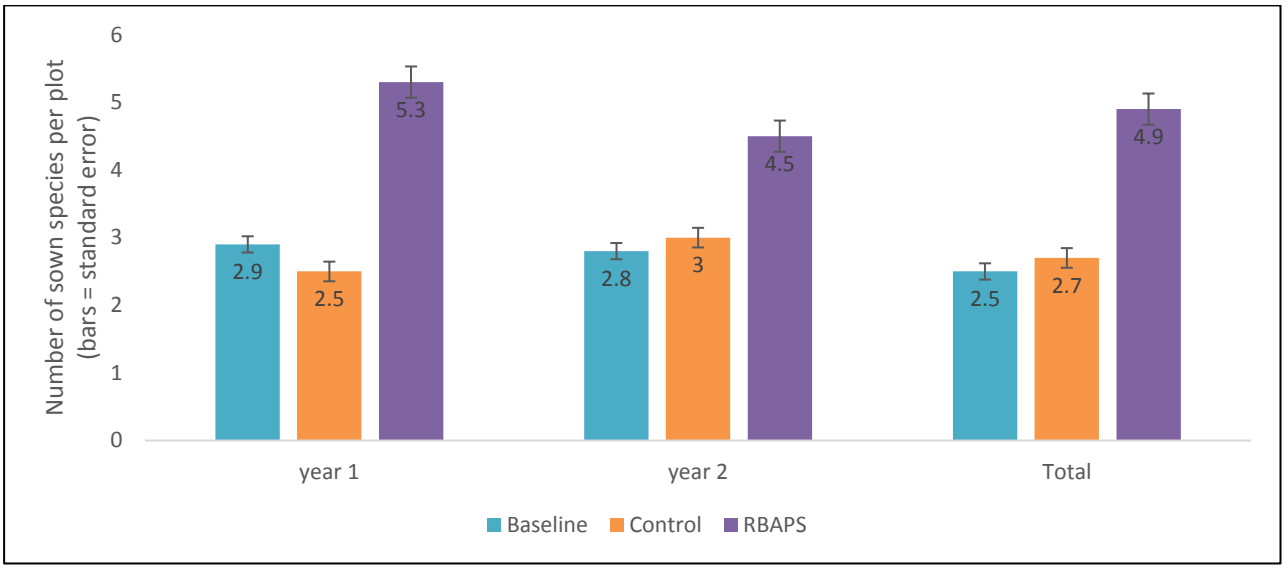


Figure 11 Winter Bird Food: average number of seed-bearing sown species.

For the baseline and control plots in mainstream ES this could be attributed to the lower number of seed crops required, but 48% of the baseline plots had a lower number of crops (two or less) than the three that the prescriptions require. There was a decrease from 53% to 42% of baseline plots with two or less crops between year 1 and year 2, but some plots had no crops recorded at all; 13% in year 1 and 14% in year 2. For the control plots in CS (which do not have a defined number of crops as part of the prescription) the results were similar with 50% having two or less seed species present and 8% no established crops. In comparison none of the RBAPS plots had less than 2 crops (Figure 12). Comparing the total values of these three groups (by pairwise Wilcoxon Test with corrections for multiple testing), those for RBAPS are significantly higher than both baseline (P0.002) and control (P<0.001).

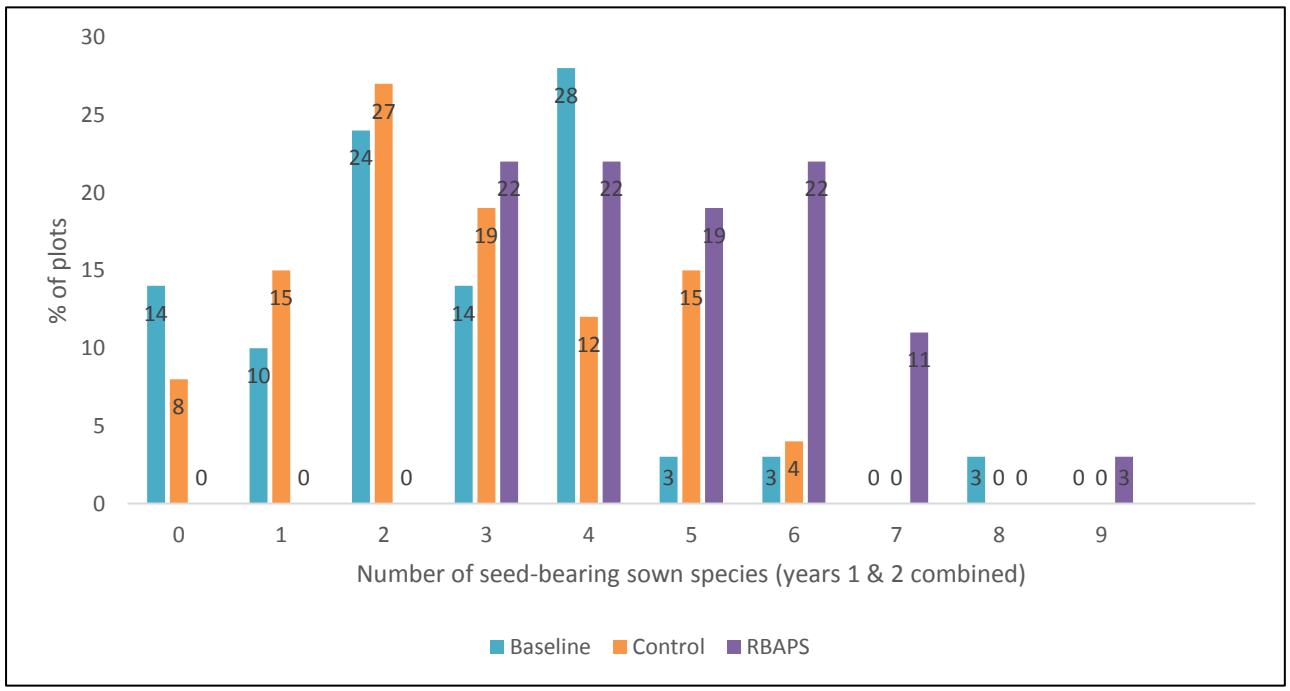


Figure 12. Winter Bird Food: number of seed-bearing sown species per plot.

*Payment Tier*

Figure 13 shows the average payment tier for each plot per year and the average over the two years (total). The RBAPS plots were paid according to this tiered rating. The ES and CS plots have standard payment rates, but this shows which tier they would have achieved if the RBAPS scoring had been applied. There are 6 payment tiers for the winter bird food objective, tier 1 is £0. 55% of the RBAPS plots had 5 or more crops resulting in the highest payment rate (62% in year 1 and 50% in year 2). This compared to 9% in total of the baseline (14% in year 1 and 7% in year 2) and 19% in total for the control (8% in year 1 and 31% in year 2). None of the RBAPS plots fell into the bottom three payment tiers (tiers 1 – 3). This compared to 56% of the baseline (total) and 50% (total) of the controls. Tiers 1 – 3 equate to 0 – 2 crops in a plot. Comparing the total values of these three groups (by pairwise Wilcoxon Test with corrections for multiple testing), those for RBAPS are significantly higher than both baseline (P<0.001) and control (P<0.001).

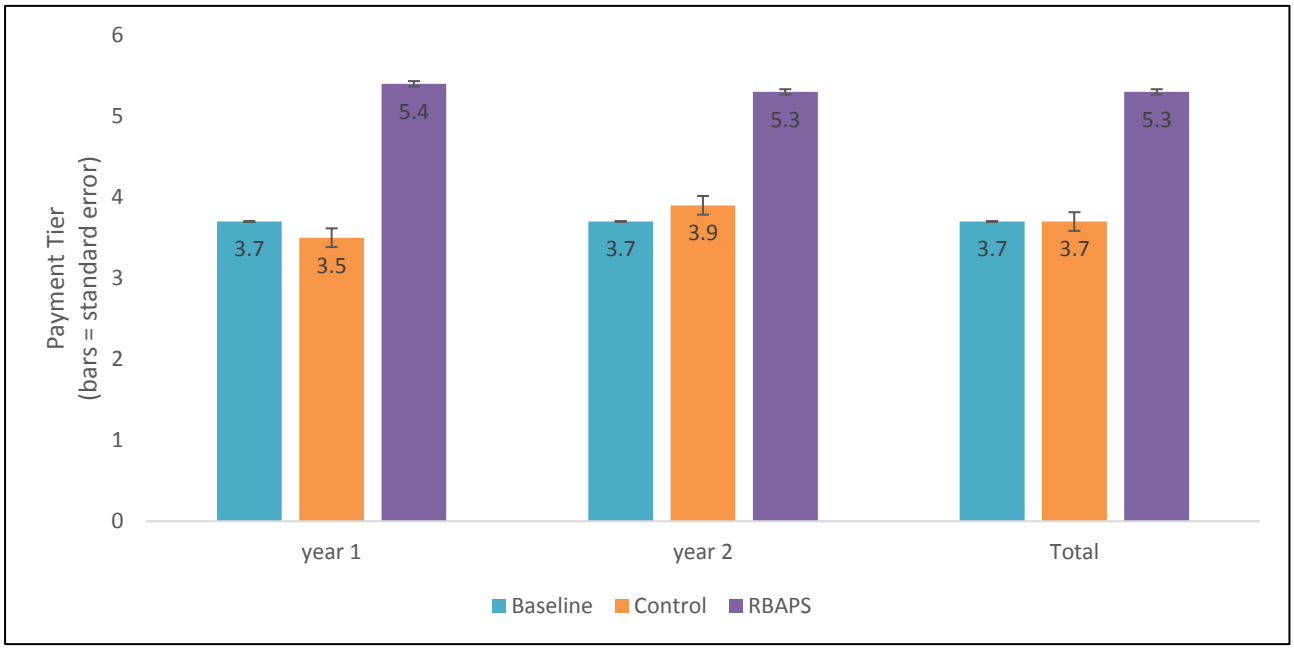


Figure 13: Winter Bird Food: average payment tier.

## *Pollen and Nectar*

*Sown Species*

The number of sown species per plot are measured to define the payment tier, with five species achieving the maximum payment rate in the RBAPS plots. The baseline plots are on the same farm as the RBAPS plots and are all in Environmental Stewardship (ES). The minimum requirement for ES plots is at least 4 nectar rich species. 11 baseline plots were surveyed in year 1 and 9 in year 2. The control plots are all in Countryside Stewardship (CS) which defines a minimum of at least 6 sown species: at least 4 nectar rich and at least 2 perennials. 13 control plots of the same age were surveyed each year.

The RBAPS plots have produced slightly more sown species than both the baseline and controls. For those baseline plots in ES this could be attributed to the lower numbered required, but 40% of these plots had a lower number of species than the prescriptions require. There was an increase from 36% to 44% of plots with three or less species between year 1 and year 2 and some plots had no species recorded at all; 9% in year 1 and 11% in year 2. For the control plots which require 6 species the results showed that 67% had less than

required this increased from 54% in year 1 to 70% in year 2. In year 1 no control plots had no species, increasing to 8% in year 2.

83% of the RBAPS plots had 5 or more species resulting in the top payment rate with an equal percentage of plots in each year achieving this. This compared to an overall total of 45% of the baseline; 54% in year 1 and 33% in year 2 and an overall total of 48% for the control; 47% in year 1 and 46% in year 2. None of the baseline plots had more than 7 crops whereas some of the control and the RBAPS had up to 10.

As Figure 14 illustrates the RBAPS plots had an average of 6.3 species compared to 3.8 for the baseline and 5.2 for the control plots. Although the average was slightly higher in year 1 (6.5) compared to year 2 (6.1) which was replicated in the baseline (4.2 and 3.2 respectively) and the control 5.8 in year 1 and 4.5 in year 2. Comparing the total values of these three groups (by pairwise Wilcoxon Test with corrections for multiple testing), those for RBAPS are significantly higher than baseline (P0.002) (and other comparisons are not significantly different).

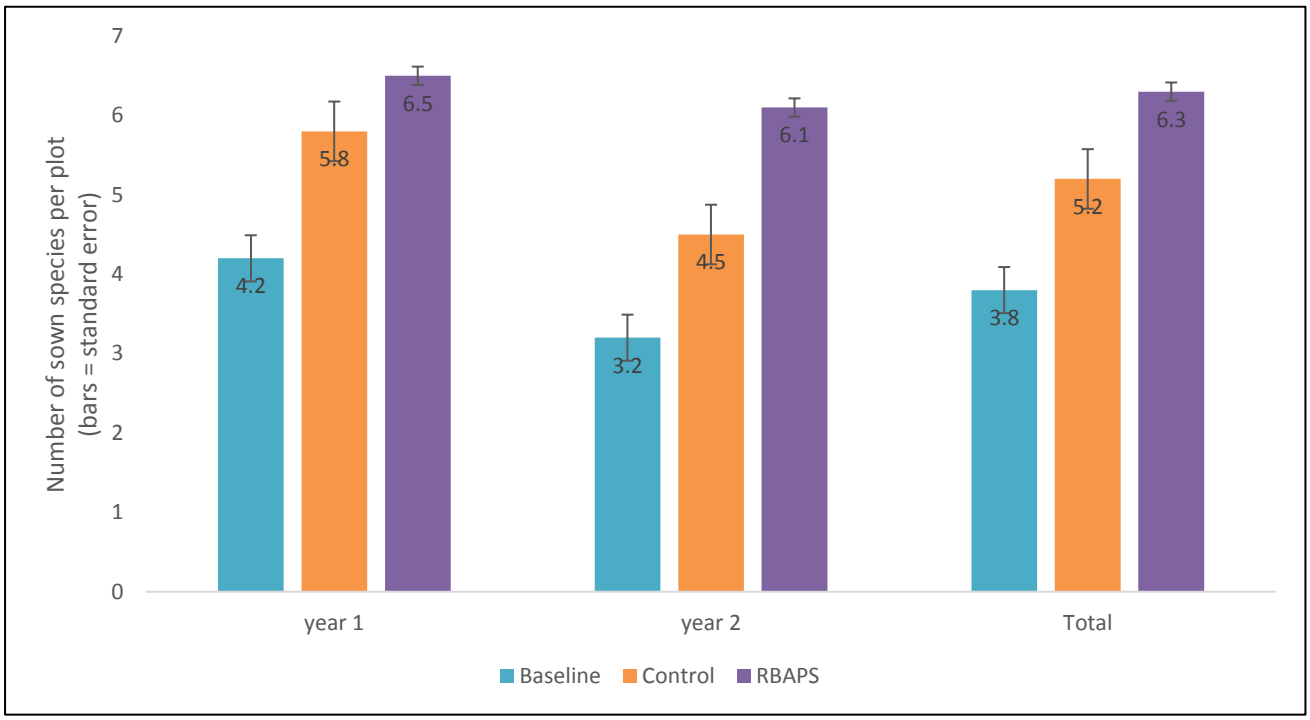


Figure 14. Pollen and Nectar: average number of sown species present.

*Proportion of ground cover*

In the second year percentage cover was assessed as well as presence/absence of species. Greater differences started to show in terms of environmental performance, but also accuracy of the assessments. Cover is a more subjective criteria to measure although the majority - 64% fell within the same 10% band in the self and adviser assessments. None of the RBAPS plots had below 50% cover compared to 44% of the baseline and 24% of the control. 55% of the RBAPS plots achieved 91 – 100% cover compared to 11% of the baseline and 23% of the control. Overall the mean percentage cover was 84.1 for the RBAPS, 70.1 for the control and 54.2 for the baseline (Figure 15).

The differences were particularly apparent when comparing the baseline and RBAPS plots on the same farm. The baseline plots were, in the main older plots that were starting to become grass dominated, which is typical of these plots. In the first year the assessment picked up the presence of a range of different species

in the baseline plots, but as the second year results shows, they are not widespread across the plot in terms of percentage cover. Therefore, the quantity of pollen and nectar is reduced compared to the younger RBAPS plots.

The differences with the controls are not so marked as with the baseline. The control plots are the same age as the RBAPS plots. Experience has shown that the mixes used for PN plots tend to be agricultural legumes designed for short term leys. This means that they have a natural lifecycle of around 3 – 4 years before they start to deteriorate allowing grasses and broad-leaved weeds to take advantage of the open ground. Therefore, the species in the control plots are still in the initial flush of growth and it was expected that they would perform well.

The decision was deliberately taken not to steer farmers towards particular species, differing to the WBF. The majority of the famers used existing standard mixes with some modifications. Generally a much larger number of species were sown (up to 14 in some cases) than required to meet the maximum payment rate threshold of 5. This is reflected in the greater number of species found, which even with differences between the adviser and self-assessment still resulted in the top payment tier. Some annual species that do not react well to topping such as phacelia were included which raises the question of why decisions were made to pay for species that are not going to count beyond the first year.

An issue that arose in the second year for the RBAPS plots was the dominance of certain species. Alsike clover started to take over to the detriment of some of the less aggressive species in some plots. Lucerne was another sown species that grew very tall and due to its long tap root was able to keep growing despite the dry weather. It then had the tendency to fall over smothering other species underneath.

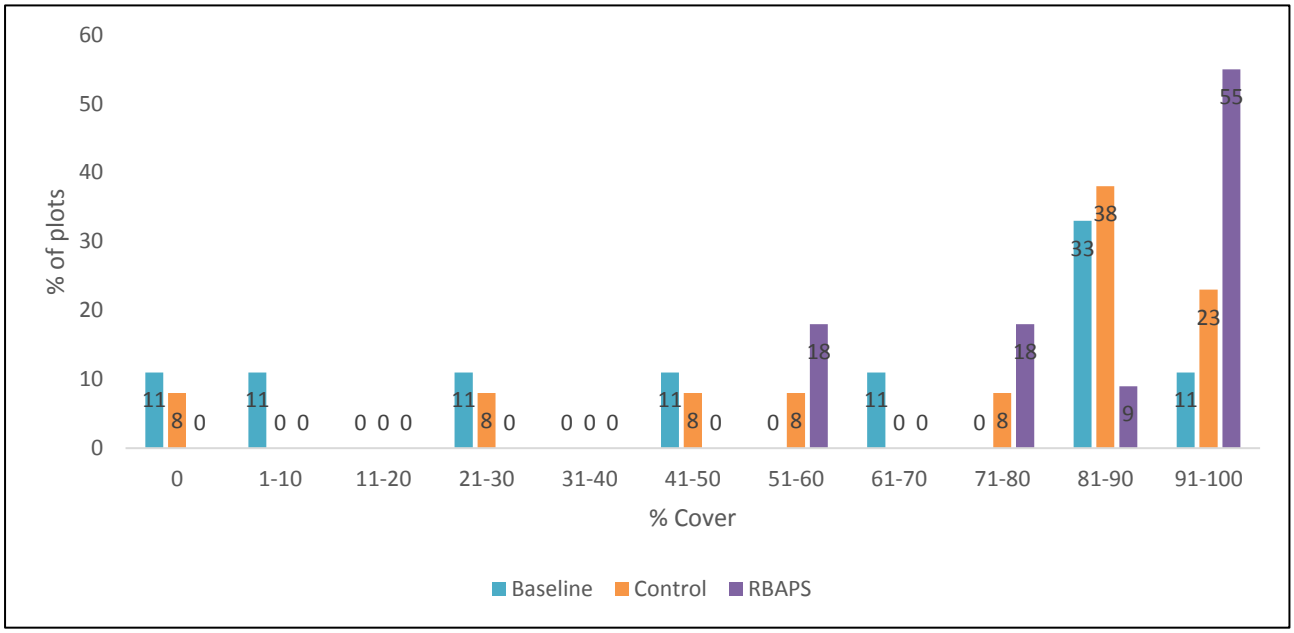


Figure 15: Pollen and Nectar: proportion of ground cover per plot in year 2.

*Payment Tier*

Figure 16 shows the average payment tier for each plot per year and the average over the two years (total). The RBAPS plots were paid according to this tiered rating, the ES and CS plots have standard payment rates, but this shows what tier they would have achieved had the RBAPS rates applied. There are 10 payment tiers for the Pollen and Nectar option, tier 1 is £0.

On average the RBAPS plots were around 1 tier higher than the controls and 2.5 tiers higher than the baseline. None of the RBAPS plots fell into the bottom four payment tiers (tiers 1 – 4). This compared to 30% of the baseline (total) who were all in tier 1 (£0) and 12% of the controls. 64% in total of the RBAPS plots achieved the top payment rate; 82% in year 1 and 45% in year 2. This compared to the baseline in which 40% in total did; 64% in year 1 and 11% in year 2 and 35% in total of the controls; 54% in year 1 and 15% in year 2. However, no significant statistical difference was found between the total values of these three groups.

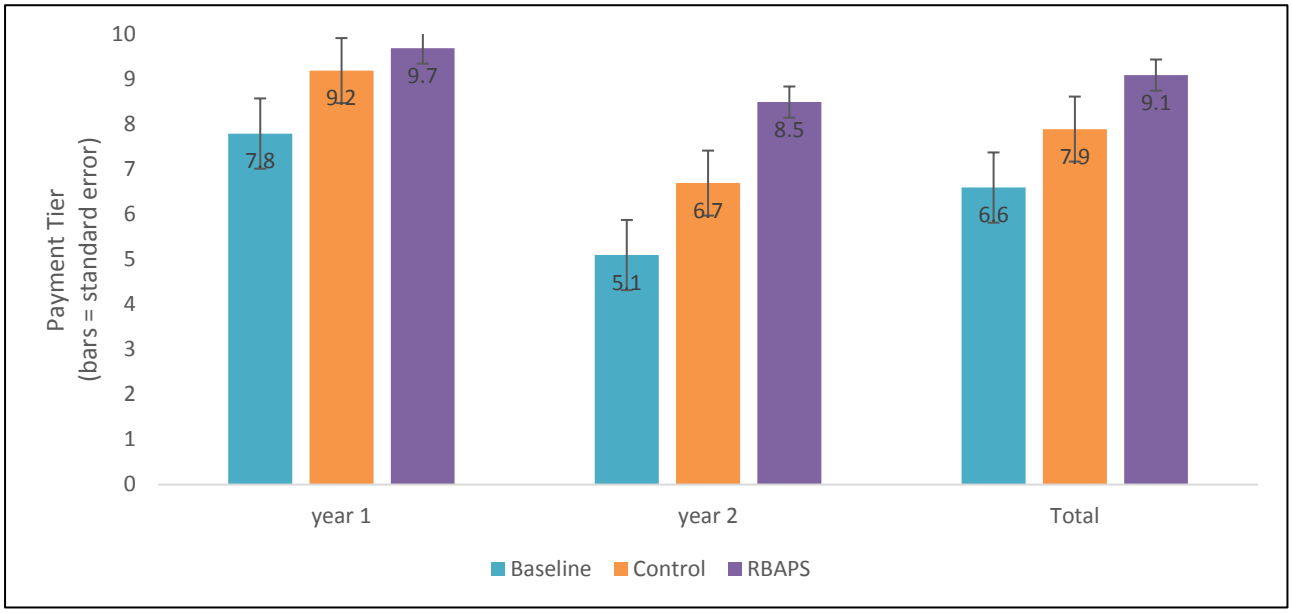


Figure 16: Pollen and Nectar: average payment tier

### *Species Rich Hay Meadows*

*Meadow Scores*

Table 20 shows the distribution of scores (shading) for RBAPS and control site meadows across different score bands for each of the three years. Before entering the RBAPS the meadow scores across the 19 fields fell within the mid to lower range of the payment scale, with scores ranging between 40 and 150 points (payment tiers 1 to 3) and averaging 83 points. It was possible to derive baseline data for five control sites managed under prescription based agri-environment schemes by referring to surveys carried out between 2011 and 2013 (4 sites) and 2016 (1 site) using the similar 'W' transect approach; their total meadow scores ranged between 104 and 171 points (payment tiers 2 to 4) and overall they were of slightly better quality than the RBAPS meadows which is unsurprising as this habitat type is targeted within mainstream AES which are competitive schemes.

By year 1 there had been an increase in score from the baseline in 16 out of 19 RBAPS sites, ranging from 2 to 48 points (average 13.25; median 8.25). One site retained the same score as its baseline, while the remaining 2 sites showed a decrease of -6 and -14 points. Overall there was an increase in the average total meadow score from 83 to 93 points (12%) and an increase in the minimum and maximum recorded scores (from 40 to 42 and 150 to 165 respectively). In year 2 the average scores had increased again to 102 - an increase of 23% on the baseline score. Two meadows had decreased their score since the baseline (by -6 and -18 points) while the remaining 17 sites had all increased their score by between 1 and 44 points (average increase = 23 points; median = 24 points). Figure 17 shows the change in score from the baseline for individual sites in years 1 and 2.

| | % Sites | | | | | |
|---|---|---|---|---|---|---|
| **Score (points)** | **Adviser Baseline** | **Adviser Year 1** | **Adviser Year 2** | **Control Baseline** | **Control Year 1** | **Control Year 2** |
| 0-19 | | | | | | |
| 20-39 | | | | | | |
| 40-59 | 16 | 11 | 5 | | | |
| 60-79 | 42 | 26 | 5 | | | |
| 80-99 | 21 | 21 | 32 | | 11 | 33 |
| 100-119 | 11 | 26 | 37 | 80 | 44 | 22 |
| 120-139 | 5 | 11 | 11 | | 11 | 11 |
| 140-159 | 5 | | 5 | | 22 | 22 |
| 160-179 | | 5 | 5 | 20 | | |
| 180-199 | | | | | | |
| 200-219 | | | | | | |
| 220-239 | | | | | | 11 |
| 240-259 | | | | | | |
| 260-279 | | | | | 11 | |
| Total Sites (n) | 19 | 19 | 19 | 5 | 9 | 9 |
| Mean score | 82.7 | 92.8 | 101.8 | 120 | 133.9 | 129.4 |

Table 20: Distribution of all meadow scores recorded in baseline, year 1 and year 2 assessments.

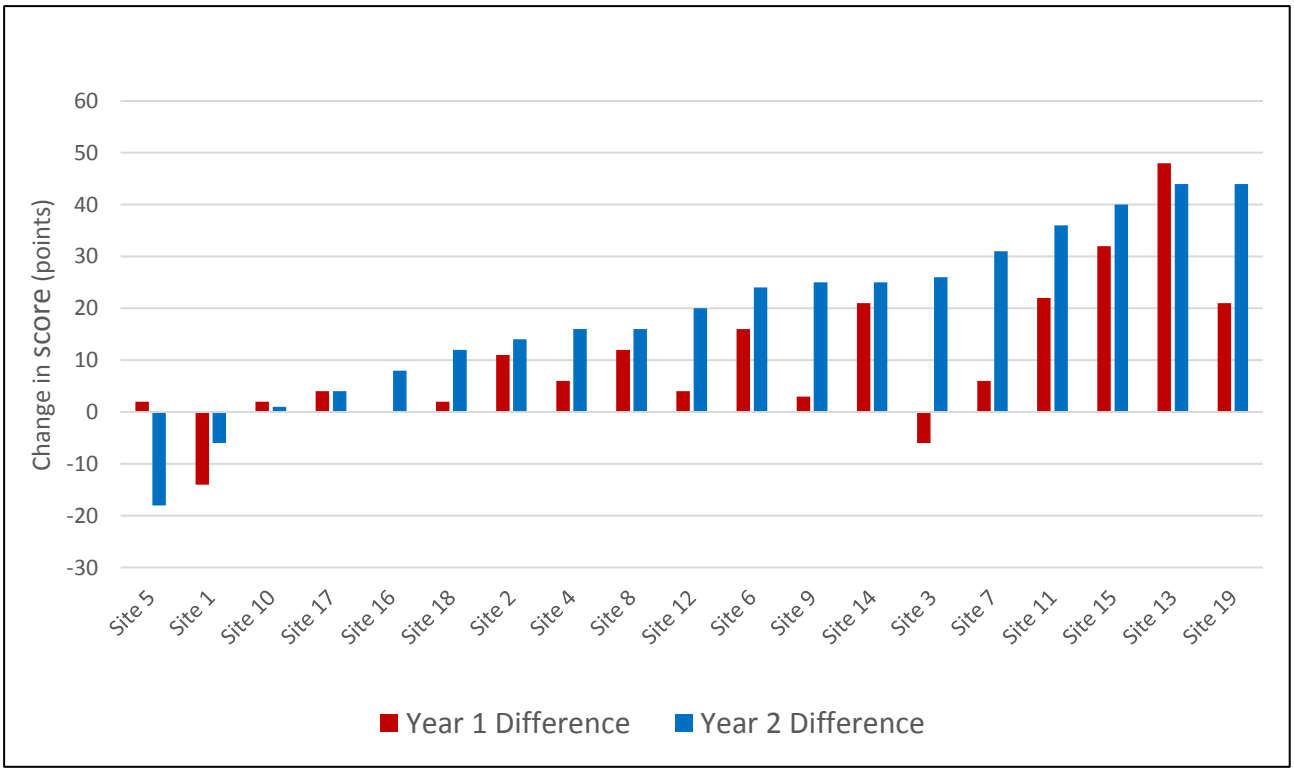


Figure 17: RBAPS Species Rich Hay Meadows: change in score from baseline to years 1 and 2.

There appears to have been a gradual annual trend of increase in adviser scores at RBAPS meadows over the study period which by year 2 had become significantly greater than baseline. Comparing the total values of the adviser baseline, adviser year 1 and adviser year 2 groups (by pairwise Wilcoxon Test with corrections for multiple testing), year 2 was observed to be (borderline) significantly different to baseline (P0.044). A trend of annual increase was not observed at the meadow control sites. No significant difference was found between the scores of control baseline, control year 1 and control year 2 for the 5 sites where baseline data were available (although the sample size is likely to be too small to provide a statistically robust sample); neither did analysis of the change in score from year 1 to year 2 only for all 9 control sites reveal any statistically significant change. In conclusion the environmental performance of the RBAPS meadows based on the meadow score showed a statistically significant increase which was not observed in the control sites, although the validity of tests on the control site data was limited by the small sample size for the baseline.

*Payment Tier*

Figure 18 shows the movement between payment tiers in each year for the RBAPS sites. It shows that in year 1 there had generally been little movement and around three quarters of sites stayed in the same payment tier as at baseline. This situation had changed in year 2 where the majority of RBAPS sites had moved up a tier.

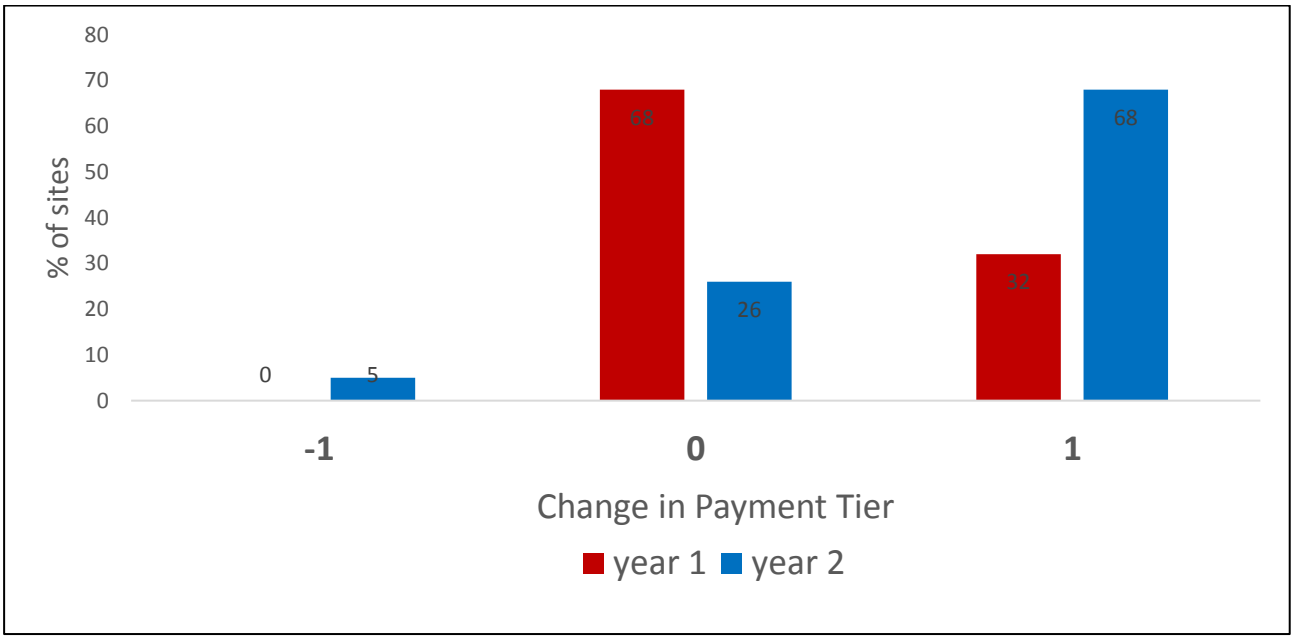


Figure 18. Species Rich Hay Meadows: change in payment tier from baseline to years 1 and 2

It is apparent that a change in score did not always produce a change in payment tier. The tiered payment system, where each payment tier covers a range of scores, has had a damping effect so a change in payment was only triggered when a score threshold for a tier was passed. Two of the RBAPS sites in year 1 had decreased their score, but this was not enough to cause either of them to move down a payment tier as their baseline score had been in the mid to high level of the points range for the payment tier; the relatively small decrease of up to 14 points - within a tier that was 39 points wide - was not enough to put them below the minimum threshold for that tier.

Similarly, where there had been an increase in score in year 1 this was not always enough to cause a site to move up a payment tier due to both the size of the annual points change and where the field had originally lain within the points range for the payment tier. Of the 16 sites that had increased their score by year 1

(84% of total), only 6 (32%) moved up into the next payment tier. However by year 2 this had more than doubled to 68% of sites moving up one payment tier from the baseline. Around a quarter stayed within the same payment tier as the baseline, while the decrease in score for Site 5 (-18 points) was enough to cause it to move down a payment tier.

*Number of Indicator species*

There were 34 positive and 7 negative indicator species on the RBAPS meadow score sheet. The number of indicator species identified by advisers in each of the three years of monitoring the RBAPS meadows is shown in Table 21.

| | **Baseline** | **Year 1** | **Year 2** |
|---|---|---|---|
| Positive indicators | 19 | 21 | 20 |
| Negative indicators | 2 | 3 | 4 |

Table 21: Number of positive and negative species recorded in RBAPS meadows.

The total number of positive and negative species recorded each year across all RBAPS meadows was relatively stable and varied by only +/- 2 in each category. In year 1, three new positive indicator species were recorded (betony *Stachys officinalis*, common bistort *Periscaria bistorta* and salad burnet *Sanguisorba minor*) and one new negative indicator (creeping thistle *Cirsium arvense*); one positive indicator (bugle *Ajuga reptans*) which had been recorded once in the baseline was not seen in year 1. In year 2 quaking grass (*Briza media*) and negative indicator rush (*Juncus spp*) were recorded for the first time, but harebell (*Campanula rotundifolia*) and common bistort dropped from the list of recorded species. Twenty seven different indicator species were observed in the control meadows across all surveys – 23 positive and 4 negative. Only the number of positive indicators varied from year to year, but as with the RBAPS meadows this was within +/- 2 species. The number of positive indicator species identified in an individual RBAPS meadow ranged from 3 to 13 during the project; the equivalent range for the control sites was 7 to 20 showing they were generally more species rich.

*Frequency of indicator species*

Figure 19 shows the percentage of times out of a total of 570 stops that individual indicator species were recorded across the baseline, year 1 and year 2 adviser surveys in RBAPS meadows. It shows that RBAPS sites had a limited number of indicator species and the records were dominated by just five species recorded at over half of all transect stops: sweet vernal grass (*Anthoxanthum odoratum*), red clover (*Trifolium pratense*), ribwort plantain (*Plantago lanceolata*), yellow rattle and pignut.

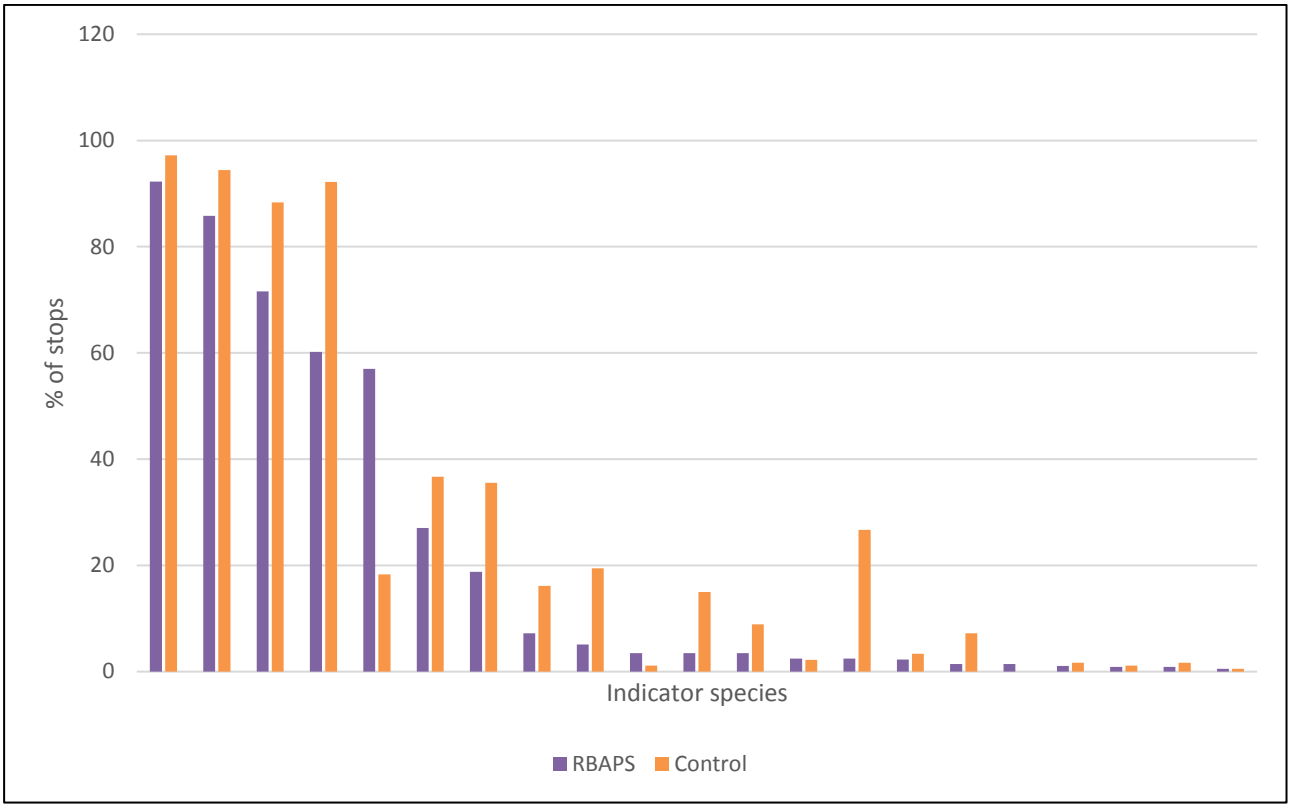


Figure 19. Species Rich Hay Meadows: meadow indicator species frequency RBAPS (570 stops, baseline, year 1, year 2) and control sites (180 stops year 1, year 2). Following indicator species were not recorded in either group. Melancholy thistle, Sedges - short & tall, Sneezewort, Water avens, Water mint ,Nettle, Spear thistle, Burnet saxifrage, Cowslip, Fairy flax, Globe flower.

Figure 19 also shows that the control meadows were similarly dominated by the same top four species as the RBAPS sites: sweet vernal grass, red clover, yellow/hay rattle and ribwort plantain. The remaining species recorded on control sites were generally present in higher abundance than on the RBAPS sites and there were more species in total.

Species frequency is variable year on year, and is sensitive to seasonal conditions/survey timing so some score fluctuation was expected. In particular the annual hay rattle population can be very unpredictable within the sward due to various factors. Over the project study period 10 of the 12 most common indicator species in the RBAPS swards showed increases in frequency of up to 37% (average 8.2%; median 5.5%). The six species that were already the most abundant in the sward in the baseline assessments of RBAPS sites were the ones that showed the greatest increases in frequency by year 2, particularly pignut which almost doubled in frequency (although this may be related to seasonal drought conditions in year 2 which delayed growth making pignut easier to spot) and red clover (Table 22).

| | % occurrence | | | Change to Year 2 |
|---|---|---|---|---|
| **Indicator species** | **Baseline** | **Year 1** | **Year 2** | |
| **Pignut** | 43% | 48% | 80% | 37% |
| **Red clover** | 76% | 86% | 95% | 18% |
| **Sweet vernal grass** | 88% | 91% | 97% | 9% |
| **Yellow / hay rattle** | 55% | 61% | 65% | 9% |
| **Hawkbits** | 23% | 27% | 32% | 9% |
| **Ribwort plantain** | 67% | 73% | 75% | 7% |
| **Eyebrights** | 17% | 19% | 21% | 4% |
| **Vetches** | 7% | 6% | 9% | 2% |
| **Greater burnet** | 4% | 5% | 6% | 2% |
| **Ladies mantle sp** | 2% | 5% | 3% | 1% |
| **Meadowsweet** | 4% | 3% | 4% | 0% |
| **Wood cranesbill** | 5% | 2% | 4% | -1% |

Table 22: RBAPS meadows: Change in frequency of the most abundant species

By year 2 fifteen of the nineteen RBAPS sites (79%) had a greater frequency of the positive indicator species than at the baseline; three showed a fall in frequency (mainly due to reductions in hay rattle, ribwort plantain and eyebrights) and one site showed no change. The overall trend in species frequency across the three years is one of improvement.

Table 23 shows the change in frequency of the fourteen most abundant indicator species in the control sites. There was a mixed picture with 6 species showing a positive increase relative to the baseline and 8 a decrease – although the species with the largest drop in abundance was cow parsley, a negative indicator. Care should be taken in directly comparing the change from the pre-project baseline in the controls with the equivalent in the RBAPS meadows due to the differing dates when the baseline data were collected on the control sites. However even comparison of just the change from year 1 to year 2 on the control sites shows a mixture of increases and decreases with no consistent upwards trend.

| | % occurrence out of 50 / 90 stops | | | |
|---|---|---|---|---|
| **Indicator species** | **Pre-project*** | **Year 1**** | **Year 2**** | **Change to Year 2** |
| Ribwort plantain | 66% | 88% | 89% | 23% |
| Sweet vernal grass | 80% | 100% | 94% | 14% |
| Red clover | 88% | 93% | 96% | 8% |
| Meadowsweet | 12% | 13% | 17% | 5% |
| Ox eye daisy | 2% | 8% | 7% | 5% |
| Greater burnet | 18% | 20% | 19% | 1% |
| Yellow / hay rattle | 90% | 97% | 88% | -2% |
| Common black knapweed | 30% | 27% | 27% | -3% |
| Hawkbits | 38% | 39% | 34% | -4% |
| Eyebrights | 34% | 39% | 32% | -2% |
| Vetches | 24% | 18% | 14% | -10% |
| Wood cranesbill | 12% | 16% | 2% | -10% |
| Pignut | 48% | 9% | 28% | -20% |
| Cow Parsley | 28% | 3% | 0% | -28% |

Table 23. Control meadows: Change in frequency of the most abundant species.

*Baseline data for controls based on data from 5 sites dating from 2011 to 2016 so should be treated with caution **years 1 & 2 data based on 9 sites

### *Habitat for Breeding Waders*

*Habitat score*

The change in average score for both the RBAPS and control sites in Table 24 indicate a slight general decline in overall habitat quality, as measured by the mean score, in both groups of sites. Table 24 also shows the distribution of scores (shading) for RBAPS and breeding wader habitat control fields across different score bands for each of the three years and includes both adviser measured results and controls sites.

| | Number of Sites | | | | | |
|---|---|---|---|---|---|---|
| **Score** | **Adviser Baseline** | **Adviser Year 1** | **Adviser Year 2** | **Control Baseline*** | **Control Year 1** | **Control Year 2** |
| **1-5** | 0 | 0 | 0 | 0 | 0 | 0 |
| **6-10** | 0 | 1 | 0 | 0 | 0 | 0 |
| **11-15** | 0 | 3 | 4 | 0 | 1 | 1 |
| **16-20** | 1 | 1 | 0 | 0 | 0 | 2 |
| **21-25** | 2 | 2 | 2 | 2 | 5 | 2 |
| **26-30** | 10 | 5 | 7 | 3 | 2 | 3 |
| **31-35** | 4 | 7 | 5 | 0 | 1 | 2 |
| **36-40** | 5 | 3 | 2 | 1 | 1 | 0 |
| **Total Plots (n)** | 22 | 22 | 20 | 6 | 10 | 10 |
| **Mean score** | 31.9 | 28.1 | 27.8 | 29.3 | 25.9 | 24.4 |

Table 24: Distribution of all habitat for breeding waders scores recorded in baseline, year 1 and year 2 assessments.

*Taken from Environmental Stewardship application data up to 6 years old.

The baseline scores for the habitat for breeding waders fields were between the middle and maximum of the points scale, ranging between 20 and 40 points (the maximum achievable). After 1 year the performance of the RBAPS habitat for breeding waders sites was mixed, nearly half the sites had dropped their scores by an average of 12 points and there was now a much wider range of results from 7 to 40 points. This lowered the average score from 32 to 28 points and there was no change to the average score in year 2. Some of the sites that had initially declined in year 1 showed some recovery by year 2 but only one managed to recover back to exceed its baseline score by year 2; the remaining 9 showed mixed performance in the second year and all were still below their baseline score in year 2. Of the 6 sites that showed an improvement in score in year 1 4 managed to retain or improve on this by year 2.

Overall by year 2 only 2 sites (out of 20 still in the scheme) were scored the same as their baseline condition, 11 had declined (by up to -23 points) and 7 had improved (by up to 14 points). Sites that had maintained or improved on their baseline by year 1 generally went on to maintain or improve this in year 2 whereas sites that had declined on their baseline level by year 1 tended to still be below their baseline in year 2. Figure 20 shows how scores for individual sites changed over the duration of the project. No statistically significant difference was observed between the scores of adviser baseline, adviser year 1, and adviser year 2:

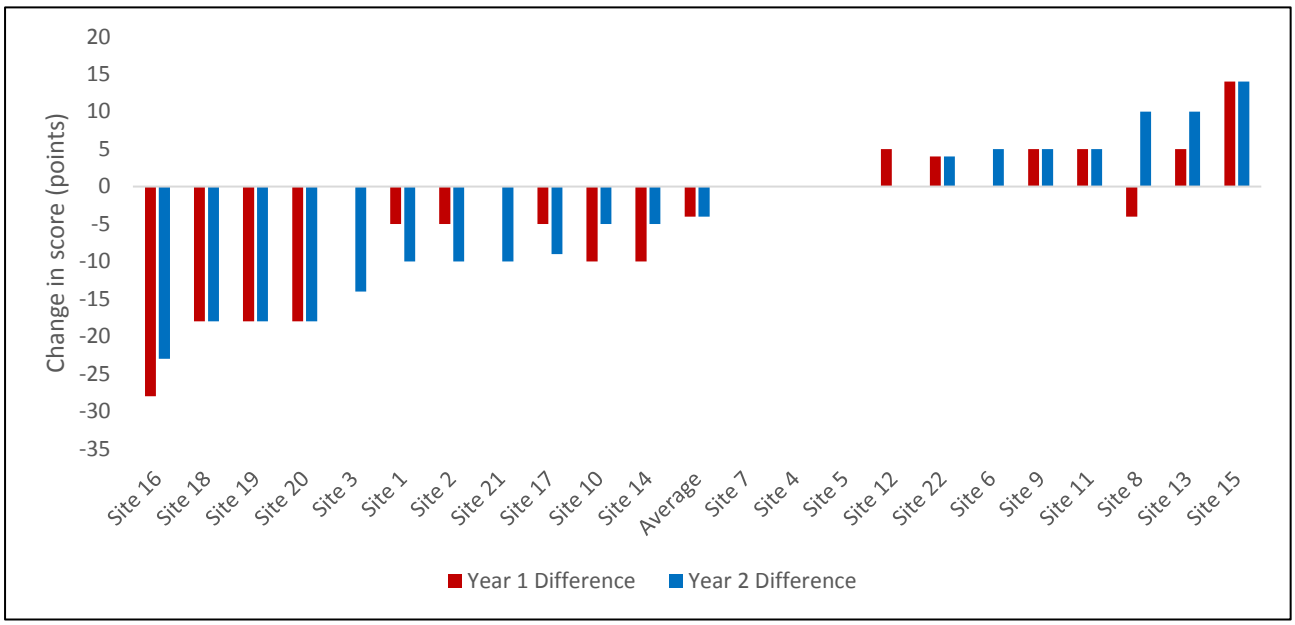

Figure 20. Habitat for breeding waders: RBAPS change in score from baseline to years 1 and 2.

Note: Sites 4 and 5 left the pilot after the first year.

Baseline assessments on control sites were not undertaken as by the time control sites were identified the assessment window had passed. A review of historic Farm Environment Plan (FEP) data held by YDNPA enabled the project team to derive an indicative score for 6 out of the 10 sites identified as controls. The FEPs were produced before the sites entered AES and used a similar feature assessment methodology to the RBAPS approach. However the age of the data (up to 6 years old) means that it does not take into account any management changes the farmer has made during the AES agreement period, some of which – such as rush control and grazing management - could change the score relatively rapidly within a single year. Thus the pre-agreement data for the controls was used with caution as an indication of the general baseline condition of the fields, rather than a direct comparison to the baseline data for the RBAPS fields. As such it was not used for statistical analysis.

Performance of the control sites from year 1 to year 2 was mixed in a similar way to the RBAPS sites: between years 1 and 2 there was a decline in score across 44% of the control sites by up to -9 points (compared with 30% of the RBAPS sites); 30% of the control sites retained the same score (40% of RBAPS sites showed no change); and 30% of the control sites showed an improvement in score by up to 9 points (30% of RBAPS sites improved by up to 14 points). Control sites was analysed for any statistically significant change but none was observed. In conclusion no significant trend has been detected in adviser scores on RBAPS wading bird pasture fields over the 2 years under agreement, or in control sites where directly comparable data exists (although the latter is limited to just one year).

*Habitat quality*

At baseline the RBAPS fields scored well as they all achieved 5 or 10 points in every feature category – the top two levels. The best scores were achieved for vegetation height (82% contained a mixed sward height so achieved the top score) and extent of wet features (77% attained the highest score where the majority of the field was 'wet'). More than half the fields scored less than top marks for both the cover of rush and quality of wet features so there was greater scope for improvement in these categories.

Figure 21 shows how the proportion of sites achieving the top score in a particular habitat attribute changed over the course of the project. Adviser assessment of the habitat across the three survey periods shows a general improvement in two of the four habitat features – vegetation height and rush cover – and this is reflected in the proportion of sites achieving top score for these attributes. No damaging operations were noted in any baseline survey or in subsequent years.

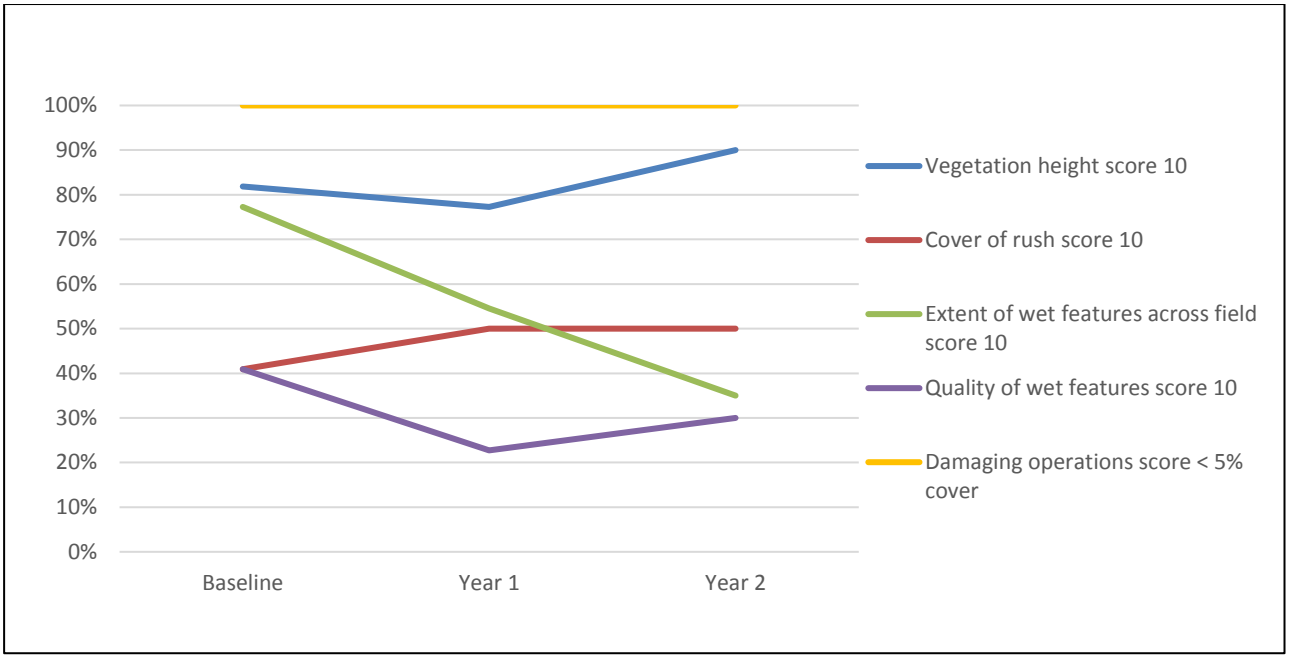


Figure 21: Percentage of RBAPS habitat for breeding waders fields achieving a maximum score for each habitat attribute.

Although the number achieving top score for vegetation height dropped slightly in year 1 this had increased by year 2. Following baseline assessments four farmers had been given advice on altering the number of grazing livestock and timing to reduce the sward height as the four fields which had not scored the maximum for vegetation height were all judged to be too long. By year 2 all four of these fields had been grazed to produce the optimum sward height and had moved into the top score category. This was partially offset by two of the floodplain fields which had previously been optimum for vegetation height moving down as they were considered to have very short vegetation; however the fields were still favoured by nesting Northern lapwing. All control sites attained the highest score pre-project and in year 1 for vegetation height, however there was a deterioration in one field where the vegetation height by year 2 had become too long.

Rush cover in fields was very variable at the start of the project with 41% having the ideal cover of between 10 and 30%, 45% of sites had too much (> 30% cover) and 14% too little (<10% cover). Advice was therefore mainly focussed on the management needed to bring the area of rush down to fall within the ideal limits. The three fields that had less than 10% rush were the flood plain pastures that were preferred by Northern lapwings; for these fields the scoring was adjusted to better reflect the specific requirements of this species. Compared to the control sites a higher proportion of RBAPS fields fell within the highest score for rush cover, which was maintained through the three years. There was more active rush management under the RBAPS fields than control as more fields moved into the highest score bracket. There was virtually no rush management evident on the control sites, and ideal rush cover declined from 33% to 22% of sites in year 2 (compared to 50% in RBAPS); this indicates a trend of increasing rush making the sites less suitable for target birds.

Participants seemed to respond to advice on managing rush as by year 1 the level of rush cover had improved with half of all sites now regarded as having optimum cover and the number of fields overall recorded as having too much cover falling from 45% to just under a third by year 2. Although the overall proportion of fields with too much cover decreased during the project, there were slight increases in the proportion of sites which had either too little or very dense cover of rush. Only a single (different) field was recorded as having >50% rush in each of the baseline and year 1 surveys and by year 2 this had gone up to 2 fields but again these were different sites to previous years. The number of fields with too little rush increased from the original three floodplain sites to include one more site where the cover had slipped down below the 10-30% optimum.

The extent of wetness across the fields was estimated by observing how wet the fields were on the day of the survey, noting the wettest areas and discussing with the farmer about how the wetness fluctuates during the breeding season. At the baseline no field scored below 5 points for either extent or quality of wet features, so all fields within the scheme had some wet areas for wading birds but these were not always extensive enough or in an ideal condition for wading birds to use. Scores could potentially be improved by blocking drains, creating shallow scrapes and re-profiling the edges of ditches that were too steep to allow easier access for birds with chicks and create more areas to feed.

During the project there was a marked drying out of the fields with habitat for breeding waders. The proportion of sites attaining the top score for extent of wet features fell by roughly equal amounts each year from 77% at the baseline to 35% by year 2. Whereas at the start of the project all fields had been damp to some degree, the drying in years 1 and 2 was so severe that in the final survey year a fifth of the sites fell into the lowest scoring category as they were mainly dry. The extent of wet features measured at the control sites followed a similar pattern in scores due to the very dry springs.

Initially there was a similar decline for the quality of wet features in RBAPS sites with only around a quarter of in the top scoring category in year 1 compared with 41% in the baseline. In this same year one site did not achieve a score at all for quality of wet features as there were none present to assess. By year 2 two sites failed to score any points in this category but the wet areas that remained on other sites tended to score better in terms of their quality and overall the proportion of sites in the top category had recovered to 30%.

*Presence and diversity of birds*

Presence and diversity of birds was recorded by a simple count rather than conducting a more thorough assessment based upon the 3 visit method of survey for bird numbers. This was a non-scoring indicator to provide some information on the use of the fields by the target bird species and potentially help farmers make a connection between bird presence and habitat quality. Table 25 and Table 26 show the results of the bird observations in each year as a proportion of all sites, for individual target species and total number of species observed in each field.

| | **Baseline** | **Year 1*** | | **Year 2**** | |
|---|---|---|---|---|---|
| | Adviser | Adviser | Farmer | Adviser | Farmer |
| **Lapwing** | 73% | 91% | 91% | 80% | 80% |
| **Curlew** | 59% | 86% | 95% | 80% | 85% |
| **Redshank** | 9% | 32% | 50% | 20% | 45% |
| **Snipe** | 36% | 36% | 55% | 20% | 55% |

Table 25. Proportion of sites where individual target bird species were observed during farmer and adviser assessments *22 assessments**20 assessments by advisers and farmers (all sites remaining in RBAPS that year)

| No of species seen per field | Baseline | Year 1 | | Year 2 | |
|---|---|---|---|---|---|
| | Adviser | Adviser | Farmer | Adviser | Farmer |
| **0** | 14% | 0% | 0% | 5% | 5% |
| **1** | 32% | 14% | 0% | 15% | 10% |
| **2** | 23% | 41% | 32% | 60% | 25% |
| **3** | 27% | 32% | 45% | 15% | 35% |
| **4** | 5% | 14% | 23% | 5% | 25% |

Table 26. Proportion of sites where different numbers of target bird species were observed during farmer and adviser assessments.

More birds were observed in both years when the fields were under RBAPS agreements than during the baseline assessment. There were also more observations of birds in year 1 than year 2. As very mobile species, the presence of birds at a particular moment in time can be dependent on a range of factors and not just the habitat quality, which is why they were a non-scoring indicator in the project. However the presence of target birds across the majority of fields within the RBAPS pilot is an encouraging indicator that fields were correctly targeted for the project and proved attractive to breeding waders. But fluctuations in their presence may be attributable to a variety of factors, including the timing of the surveys (baseline and year 2 assessments were done later in the breeding season than year 1) and/or different weather conditions.

*Payment tier*

The baseline condition of all the fields with habitat for breeding waders was tier 3 or higher. Figure 22 shows the distribution of the fields across the payment tiers over the duration of the project.

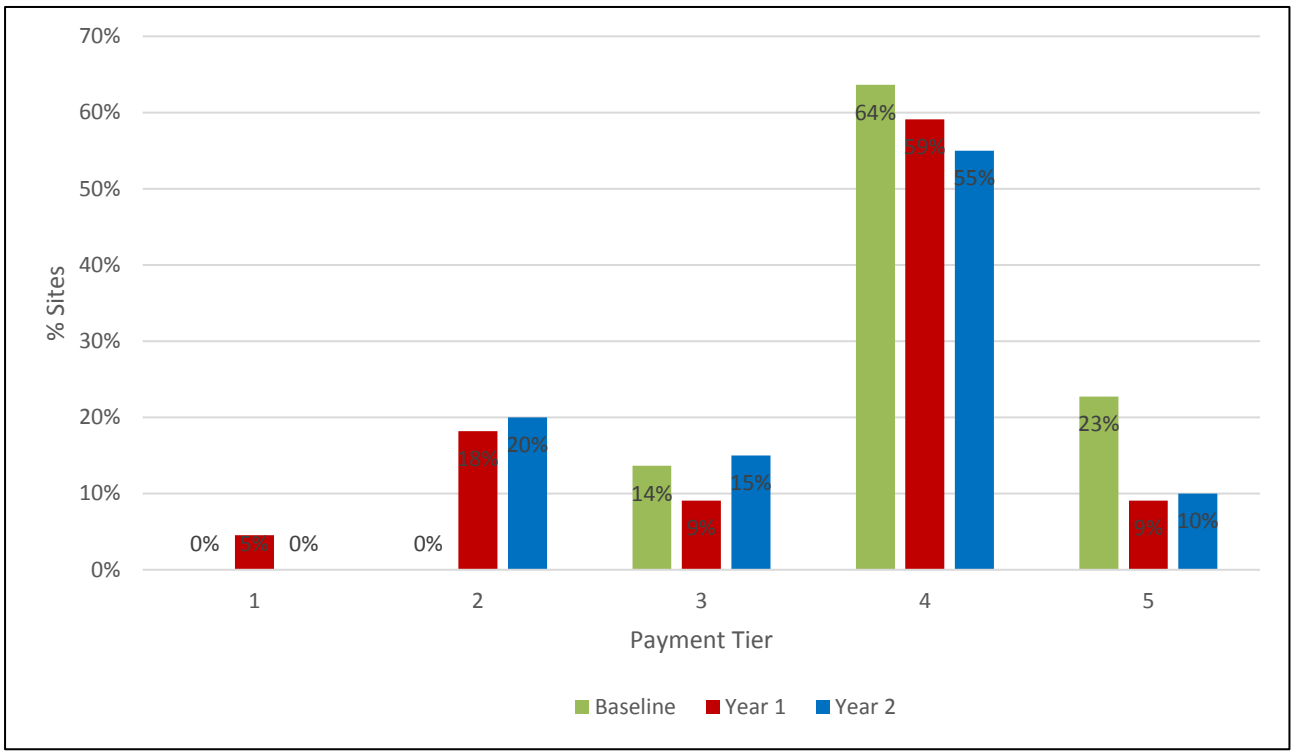


Figure 22. Habitat for Breeding Waders: payment tiers (includes 2 sites that left)

The fluctuations in score from year to year resulted in some movements between payment tiers as shown in Figure 22. In year 1 the majority of sites had stayed in the same payment tier as their baseline but a large proportion of the rest had moved down. There was further movement in year 2 when 12 of the 20 sites changed score again from the previous year. The proportion of sites that had gone down by 1 or 2 tiers relative to their baseline increased, but the range of change was less (no site had gone down by more than 2 tiers) and there was an increase in the proportion of sites that had shown an improvement (by 1 tier maximum). The net result by year 2 was that half of the 20 sites still under RBAPS management had moved down 1 or 2 payment tiers from their baseline condition and half were at their original level or one tier higher (7 and 3 sites respectively). The average change in payment tier from baseline to year 2 was -0.5.

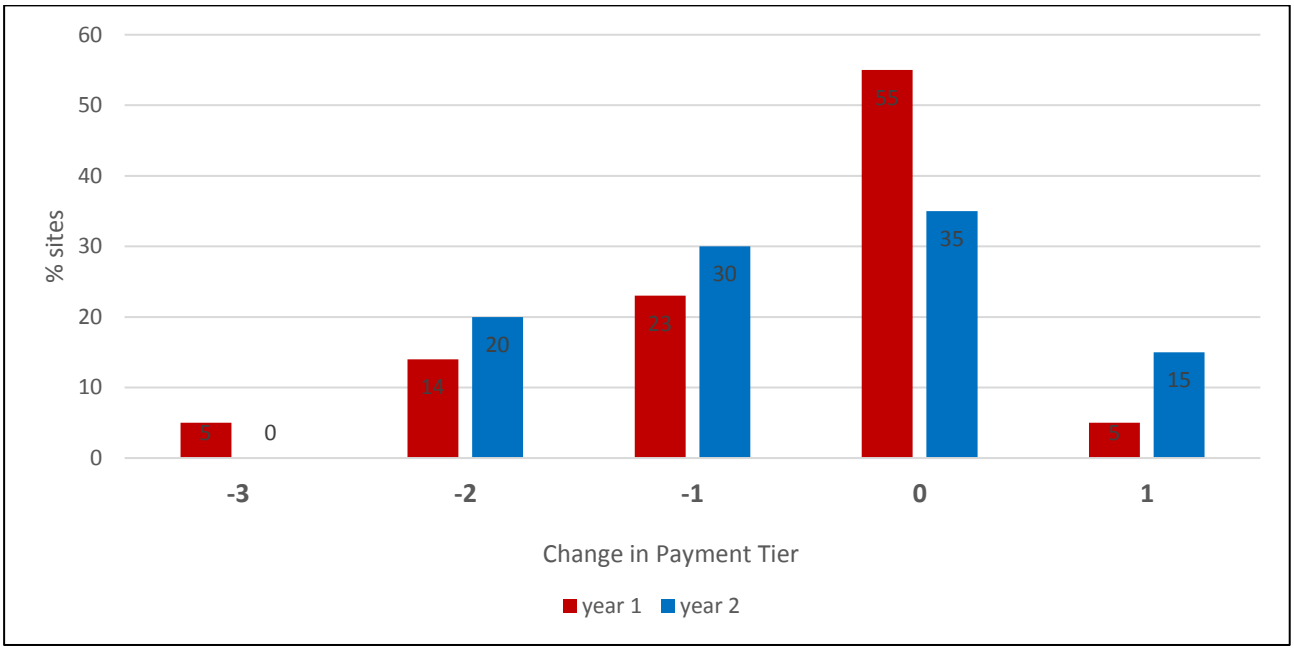

Figure 23. Habitat for Breeding Waders: change in payment tier from baseline to years 1 and 2.

Just over half the sites remained in the same payment tier in year 1 despite the fact that the majority had reduced their scores from baseline. However the system was still sensitive to change and the majority of the other sites dropped 1 or more payment tiers. This is because the average decrease was 12 points which is greater than the relatively narrow range of 9 points accommodated by each tier. Of the 6 sites that increased their score by year 1, only 1 managed to move up a payment tier as the average increase was 6 points. More detailed analysis of the drivers behind these score fluctuations is explored in the next section.

## Management Responses

The majority of farmers undertook actions to improve the habitat and therefore improve score and payment. Their reasons for doing the work were split between an increase in payment and a passion for the environment. Pride also played a big motivating part in the farmers' decision to do the extra work.

*Arable*

In year 2 75% managed their plots differently to their equivalent mainstream agri-environment plots with a range of different activities being carried out. In the majority of cases this related to timeliness of operations. Two farmers moved a winter bird food plot this year and another observed that the weed burden on the plot they hadn't moved was increasing. For winter bird food this included care taken over the timing of drilling due to the dry conditions, additional seed added, different seed mixes used, fertiliser applied and being able to make better use of equipment (as the plots were bigger than conventional AES). One farmer even tried irrigation, noting that '*Irrigation did not benefit the plot results*.' For pollen and nectar this included adding more species to the mix, applying a flexible and better timed topping regime and cutting and removing arisings and spot treating weeds.

*Meadows*

Meadows in payment tiers 1 and 2 at baseline were considered semi-improved and therefore would require proactive intervention to increase the number and frequency of positive indicator species within the field. For these lower scoring meadows, advice was given by YDNPA advisers on various management changes that could potentially lead to a higher Total Meadow Score and payment. Advice focussed in particular on lighter spring grazing, reduction in volume of farmyard manure spread, reduction of inorganic fertilizer application, use of lime, seed spreading from local sources and earlier shut up dates. Following a review of the positive indicator species already present in the meadows and advice from the Yorkshire Dales Millennium Project, 1kg of native wildflower seed containing yellow or hay rattle, common knapweed and oxeye daisy (*Leucanthemum vulgare*) was made available to participating farmers in autumn 2017 (the beginning of year 2) to spread on their fields.

Farmers were asked by YDNPA advisers whether they had undertaken any specific management activities to increase their Meadow score. Most had undertaken a series of management changes to their meadows and Table 27 shows the range of actions undertaken.

| Management Action | Total sites |
|---|---|
| Lime application | **4** |
| Reduction or cessation of inorganic fertlizer application | **3** |
| Earlier shut up date | **5** |
| Later mowing date | **2** |
| Seed introduction | **9** |
| Grazing management change | **5** |
| Traditional small bales | **4** |
| Weed control | **4** |
| Clearance of old muck heaps/machinery/plastic etc left in meadow | **0** |
| Sensitive machinery use on wet soils | **1** |
| Other | **2** |

Table 27. Management changes undertaken on RBAPS meadows during agreement period.

All eleven farmers with meadows undertook at least one management change and the majority undertook more, with five farmers undertaking 4 or more separate actions in order to generate an increase in score. These actions, together with more favourable weather conditions in year 2, may have contributed to the overall increase in score the meadows experienced during the last two years.

The most popular action was to introduce a wider range of wildflower species either using seed, or through planting small plug plants. In the autumn of year 1, nine out of eleven farmers added wildflower seed to their meadows, with a smaller number growing hay meadow flowers from locally collected seed and planting these as plug plants. In addition, four farmers applied lime to their meadows to raise the soil pH from acidic to a more neutral state in order to create better conditions for wildflowers to germinate and improve conditions for grass growth, reducing the need for additional nutrient input. Three farmers reduced or cut out inorganic fertiliser applications as well. Timings of shut up dates were altered with 5 farmers shutting their fields earlier on the advice of the YNDPA advisers. Grazing levels during the spring were also reduced. Those farmers who had weed problems affecting their baseline score undertook additional weed control to reduce the incidence of negative indicators and improve the total score of their meadows.

*Breeding Waders*

Analysis of the changes in score from year to year showed that the main drivers behind an improved score on individual fields were better rush management and the creation of quality wet areas, both of which would require active intervention by the farmer. Maintaining swards at optimum height during the breeding period would also require careful management of grazing levels. Participants reported management changes on their survey forms and in discussions with the YDNPA advisers and these are summarised in Table 28.

| | Totals | Comments |
|---|---|---|
| **1. Vegetation Height** | | |
| Higher/lower stock levels | **6** | Used cows (2) |
| More frequent stock rotation | **1** | |
| Selective mowing | **5** | |
| No topping | **1** | |
| Anything else? | **2** | Weed wipe (9) |
| | | |
| **2. Cover of rush** | | |
| Mowing | **6** | |
| Spraying | **6** | |
| Higher stocking levels | **1** | Used cows |
| Lime application | | |
| Anything else? | **2** | Weed wiping / knapsack. Keeping cattle on the land (8) |
| | | |
| **3. Extent of wet features** | | |
| Blocking drains or other watercourses | **3** | |
| re directing water sources | | |
| Introduction of a water course | | |
| Anything else? | | |
| | | |
| **4. Quality of wet features** | | |
| Creation of shallow pools | **5** | |
| Re profiling steep sided wet features | | |
| Using livestock/machinery to create lightly poached areas | **2** | Used both (1) |
| Anything else? | **1** | |

Table 28. Management changes – RBAPS habitat for breeding waders.

Over 70% of the fourteen participants with habitat for breeding waders reported undertaking some form of management change to improve the conditions for breeding waders. Alterations to livestock type (sheep to cattle) and alterations to timing and number of grazing livestock was undertaken by six (43%), selective mowing was undertaken by 5 (36%) and weed control undertaken by 2 (14%). One farmer also replaced a plantation of tall fir trees with native, shorter trees to discourage birds of prey from the area (something that was not covered by the scoring system but could increase breeding success). A number of farmers had undertaken work to improve their score after the adviser assessment had taken place in year 1 but still within the first agreement year e.g. rush control. This positive management was anticipated to result in an improved score in year 2.

Grazing management

The baseline assessment of the swards found four fields scored 5 points due to the sward being too long. By the year 1 assessment, three of those fields had altered grazing numbers, timing and livestock type to bring the swards into ideal condition and score 10 points and by year 2 the sward management had also improved in the fourth to score 10 points.

The year 1 assessment found four sites that had previously scored the maximum 10 points for sward height were now too short, probably due to higher stocking rates in the period leading up to and during the survey and/or the late, dry spring which had suppressed grass growth. By year 2, two of those sites had altered their stocking rates to progress the sward height back to the ideal state. The two sites that remained in the "too short" category in year 2 were floodplain pastures where Northern Lapwing were observed.

Rush management

Eight farmers undertook rush control by mowing, spraying or spot treatment - often in combination - and one followed this up with cattle to graze and trample re-growth. Scores for rush cover indicate that the effort put into reducing the overall cover in many fields has had an impact and overall there was an increase in the proportion of fields that met the ideal cover criteria. However the effects on the scores in individual fields was variable.

Rush control improved the score on five of the ten fields which had >30% cover at the baseline, moving four of them into the top scoring category and reducing the cover in the fifth to under 50%. Control measures may have also helped maintain maximum scores in five sites throughout the project and keep levels below 50% in another two. Control appears to have led to scores decreasing on two sites where cover dropped from the ideal 10-30% range in one and from over 30% in the other to less than 10% cover in both.

Rush control was not actioned on at least seven of the ten fields that scored lower than 10 points. Inadequate control led to a decline in score on three sites due to rush cover increasing above the 30% or 50% thresholds. Conversely, on one of the floodplain grasslands where cover had initially been very low rush was allowed to increase to fall into the ideal range by year 2. The remaining two sites also had very low cover of rush at the start of the project but had no change in score by year 2.

Wet features

Seven of the eleven participants with habitat for breeding waders undertook active management to improve the quantity and quality of wet features for the target birds. Three reported that they had tried to increase the extent of wet features by blocking drains or other watercourses and five had created shallow pools or scrapes to improve the quality of foraging areas for birds. Two also inadvertently created good muddy zones for chicks to feed by leaving tractor tyre marks in soft ground or poached areas from late autumn cattle grazing.

The quality of wet features did indeed show an improvement by year 2 which can be attributed to these efforts (some of which were carried out after the survey in year 1 so did not affect the score in that year). But the much drier weather experienced in year 1 and year 2 led to significant drying out of the fields which was beyond the farmers' control and in two fields wet features were completely absent by year 2. The effect of the weather is discussed in more detail in the following section.

## External Factors – Weather

For the arable element of the pilot year 2 (2018) was an exceptional year weather wise. A cold, wet, late spring led into a prolonged period of hot, dry weather with some of the participating farmers not having rain from the end of May until August (See Figure 24) resulting in high soil moisture deficits. Similar prolonged dry weather and high temperatures have not been experienced in England since 1976 so the weather during summer 2018 was exceptional.

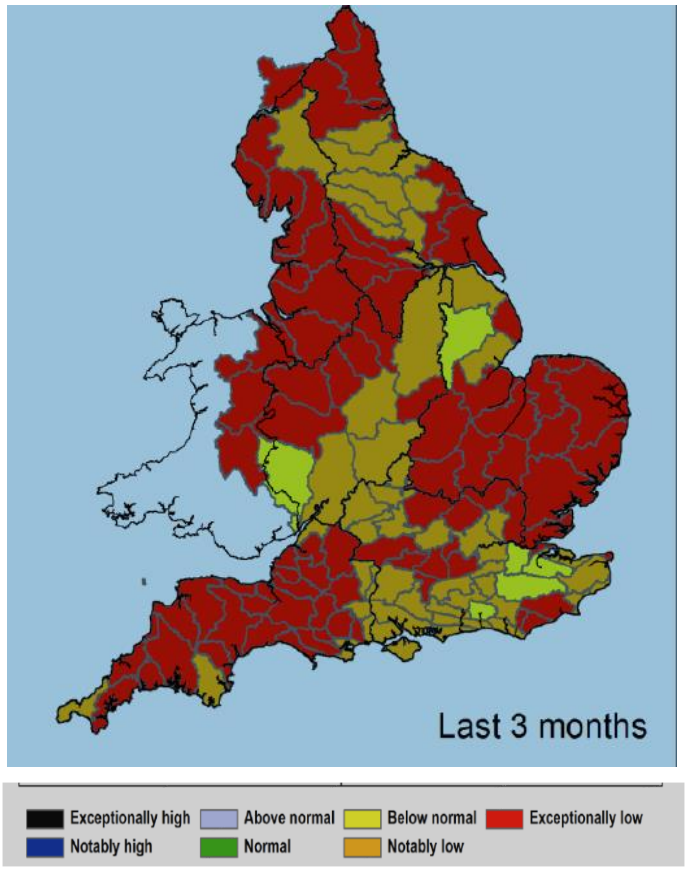


Figure 24: Average rainfall in England for the three months to end of July 2018.

(Source: Environment Agency: Water situation: national monthly reports for England 2018)

The Winter Bird Food option is a spring established mix, ideally sown between May and early July depending on the weather. The late wet spring meant that ground preparations could not be carried out in March and April as it was not possible to get on the ground, this led to challenges around creating suitable seedbeds. The hot dry weather that superseded this resulted in seed not germinating, seedlings burning off or the farmers not sowing whilst they waited for rain which was not forthcoming. As a result by mid-July the farmers were starting to worry about reseeding and carrying out further costly operations that might still result in failure and no payment. Weather is a significant factor that affects both agricultural and environmental results. Successful delivery of many biodiversity outcomes is closely linked to the weather. Generally it is not unreasonable to expect farmers to make more interventions in some years to deliver optimum results (or accept a lower level of results, which would be no different to agricultural production affected by weather).

However, it was decided that the conditions were exceptional and completely outside of the farmers control. In year 1 (2017) all the winter bird food plots fell into the top three payment tiers and of those 10 achieved

the highest performance tier indicating that the farmers could all achieve a top performing plot given reasonable conditions. A number of options were discussed, all with various pros and cons, summarised in Table 29. The arable team discussed the options with the Commission and concluded that the fairest option for year 2 would be to base the payment on the average performance levels of the year 1 and year 2 plots.

| **Option** | • **Pro** | • **Con** |
|---|---|---|
| Payment based on an average informed by previous and current year's performance | • Recognises and rewards previous performance<br>• Provides incentive to produce best possible plot in current year to improve average<br>• Reduces risk based decision of whether to include option in an agreement<br>• Does not penalise agreement holders for factors outside their control and retains their support in the scheme. Risk is agreement holders may not wish to continue if they feel they are treated unfairly. | • Administratively resource intensive; maybe hard to replicate in a mainstream situation<br>• If more than one year of extreme weather average reduced through conditions outside of farmers control<br>• Not value for money to pay for a sub optimal plot |
| Payment based on results achieved | • Reflects level of environmental performance<br>• Mirrors risk based approach of other crops/sectors on the farm | • Doesn't reflect costs of operations/seed in establishing the plots<br>• Could be viewed as to high a financial risk to include option in an agreement |
| Payment at the same rate as mainstream winter bird food option | • Guarantees a payment therefore reducing financial risk of establishment costs<br>• Reduces risk based decision of whether to include option in an agreement | • Reduces incentive to produce the highest performing plot<br>• Not value for money to pay for a sub optimal plot |
| Pay a base rate covering income foregone and cost of operations | • Guarantees a payment therefore reducing risk of establishment costs<br>• Reduces risk based decision of whether to include option in an agreement | • No incentive to produce the highest performing plot<br>• Base rate costs equate to the top payment rate if every effort has been made to establish the plot resulting in high payment rate for poorer performing plot.<br>• Not value for money to pay for a sub optimal plot |
| Pay 50% of the top payment rate | • Guarantees a payment therefore reducing risk of establishment costs<br>• Reduces risk based decision of whether to include option in an agreement<br>• Risk shared equally between administrative body and farmer | • Reduces incentive to produce the highest performing plot<br>• Base rate costs equate to the top payment rate if every effort has been made to establish the plot<br>• Does not reflect costs of establishment<br>• Not value for money to pay for a sub optimal plot |

Table 29. Potential approaches to payments under exceptional weather.

This issue also led to discussions around the timing of the assessment. In year 2 due to a combination of the dry weather (so plots were sown later) and the need to analyse results for the final report, the assessments had to be done before seed heads were present on all species. Therefore, it was decided that it would not be fair to only count plants that had seed heads so plants which hadn't developed seed heads but still reached the necessary thresholds within the quadrat were counted. However, identification is more challenging and there is no guarantee that a plant will subsequently set seed. Seed provision is a key objective so timing of assessments is important to ensure that assessment reflects actual seed yields as far as possible.

For the grassland pilot spring in year 1 (2017) was warmer than the baseline year with two periods of significant rainfall at the start and end of the spring period. April and May were comparatively dry, with rainfall in April - the month before most breeding wader habitat assessments were undertaken – being very low in particular and only a fifth of that recorded in the previous year. In year 2 spring arrived late after a long cold spell that lasted well into April. March was significantly colder than the previous years with a number of days when snow fell and/or lay on the ground. After this late start to spring, the weather turned much warmer and became very dry through May and into June when the majority of assessments were undertaken.

The dry springs in year 1 and especially year 2 created problems assessing the wet features element of the habitat for breeding waders result measure. This meant that many features which, under normal conditions, would have been wet were not at the time that the surveys took place. Both quality and extent scores for these features saw a marked decline in year 1 and while the quality of wet features went on to show some recovery in year 2 the extent did not and the scores for this attribute continued to decline.

After this issue had been identified in year 1 the assessment window was extended in year 2 to include March to try and avoid another potential dry period during spring. The assessment would therefore take into account the conditions prior to the birds arriving back from their wintering sites, with a later visit carried out to count actual bird numbers once birds had returned. This was agreed after discussion with the farmers at the meeting at the end of year 1, with farmers officially notified early March in year 2. However, only four farmers took up this opportunity (and benefitted as their scores increased to the maximum 10 points in those fields). In both years the timing of the majority of breeding wader habitat surveys coincided with the land turning dry from lack of rainfall in the preceding period. Adviser surveys were carried out once the farmers had confirmed they had completed theirs, so these were often done at the end of the assessment period in late May or early June.

The very dry conditions of year 2 may also have affected the frequency with which some species were recorded in the hay meadows because of changes in the timing of flowering/visibility relative to other species.

## Accuracy of self-assessment

### *Winter Bird Food*

Figure 25 shows there was a slight reduction between year 1 and year 2 in the proportion of assessments where the self and adviser assessments matched; overall in 36% of cases the different assessments found the same number of crops. In year 1 44% of the self-assessments found one more crop than the adviser and 17% found one less. In year 2 there was more variability with the adviser finding 2 more crops than the self-assessment in 11% of plots and the farmer finding 4 more crops in 6%. When this is translated to payment tier (Figure 26) the difference is not so marked with 67% of plot assessments resulting in the same payment tier. In year 1 78% of the assessments agreed on the payment tier with a smaller percentage (23%) having a difference of 1 tier. There was greater disparity in year 2 with only 56% agreeing and 17% of plots measured by self-assessment were 2 payment tiers higher than the adviser.

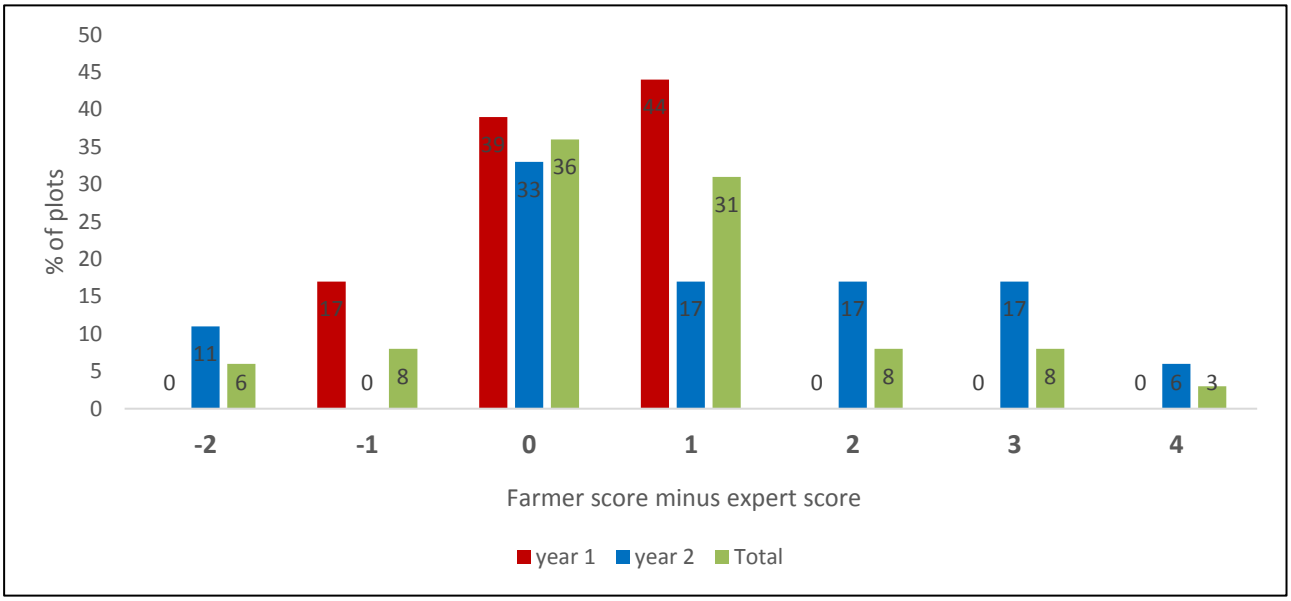


Figure 25. Winter Bird Food: accuracy of farmer assessment, difference in number of sown species.

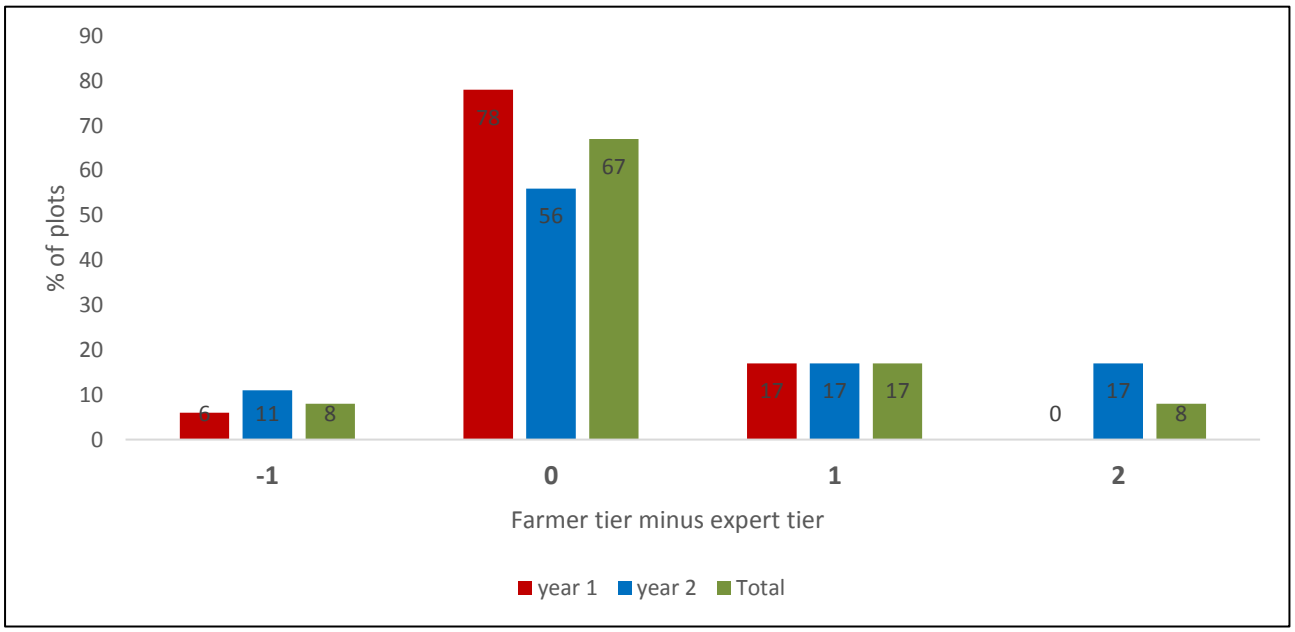


Figure 26. Winter Bird Food: accuracy of farmer assessment, difference in payment tier.

The verification visits agreed with the adviser in 75% of payment tiers with all other assessments having a difference of 1 payment tier. The number of crops were agreed on in 58% of assessments; 8% had a difference of 2 crops and the remainder 1 crop.

### *Pollen and Nectar*

Figure 27 shows that overall 36% of self and adviser assessments found the same number of species. However, there was a marked change between year 1 and year 2 with a decline from 45% to 27%. In year 1 9% of the self-assessments found one more crop than the adviser, 27% two more and 9% three more, 9% found one less. However, in year 2 this became more dispersed with 27% finding one more species, 9% three more, 9% one less and 14% two less. When this is translated to payments the difference is not as severe as plots with 5 species or more all receive the top payment tier.

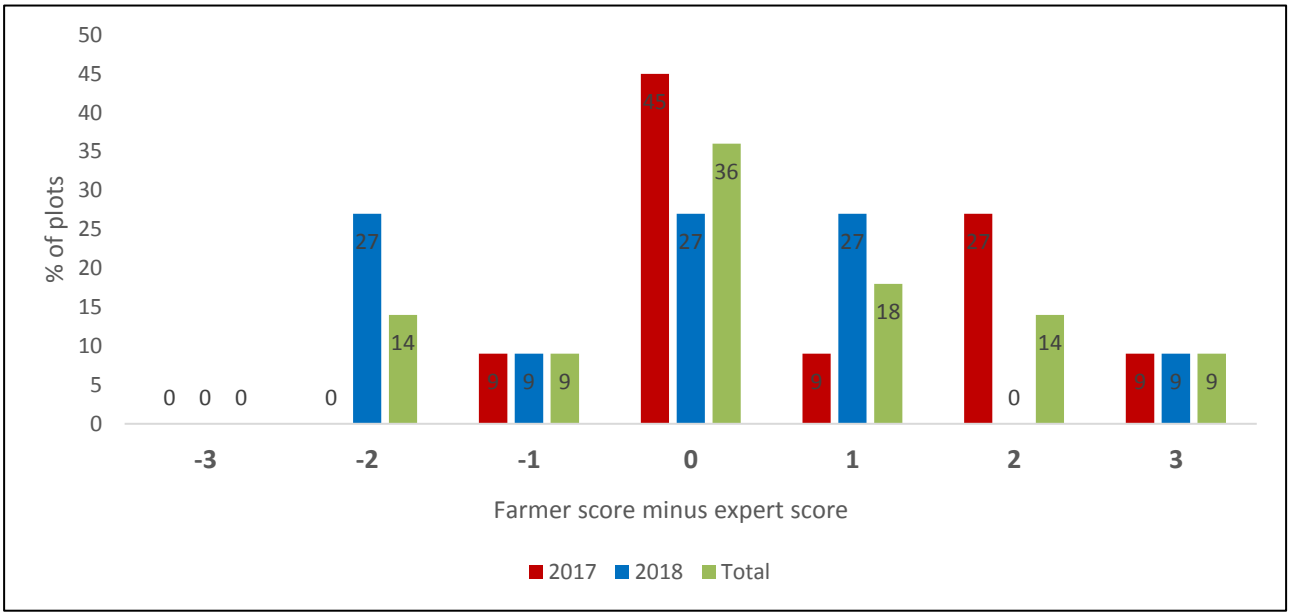


Figure 27. Pollen and Nectar: accuracy of farmer assessment, number of sown species.

Figure 28 illustrates that in year 1 82% of the self-assessments resulted in the same the payment tier as the adviser with the remainder one tier higher than the self-assessment. There was a bigger difference in year 2 with only 55% agreeing although the remainder were all no more than 1 payment tier different. For the percentage cover measure that was assessed in year 2 64% of the adviser and self-assessment fell within the same tier while for the remainder the self-assessment was one tier higher

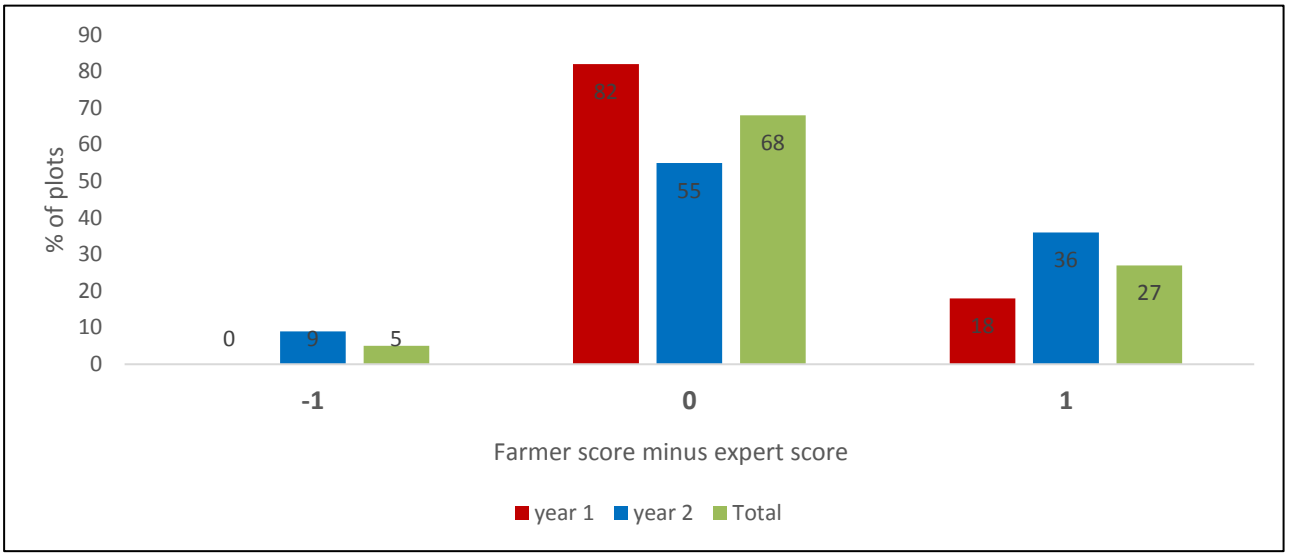

Figure 28. Pollen and Nectar: accuracy of farmer assessment, difference in payment tier.

The verification visits agreed with the adviser in 75% of cases with all other assessments having a difference of 1 payment tier. The number of species were agreed on in 25% of assessments with the remaining 75% finding one species less. Half agreed on percentage cover with the remaining 50% one tier lower.

### *Species Rich Hay Meadows*

In year 1 eight of the eleven participating farmers undertook a self-assessment survey. The other three (who managed six meadows between them) did not feel confident enough to undertake the self-assessment without support from an adviser so the results from these joint surveys are not included in the analysis. In year 2 most farmers attended a refresher species identification training day in early June. This gave them confidence to undertake the self-assessment survey without support and all succeeded in carrying it out independently. In some cases, farmers emailed and telephoned the project team for advice with photographs and descriptions of plant species they were unable to identify. In year 2 all the hay meadows were assessed in June or early July by the adviser after the farmer had completed their self-assessment. All were in full flower during the survey period but with the prolonged dry period lasting through to July, some meadows were starting to show signs of drought stress.

In year 1 the average scores recorded by the adviser and farmer on the 13 meadows were the same at 92 points each, although this conceals differences between the scores recorded on an individual field between -2 and +40 points. In year 2 when all 19 fields had a self-assessment the adviser scores averaged 102 points while the average for the self-assessments was 106; the range of discrepancies for an individual field was narrower than year 1 ranging from 0 to -34 points. Figure 29 shows the differences between the farmer and adviser scores in each year shown as a percentage of all fields to account for the different number of fields each year where a self-assessment was available (73% of participants completed self-assessment in Year 1 and 100% in year 2).

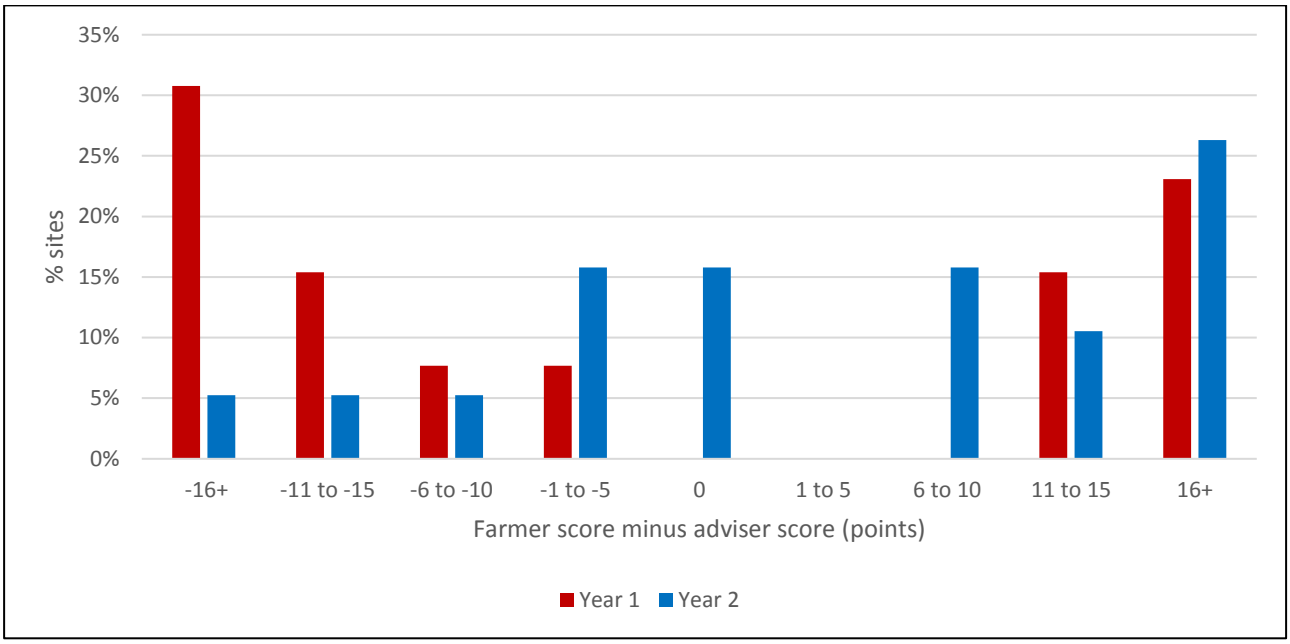


Figure 29. Species Rich Hay Meadows adviser and farmer self-assessments: difference in scores in years 1 and 2.

In year 2 there was a movement towards a closer match between the self-assessment and adviser scores. This is reflected in Figure 30 which shows whether the difference in scores translated into a different payment tier. The width of each tier was 39 points, therefore providing some room for differences of scores and buffering against payment tier changes as a result. In year 1 in over half the cases the payment tier for the self-assessment and adviser assessment was the same and by year 2 this had improved to almost three quarters of the surveys resulting in a match. Where there was a difference in payment tier it was only +/-1 tier. In both years, where there was a discrepancy in tier, the payment rate was based on the adviser's score rather than the farmer's in around two-thirds of the cases because the farmer was found to have either under-recorded or misidentified species. For the remainder the farmer's score was used rather than the adviser's when there was evidence they had very good identification skills and the additional species they had recorded were known from previous surveys to occur in the meadow.

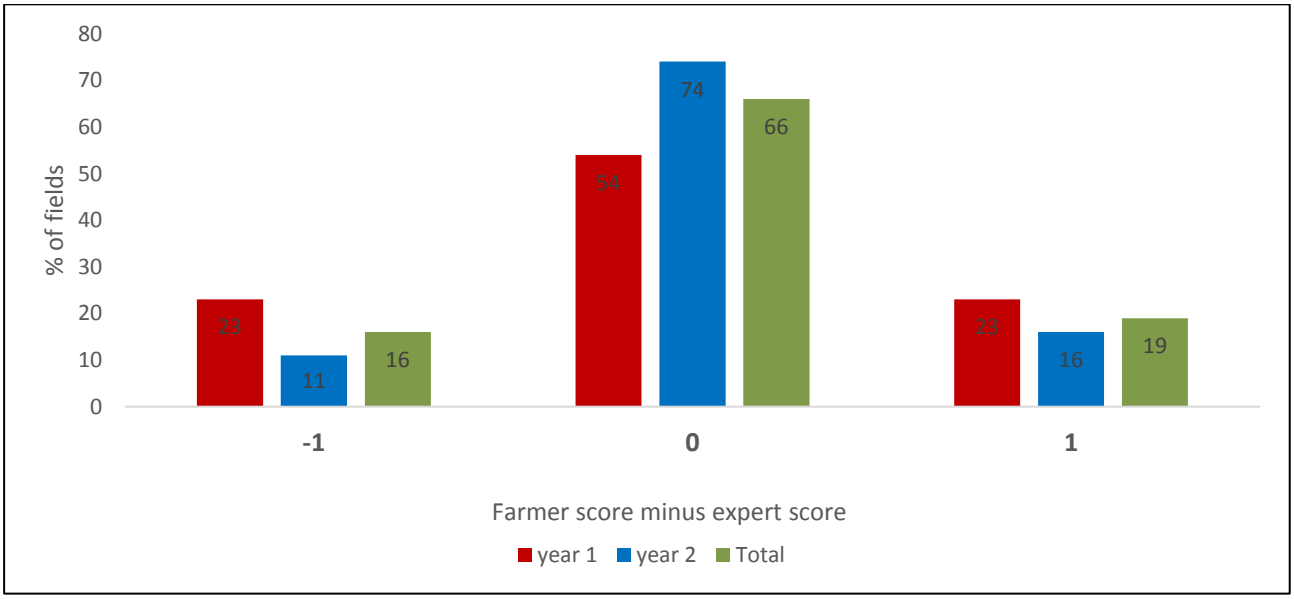


Figure 30. Species Rich Hay Meadows adviser and farmer self-assessments: difference in payment tiers in year 1 and year 2.

Comparison between farmer and adviser meadow surveys shows there has been a high degree of upskilling by the farmer as there are a higher number of comparable results. Farmers have been able to identify the most common species to nearly the same degree as the advisers and at a similar frequency. Table 30 illustrates the frequency with which the top 9 most commonly found species were identified by advisers and farmers.

| | % occurrence | | | |
|---|---|---|---|---|
| Indicator species | Year 1 | | Year 2 | |
| | Adviser | Farmer | Adviser | Farmer |
| Sweet vernal grass | 91.1 | 76.2 | 97.4 | 93.2 |
| Red clover | 86.3 | 84.6 | 94.7 | 91.1 |
| Ribwort plantain | 72.6 | 67.7 | 74.7 | 77.9 |
| Yellow / hay rattle | 60.5 | 57.7 | 64.7 | 69.5 |
| Pignut | 48.4 | 57.7 | 80.0 | 75.3 |
| Hawkbits | 26.8 | 24.6 | 31.6 | 27.9 |
| Eyebrights | 18.9 | 23.1 | 20.5 | 23.7 |
| Vetches | 5.8 | 21.5 | 8.9 | 8.4 |
| Greater burnet | 5.3 | 6.2 | 5.8 | 5.8 |

Table 30 Percentage occurrence of species frequency for adviser and farmer surveys for the most commonly recorded species.

Under-scoring or over-scoring is to be expected at such an early stage of the project. Farmers generally detected fewer of the more abundant species, and saw slightly more of the less abundant species. In year 1 farmers saw 15% less sweet vernal grass than the adviser but the gap had narrowed to just 4% difference in year 2. During the training events farmers found it difficult to consistently identify this particular species but their skills did improve. The farmer's ability to identify a greater range of plants has increased and is shown in the higher degree of accuracy of their scores.

### *Habitat for Breeding Waders*

In both years farmers managed to complete their self-assessments independently. Participants tended to be happy to undertake the assessment without adviser help as the habitat assessment was perceived as being easier to undertake than the meadow surveys as it wasn't reliant on species identification.

Farmers tended to score their habitats higher than the advisers, as can be seen by the difference in the average scores for farmer and adviser assessments in Figure 31. In year 1 the discrepancies ranged from -14 to +15 points, there was concurrence on just under a quarter of sites but farmers typically scored themselves 5 points or more higher than the adviser. The pattern in year 2 was similar, with a match between adviser and farmer surveys in 25% of cases, but farmers scored themselves higher in 60% of surveys and the variance in points was -9 to +19.

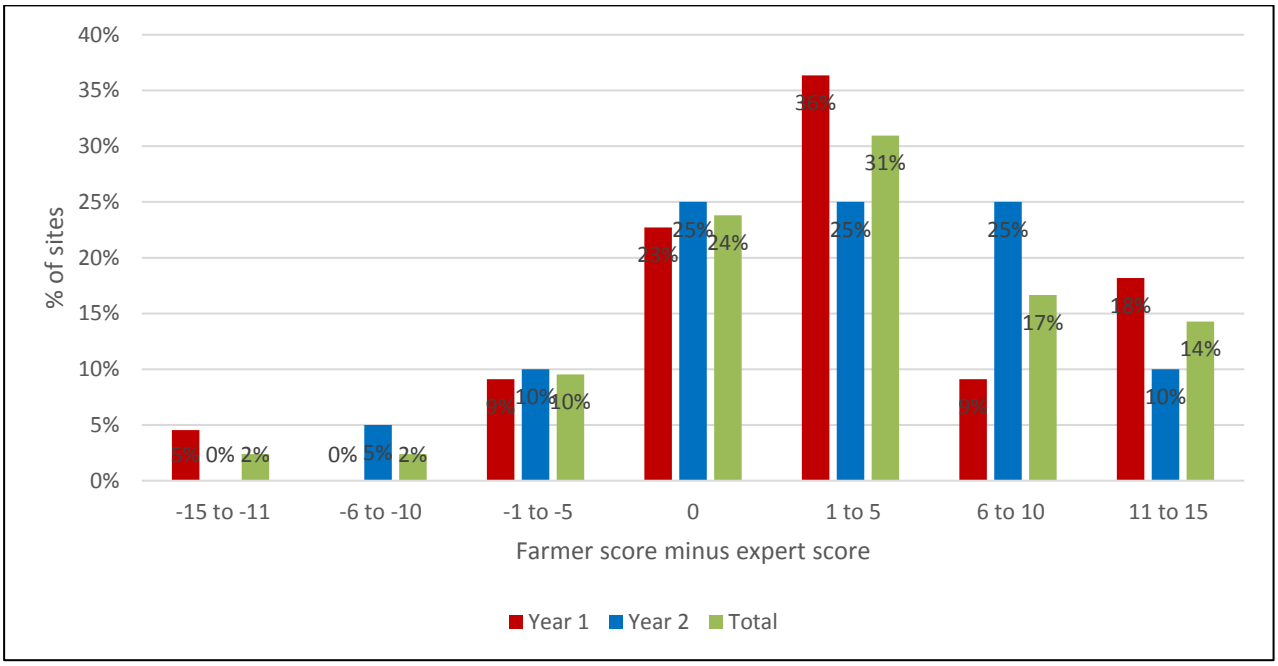


Figure 31. Habitat for breeding waders: accuracy of self-assessment points score.

Figure 32 shows whether the difference in scores translated into a different payment tier. Generally whenever there was a disparity between the adviser and farmer scores (74% of all assessments) these did fall into different payment tiers (65% of all assessments), mainly one tier higher for the farmer but in one or two cases each year the farmer put themselves 2 tiers higher.

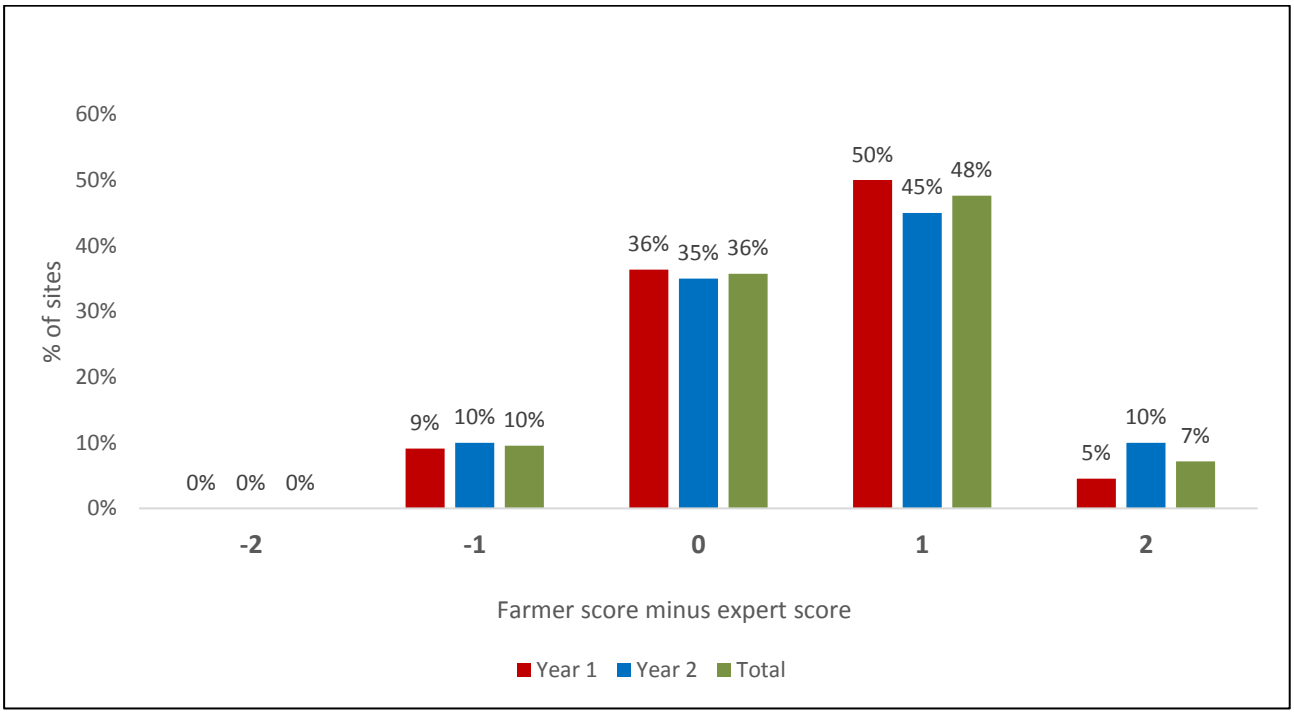


Figure 32. Habitat for Breeding Waders: accuracy of self-assessment payment tier.

The width of each tier was 9 points so there was some potential to accommodate changes in score without it impacting on the payment tier, depending on the size of the change and where the field's score lay within the tier's range. However, the scores within each category of the assessment system were 10, 5 and 1 points, so a change between levels in just one category would have an impact of 4 or 5 points which could easily be enough to push the score beyond the points range for the tier.

With a scoring system that relied on matching different aspects of habitat condition to a series of descriptive statements it was perhaps inevitable that there would be some differences in opinions. The scoring system and payment tier structure proved sensitive to change and any difference between the farmer and adviser scores was also likely to result in a difference between payment tiers. In both years, where there was a discrepancy between the farmer and adviser tiers, the payment was made based on the farmer's score in around two-thirds of the cases. The following section analyses the differences between the farmer and adviser assessments for each feature category shown in Table 31 to identify the key drivers behind discrepancies.

| | % of fields attaining the scores | | | | |
|---|---|---|---|---|---|
| | RBAPS - Adviser | | | RBAPS - Farmer | |
| **Year of assessment** | Baseline | Year 1 | Year 2 | Year 1 | Year 2 |
| **Number of sites** | 22 | 22 | 20 | 22 | 20 |
| **2. Vegetation height** | | | | | |
| Mixed sward height where between 25 - 75% of the field is short and the rest varied, grass tussocks frequently seen | 82 | 77 | 90 | 86 | 85 |
| Over 75% long. Short swards confined to very small parts of fields (eg gateways, sup feed sites only) Tussocks indistinguishable from other tall vegetation | 18 | 5 | 0 | 9 | 5 |
| Over 75% short with little variation in height. Tussocks rare or absent | 0 | 18 | 10 | 5 | 10 |
| No difference in height – either all short, or all long with no variation | 0 | 0 | 0 | 0 | 0 |
| **3. Cover of rush** | | | | | |
| 10 – 30% cover, well scattered with local areas of dense rush | 41 | 50 | 50 | 64 | 50 |
| 30 - 50% rush cover, large areas of dense rush and tall vegetation | 41 | 32 | 20 | 9 | 15 |
| Over 50% rush cover | 5 | 5 | 10 | 5 | 10 |
| Less than 10% rush cover | 14 | 14 | 20 | 23 | 25 |
| **4a – Extent of wet features across field** | | | | | |
| Field is damp across the majority of the area with a number of significantly wet areas – flushes, wet ditches, springs. | 77 | 55 | 35 | 68 | 80 |
| Damp areas are contained to approximately 10% of the field, eg springs, remainder of field is dry | 23 | 32 | 45 | 32 | 20 |
| Damp areas are rarely seen | 0 | 14 | 20 | 0 | 0 |
| **4b – Quality of wet features** | | | | | |
| Wet features contain a mix of shallow pools and wet vegetation, gently sloping edges with less than 25% rush or tall vegetation | 41 | 23 | 30 | 41 | 60 |
| A number of wet features on the site but not meeting all criteria above | 59 | 73 | 60 | 59 | 40 |
| Steep sided, dense rush cover, inaccessible to birds | 0 | 0 | 0 | 0 | 0 |
| *Did not score* | 0 | 5 | 10 | 0 | 0 |
| **5. Damaging operations** | | | | | |
| Damage more severe covering between 10 - 25% of field area | 0 | 0 | 0 | 0 | 0 |
| Limited areas covering 5 – 10%tended | 0 | 0 | 0 | 0 | 0 |
| Less than 5% | 100 | 100 | 100 | 100 | 100 |

Table 31. Habitat for breeding waders: comparison of adviser and farmer scores for individual scoring elements.

The scoring for vegetation height showed the greatest parity between farmer and adviser. Both recorded the majority of fields as having a good, varied sward height but there were some subtle differences: in year 1 farmers considered more swards were in the optimum condition with the rest mainly too long while advisers put fewer in the top category and considered more to be too short; this maybe highlights different perceptions of "long" and "short" in this context. By year 2 there was closer parity between the proportion in top score and the same proportion were regarded as too short, so results had come closer together.

Differences in opinion were quite common for rush cover in year 1; most farmers thought they fell within the 10 – 30% rush cover statement (maximum score) or had less than 10% cover, whereas the advisers thought a greater proportion of fields had over 30% cover and less had under 10% cover. The boundaries between the categories are difficult to quantify / visualise in the field, although there was agreement on what constitutes over 50% cover. However, by year 2 there was a much higher degree of correlation between farmer and adviser score indicating the skill of estimating percentage cover had increased.

Farmers were much more likely to record their fields as predominantly damp or wet and thus worthy of the top score - particularly in year 2 where they scored 45% more fields in this way. And while advisers recorded a decline in the proportion of sites attaining the top score between year 1 and year 2, the farmers' observations were that this had increased and unlike the advisers, they did not record any field as falling in the lowest category in either year.

The overall decline in the wetness of the RBAPS sites observed by the advisers could be attributed to the weather, timing of surveys and possibly the approach taken by some farmers. Both years were much drier in spring than the baseline. In year 1 most farmer visits were undertaken in May with advisers undertaking assessments up to a week later, during a period of little rainfall and when ground conditions were drying rapidly. While both advisers and farmers recorded around a third of fields in the middle score category, when the advisers visited they judged 14% of fields to be dry so overall they scored fields lower.

In year 2 and following consultation with the farmers after the very dry conditions of the previous year, the assessment window was extended to allow the habitat to be scored in March when conditions were likely to still be wet and birds about to return to breed. Four fields were assessed by farmers during March when conditions were significantly wetter than later when unusually dry conditions developed again. Unfortunately the advisers weren't notified that these assessments had been undertaken early and therefore visited in May or June after the farmers had been back to do the bird count. It is very likely that if the adviser had undertaken the surveys at the same time in March, then the difference in scores would be narrower with more fields achieving the maximum score.

In subsequent discussions with participants on the score differences, it was evident that some had perhaps based their assessment on what the field had generally been like in the period running up to the survey, rather than what it was on the actual day because it had been better before the effects of the dry weather had taken their toll (particularly if wet features were present but had dried up by survey day). Advisers based their scores more on the observed conditions on the day, but took into account signs that wet features had been present and the unusual weather in later discussions on the appropriate payment level if the farmer and adviser scores were in different tiers.

Both advisers and farmers recorded an increase in the proportion of sites with high quality wet features from year 1 to year 2, with farmers recording a larger increase (19%) compared to advisers (7%). Although there was an improvement in the quality of wet features the much drier conditions in the years 1 and 2 highlighted an issue with the score sheet as there was no criteria statement to record a zero results against i.e. if no wet features were present at all. In both years advisers couldn't give a quality score to one or two sites as they

were unable to find any wet areas to assess, so an assumed zero score was given and note made. Farmers attributed a quality score to every site.

There is an obvious link between the assessments of the extent of wet features and their quality. Experience has shown that quality has been a difficult category to assess both for the farmer and adviser. With half of the farmers with habitat for breeding waders undertaking work to improve both the extent and quality of wet features the differences in score may be partly driven by the farmer's awareness of the site conditions leading up to the survey and their efforts to improve feature quality which would be expected to improve the score e.g. scrape creation.

For damaging operations, both farmer and adviser were in agreement with regard to this measure and no change from baseline recorded.

The results for both years conclude that both farmers and advisers have difficulty in recording the percentage cover of a plant group, specifically rush. The process is subjective and there is no definitive method of accurately assessing the vegetation cover, especially over larger sites or sites that are undulating and where the whole field cannot be seen from one vantage point.

Advisers considered the wet feature criteria were easier to record. However some farmers tended to over record the extent and quality when matched against the adviser results. This may have been due to the perception of wetness by the farmer as the fields put forward for the project have always been classed by the farmer as "wet". In year 2 some farmers surveyed the sites in March which would have been much wetter than May when most adviser visits were undertaken.

The accuracy of assessments may have been compromised due to the limited wording of the criteria statements especially regarding the wet features. After 2 survey years it has been noted by advisers that on some sites the criteria statements could not capture the true ground conditions and therefore recording an accurate result was difficult for both advisers and farmers.

The presence and diversity of birds was a non-scoring element of the assessment to record the number of individuals of the four target species present in each field. Farmers generally observed more birds than the adviser and picked up a greater range of species, particularly the less often recorded common redshank and common snipe. Comparing survey approaches, farmers tended to use a quad bike or similar to go around the field whereas the adviser would carry out the survey on foot, and these different methods of observation may potentially have had an impact on the range of species seen. Using a quad bike is more likely to flush out common snipe, but some farmers provided anecdotal feedback that Northern lapwing, common redshank and Eurasian curlew were easier to count from a quad bike as they tended to stay a little more on the ground compared to when someone walks through, and chicks became accustomed to the vehicle as well so tended not to bolt for cover. It is also difficult in some circumstances to accurately count the number of birds using a site as duplicate sightings and recording are a common problem both for the experienced and inexperienced observer alike.

In year 2 farmers also reported that bird numbers could fluctuate significantly in the run up to the surveys. Over a week, a farmer would either see a high number of one species or none at all. This is probably the response of the birds to the adverse weather conditions during the spring of that year, when flocks returned to the hills from overwintering sites much later than normal and may still have been moving to breeding sites.

# Participant and Stakeholder Views

Twenty-eight participants completed the initial survey, split equally between the pilot areas. The same number completed the second survey (16 grassland, 12 arable).

### *Reasons for participating*

A wide range of reasons for participating were expressed including opportunism, fit with particular business circumstances, flexibility, environmental interest and financial motives. A number of participants highlighted the opportunity to influence future scheme design as a consideration, for example:

> "It is an important step toward the future of agri-environment schemes for the first time quantifying environmental benefit. I wanted to be involved"

### *Views about the RBAPS approach*

Farmers and stakeholders were asked to state what they thought the key advantages and disadvantages of the RBAPS approach these can be summarised as:

| | **ADVANTAGES** | **DISADVANTAGES** |
|---|---|---|
| Arable | Flexibility and freedom<br>Reward for effort<br>Ability to use local knowledge<br>Incentive to produce better results<br>Benefits the wildlife<br>Better value for money<br>Happy Birds! | Crop failure and risk of no payment<br>Time consuming to complete assessments<br>Intensive farming of the plot vs wildlife benefits<br>More time consuming for the administrators due to increase in checking and time to set up an agreement.<br>Getting stung by bees when doing the pollen and nectar assessment! |
| Grassland | Increased understanding of the ask<br>Flexible<br>Nature is at the heart of the scheme<br>Simple to understand<br>Clear payment structure designed to incentivise<br>Paid solely on outcome<br>Encourages positive environmental farming<br>More straightforward for tax payers to support | Weather conditions/ factors outside the farmers control could affect score<br>More work & responsibility on the farmers part<br>Payment rate could go up or down<br>Resource intensive<br>Costly to deliver<br>Limited to 2 habitats and 2 years of an agreement |
| Stakeholders | Farmers lead rather than follow<br>Sharing best practice<br>Innovative management<br>Flexibility<br>Increased understanding of the agreement<br>Use of skills and expertise<br>Incentive<br>Delivery of better outcomes | Risk of lower payments, inspection, lower uptake, investment without income.<br>Demotivation through not achieving the results and losing income, making budgeting challenging<br>Self-assessment could be time consuming<br>Scalability<br>No prescriptions resulting in inappropriate/damaging management<br>Funding for levels of advice needed to support and verify |

Table 32. Participant and stakeholder views on the advantages and disadvantages of the RBAPS approach.

Fairness and equity emerged as a strong positive theme. The following quotes illustrate this:

*"It directly rewards for skill, effort and care"*

*"The more that you put in, the more that you get out"*

*"Farmers if rewarded fairly will up their game"*

### *Views on Pilot Design*

A range of views and suggestions were made about the design of the pilot, the selection of result measures (and alternatives), the number of payment tiers and the use of a zero payment threshold. The majority of participants from both the arable and grassland elements were positive about the detail of the pilot design in the initial survey but inevitably their views had changed somewhat by the second survey.

*Result Measures - Pollen and Nectar*

At the outset all the farmers felt the results measures being used were the right ones for this option and that the survey methodology was the best way of measuring these results. However at the end of the project 33% of farmers felt that the assessment criteria or methodology should be changed, suggestions on what could be done differently mainly centred around adopting a set sampling pattern for plots.

*"Pollen and nectar how do you evaluate it? Plenty of bees and butterflies in RBAPS because all flowers, in HLS plenty of bees on reduced flower numbers but tussocky grasses probably held more insects over winter, more diversity in a more traditional flower meadow than just flowers because a non-specific habitat, more pollen and nectar yes but only bee friendly so could not say whether it's better or worse.'*

And another observing:

*'very full of bees and butterflies on occasion".*

*Result Measures - Winter Bird Food*

The result measures for winter bird food elicited a stronger response and 50% of the farmers felt that the assessment criteria or methodology should be changed. Suggestions on what could be done differently included using a smaller number of stops in smaller plots, adopting a set pattern instead of representative sampling and using an average assessment of the whole plot instead of quadrats. Comments were also made on counting birds, reducing plant density, use of photos/video diary instead of surveys and aiming for less crops. Feedback included:

*"Although the assessment criteria works I am not sure it is best geared to the target outcome, particularly for WBF. So you can have a dense tall WBF plot which scores highly but is not suitable for birds".*

*"A set pattern for sampling the plots would be better to allow less variation between my results and advisers. Timing of sampling could be altered as assessing the wild bird plots was tricky for us - massive plants - like hacking through a jungle!"*

*"Lower overall score count should be acceptable, as there is a tendency for two plants to dominate".*

*"Yes and no, criteria still needs looking at as whether what we are doing is going to help nature as wild bird food over done is worse than a modest thinner crop that is eaten before December and*

*then a stubble created to feed on, the scoring of density and crop per metre is fine and works well but the crops are still not quite the correct balance"*

"*For bird densities the existing covers that are more adjacent to covers for game birds hold more birds where the height of maize gives more security, water, roosting and feed for longer. The crops I grow outside any scheme hold more birds in general. Any plot close to protection of large wide hedges are better still!"*

*Result Measures - Hay Meadows*

The majority of agreement holders thought the approach was the fairest way to assess the meadows. However, nearly half were concerned that the diagonal transect line didn't pick up all the species within the field. There was also concern that a single visit further limited the range of species that could be identified as it was easy to miss the early flowering ones.

*Result Measures - Habitat for Breeding Waders*

The majority of agreement holders thought the initial suite of measures was appropriate and the fairest way to assess the habitat for breeding waders. Two farmers suggested adding in bird counts as part of the score either via their own observations or using skilled people.

Most stakeholders were unable to comment on the assessment methodology and results criteria, but those that did felt that the arable habitats would see improved results more quickly than the grassland as it was possible to move arable plots to optimum areas and responses would be rapid.

*Zero Payment rate*

The use of a zero payment rate elicited a more polarised initial response (Figure 33) with a small majority overall in favour but a majority of the arable participants against. This is unsurprising as although the grassland participants had a theoretical risk of falling below the minimum score threshold to receive a payment all the habitats entering the scheme had received a baseline score which, even if just maintained, would secure a known level of payment. In contrast the arable habitats are created more frequently, with winter bird food being an annual measure, so entail a much greater risk. Stakeholders felt even more strongly that a zero payment rate was not appropriate if none of the results measures were achieved (83%). The notion of risk is interesting as it appeared both in terms of the risk of not achieving the results and therefore no payment, but also that risk can help improve delivery:

*"risk provides focus"*

"*Simply you have more to lose, so you take greater care"*

Despite successful delivery under the arable measures in year 2, even under very challenging weather conditions, there was a strengthening of feeling rising to 75% who felt that a zero payment rate was not appropriate. There was also an increase in the proportion of grassland respondents sharing this view, although they remained a significant minority.

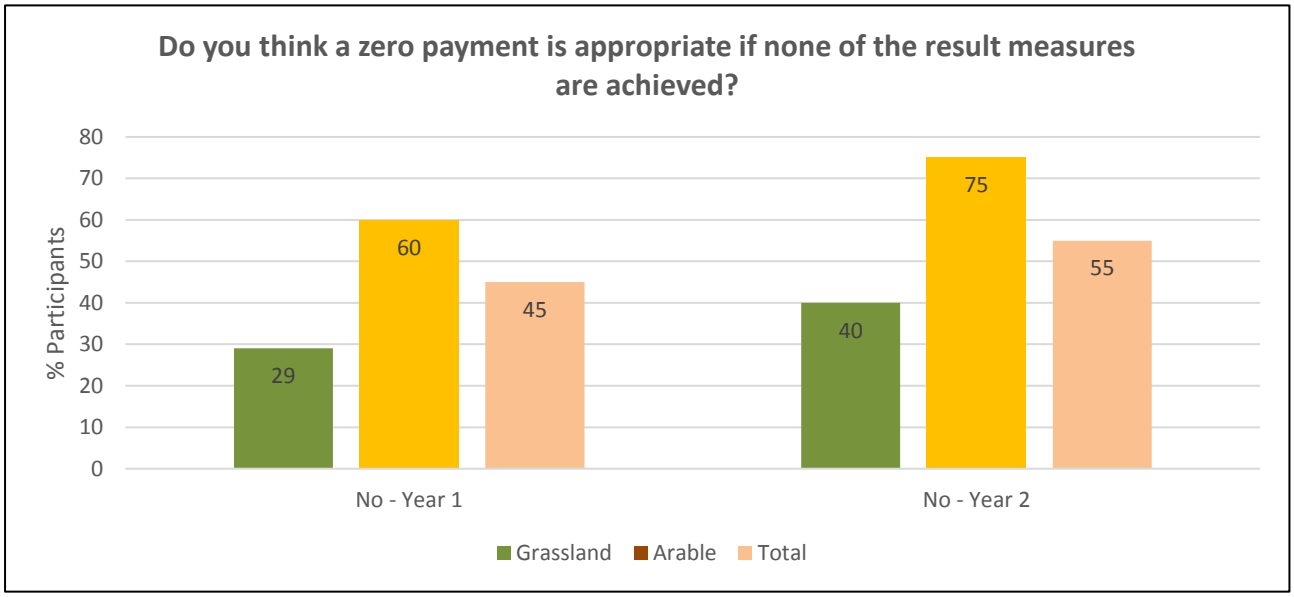

Figure 33. Appropriateness of a zero payment rate.

### *Payments Rates and Tiers*

The majority of the respondents thought that the payment rates for all measures were appropriate with a small proportion responding that they were generous and an even smaller proportion (~10%) that they were not enough. A number of specific comments were made that the payment rates needed to be more enticing to encourage farmers into the scheme, particularly at the lower payment tiers for meadows, so as to provide more incentive to move up a tier and discourage intensification.

Comments received on this were the following:

*"I was happy with the payment received, I spent quite a lot of time and effort to achieve the top tier"*

*"I think that it probably needs to be more in order to attract more uptake"*

*"In this scheme you have mainly selected dedicated conservationists- We tend to gold-plate everything. From re-drilling crops I didn't think quite good enough, to adding extra fertiliser to optimise seed production... I suspect the real answer is that the payment is appropriate but never underestimate an incentivised farmer's willingness to produce the best...."*

*"Scale... it has got to be financially viable for the time and effort involved for all parties... schemes always are simpler when first launched and inevitably get more complex as they mature"*

*"to produce good seed bearing wildlife plots requires as good or better management than a commercial crop, and is much more time consuming per ha than field crops in both time taken to establish/spray/ fertilise wild bird covers and assess results"*

With regards to the design of the scheme there were mixed views on the number of payment tiers, the majority thought that the current number of payment tiers within the pilot was the right balance. However, there were a small number of contrary views, both for more and less with respondents arguing that a higher number of tiers would work if the score bands were narrower, making it quicker to progress and thereby maintain the engagement and commitment to the approach whereas some suggested fewer payment tiers, making it more attractive to improve your score as the payment reward would be greater.

Stakeholders consistently felt that the number of payment tiers in the pilot was about right, but caveated that further fine tuning may be needed as the pilot progresses. There were mixed views on whether a stepped payment rate provides more incentive or risk or both with 50% responding that it provided both.

### *Baseline confidence and ambition*

Participants expressed reasonable levels of confidence about their ability to decide the appropriate management required to achieve the best results across all four objectives (Figure 34). Farmers were generally 'quite confident' in applying the management required for hay meadows and there was a greater level of confidence for delivering habitat suitable for breeding waders with just under half of the agreement holders 'very confident' and the remainder 'quite confident' about deciding the management that was required to maintain and improve their score. At the time of the second survey the proportion of farmers reporting they were 'very confident' in knowing what management was required to improve the habitat score had increased for hay meadows and remained the same for those with wader habitat.

Confidence in their ability to undertake the self-assessment was lower (*Figure 35. Farmer confidence - self-assessment*) with a significant proportion of both arable and grassland participants responding 'not at all confident' at the start of the project. The major exception was habitat for breeding waders which exhibited much higher levels of confidence. By the time of the second survey confidence levels had generally increased for both arable and grassland elements with the total expressing 'very confident' rising from 16% to 35%. The exception was habitat for breeding waders which showed a slight decline in the 'very confident' proportion (from the high baseline). For hay meadows the farmer's ability to identify the plants on the score sheet has increased from an average of 1 – 10 in year 1 to 6 – 16 species in year 2.

Many farmers indicated that they expected to achieve high levels of performance/progress to higher result/payment tiers, for example 72% of the hay meadow participants expected to have achieved an increase of 1 or more payment tiers over the 2 year pilot, and after a further 3 years 50% expected to have achieved 3 or more payment steps.

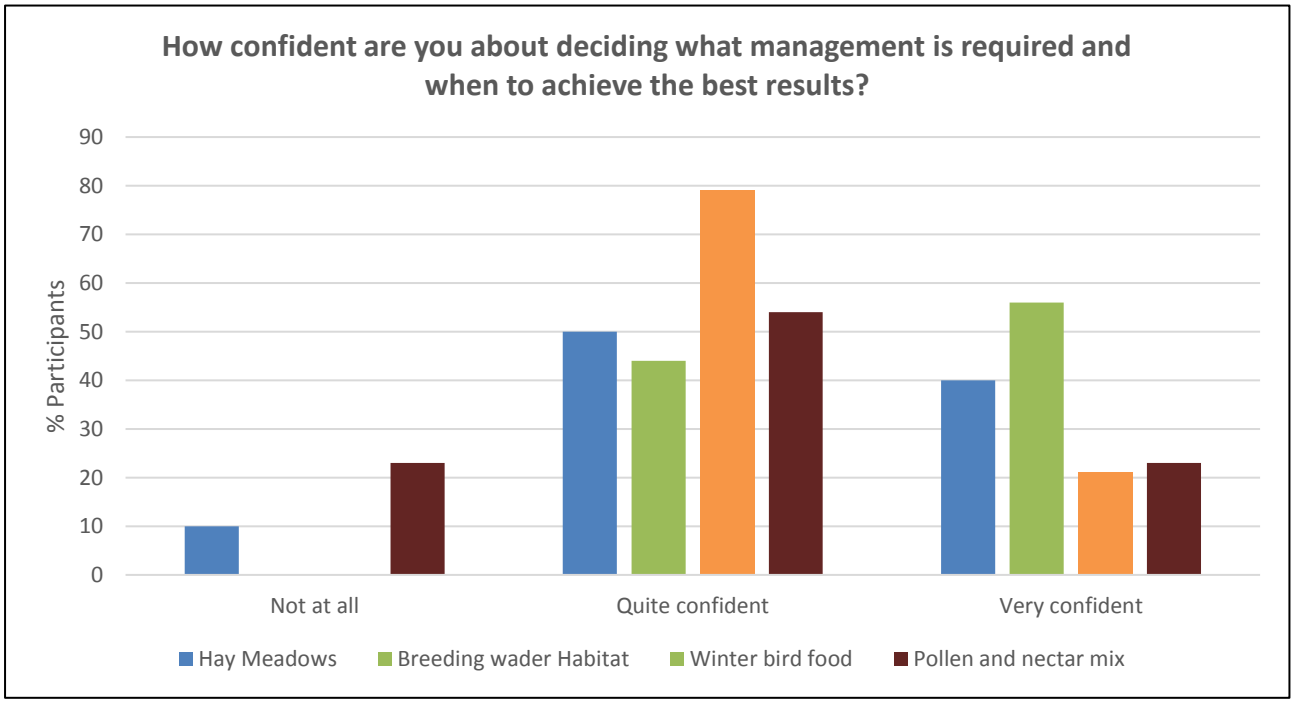

Figure 34. Farmer confidence – management required (first survey).

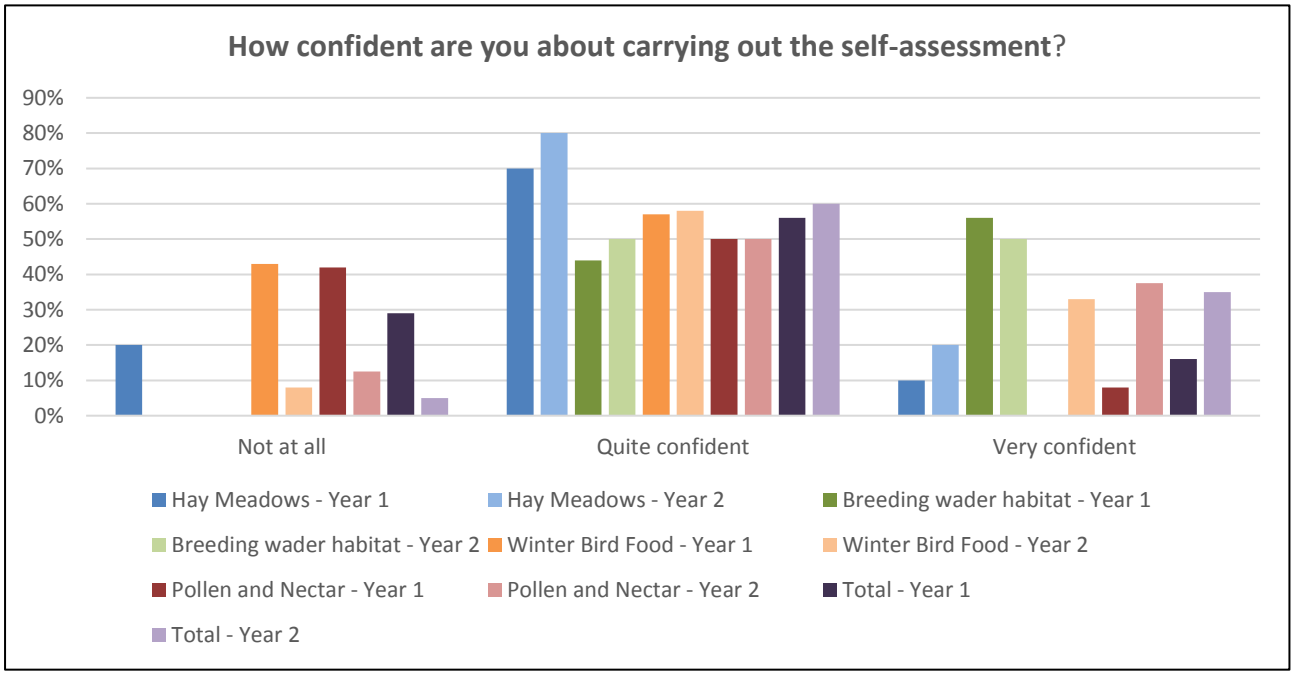

Figure 35. Farmer confidence - self-assessment.

### *Advice and Training*

Training and ongoing support from advisers was a very important part of the project – guidance notes, one to one visits and events were used by the majority in order to improve their habitat score. Key areas identified for training included plant identification, habitat management techniques and the results assessment methodology. Stakeholders also saw plant identification, management technique, results assessment methodology and seed choice (arable) as very important or important areas for training and advice. Stakeholders also highlighted the importance of ongoing support to help a farmer progress through the payment tiers.

Not every participant farmer attended the training events, but those that did found them particularly helpful and a good way of learning from one another as well as the specialists. They have used the advice and guidance to improve their habitat knowledge, alter their management techniques or undertaken the self-assessment with more confidence. All the farmers said that the training and guidance provided by the pilot was adequate in terms of quality and quantity.

*Formats*

Overall, farm walks were the most popular format followed by 1:1 advice, the training day and the picture guides in order of popularity. A couple of farmers also used other formats to improve their skills including internet sites.

In terms of the ongoing support and advice one to one discussions with advisers were most valued, followed by the picture guidance and phone support. Apps were not used at all, some farmers use videos and others have used third party advice from seed merchants or national organisations. All the farmers felt that ongoing support and advice is important or very important to the success of their agreement. Support was mentioned a lot. Some characteristic quotes below:

*"Realisation that advice and input from outside sources is key to improving the effectiveness of these conservation areas. With general agriculture we have so many magazines advising best practice; in conservation there is so little palatable, practical literature dealing with hows, whys and wherefores on an agricultural scale. The opportunity to talk shop with other farmer conservationists has been most valuable."*

*"I should have got things right from the start!"*

*"Increased knowledge of different establishment techniques and timings"*

*"Increased knowledge about wildlife issues"*

*"It has been a great learning process and a chance to have the freedom to experiment with the management of both WBF and P & N in order to work out what work best on my farm (still learning)"*

*"Effective training of farmers and trainers is the key to success. Training should include why farmland habitats are so important to people and wildlife alike"*

*Sources of advice*

Nearly all of the respondents depended on the support from the project advisers and the training events to help them with the habitat management. However, a number - mainly arable - had also used 'external' specialists and farmers not connected with the project (typically seed merchants and agronomists). The majority of the farmers had discussed / shared their learning and experience with other participating farmers on how to improve their habitat scores with most stating that this occurred at the meetings the project team organised. Preference on who should provide the advice was split between a national delivery organisation (arable participants) and a local organisation (grassland participants), perhaps reflecting more on the value of trusted advice than necessarily the source. Indeed, a very strong emphasis was placed on the quality of the farm advisers – this was essential to make such a scheme work effectively.

*"only concern is will there be enough one to one contact …..if the scheme is rolled out to all farmers"*

# Design and Delivery Costs, Scheme Payments and Cost-effectiveness

### *Introduction*

Making comparisons between the design and delivery costs of a mainstream, nationally implemented, multi-objective AES and a small scale pilot scheme focused on a narrow set of objectives is extremely challenging. Pilot projects are necessarily more resource intensive and don't benefit from the economies of scale and operational efficiency gains that typically exist in established mainstream schemes. In making such comparisons it has been necessary to adopt a number of major assumptions about how the pilot scheme would be scaled up if it were to be mainstreamed and adjust the data accordingly. These assumptions are detailed in the relevant sections below.

### *Design*

No attempt has been made to quantify the resources required to design a results-based scheme and no comparator measure exists for contemporary action-based schemes in England. Developing result-based measures, especially those suitable for farmer self-assessment, is time consuming and requires a high-level of technical expertise. However, this is little different to management-based schemes which require development and testing of management actions and prescriptions. The key difference is that in most cases the investment to develop such measures has already taken place and their operation has been tested and refined over many years. Conversely developing a result-based scheme is likely to require significant initial investment and there is also currently relatively little wider experience to draw on. One option, to smooth major initial design costs, is to operate a composite scheme comprised primarily of management-based elements with a small result-based element initially, adding further result-based elements over time.

### *Delivery Costs*

This section compares the costs of processing applications and managing agreements in the pilot to those of the mainstream AES Environmental Stewardship, specifically Higher Level Stewardship (HLS)[4]. In contrast to the pilot, HLS is a management-based scheme. However, making direct comparison is misleading because of the pilot nature of the project and a number of adjustments have been applied to enable analysis. The results need to be interpreted with caution because they are based on a number of significant assumptions/adjustments to enable comparison of the data. Specifically, the data has been adjusted for the following factors (full details in Appendix 6):

- **Staff costs:** RBAPS is a pilot and as such was administered and delivered mainly by those who developed the project. If RBAPS was a national scheme, some tasks would be done by people at different (pay) grades.
- **Specialist support:** under HLS the Land Management Team (LMT) received specialist support when processing applications. This is currently not the case in the pilot because of the narrow range of environmental objectives involved but would be if RBAPS was a national scheme with a more ambitious range of environmental objectives.
- **Tasks:** there are several tasks that were not carried out in the RBAPS pilot but which would be required if RBAPS was a national scheme.
- **Efficiency gains:** the comparative mainstream HLS data is from 2013/14. By then, the scheme had been in operation since 2005 and had benefited from significant efficiency gains (time spent per application and existing agreement fell with time).

[4] HLS covers more complex type of management and agreements tailored to local circumstances. Within ES, it is the level that is most comparable to RBAPS.

- **Greater scale and complexity of agreements:** Mainstream scheme agreements cover on average 16.49 management options and 199.93ha. This is compared to 1.7 options and 2.8ha per RBAPS agreement. As a result, the time recorded for the RBAPS pilot will not be representative for many tasks at the agreement level. Consequently, if RBAPS was a national scheme, more time would be spent on certain tasks as more (or different) management options and a larger area are covered.
- **Agreement duration:** certain tasks only occur once during an agreement, for example agreement development. In the RBAPS pilot the short length of the agreements inflates these costs as a proportion of the overall agreement delivery costs.

It is also necessary to make a number of assumptions about how a mainstream RBAPS would operate. For the purpose of the calculations presented here the following assumptions have been used:

- Payments would be made based on self-assessment scores, with a proportion subject to annual verification/compliance visits.
- The impact of larger more complex agreements (covering a wider range of objectives and greater area of land) are only factored in for the time taken for certain tasks (pre-application visits done by the LMT and office based advice for existing agreements).
- That the advice provision (farm walks, training events, one-to-one advice etc), at the agreement level, would be the same even if agreements contained a greater number of options and/or area of land under scheme agreement.
- Overhead costs, IT costs and compliance inspection costs are excluded from the comparison as they are not readily available for the pilot (eg for the small scale pilot no IT system was used). However any mainstream implementation is unlikely to have significantly different costs in these areas, with the exception perhaps of compliance inspection costs. The need to undertake inspections within specific time windows, which will vary according to the breadth of scheme objectives, may mean that a greater number of separate visits are required compared to a management-based approach.

The analysis indicates that the RBAPS approach is cheaper than HLS: processing applications is significantly cheaper under a results-based approach (£1,625 vs £2,721), whereas managing existing agreements is slightly more expensive (£521 vs £478). Processing applications is significantly cheaper because a results-based scheme does not involve any editing and negotiating of land management prescriptions for individual sites which can be a very time consuming process. Under HLS this task takes up roughly 40% of the total time spent on processing applications by the Land Management Team (LMT).

Figure 36 captures total per-unit costs of processing an application and breaks these costs down for the Land Management Team (LMT; technical advice) and the Technical Support Team (TST; administration).

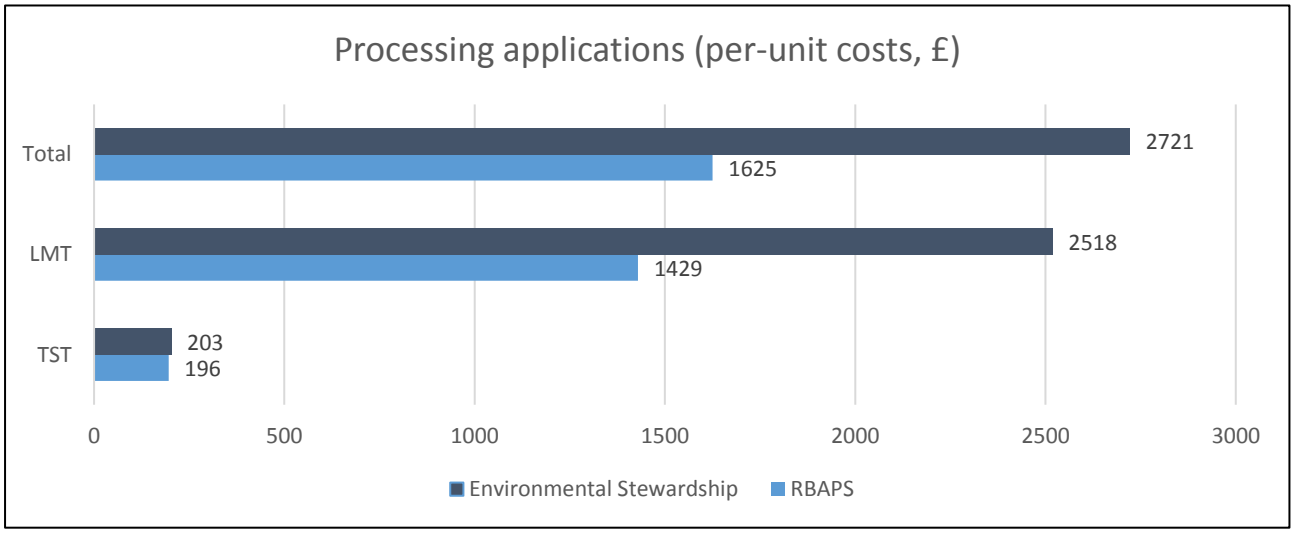

Figure 36. Processing applications (per-unit costs, £).

Managing existing agreements is slightly more expensive under RBAPS than HLS (see Figure 37). This is mainly due to the fact that RBAPS is more advice intense. Time spent on farm advice (farm walks, whole day training events, 1:1 advice/training) will likely be even larger in a national RBAP scheme due to a wider range of environmental objectives (which are likely to require separate, bespoke training sessions) and land area covered. We do not adjust for this as a reasonable estimate is not readily available. This is likely to be most significant in the early stages of the transition to a result-based approach

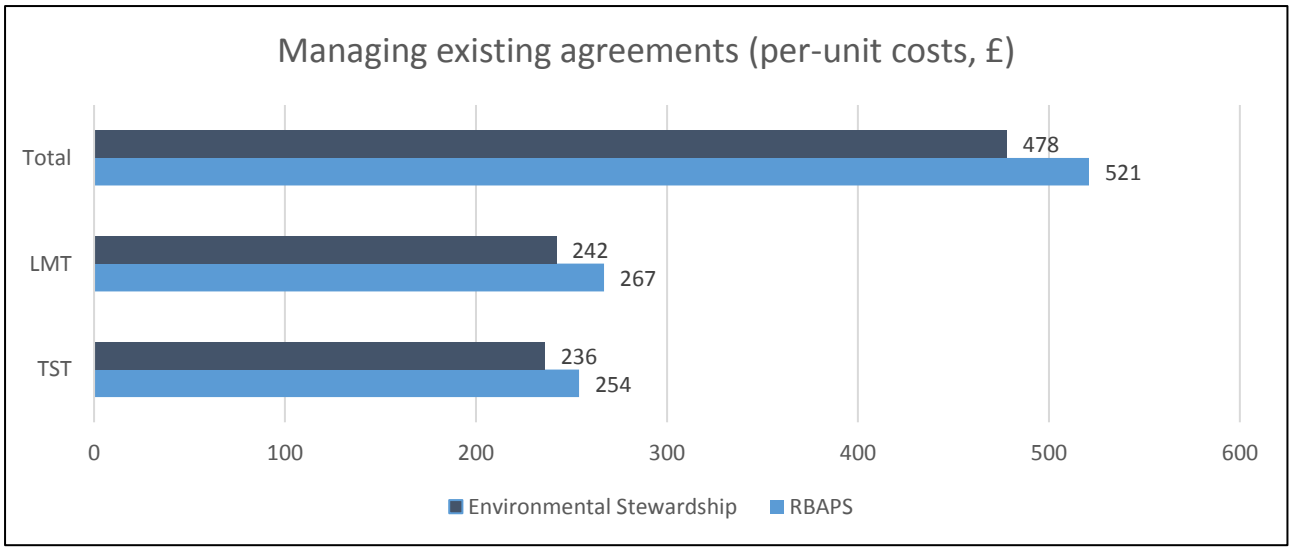

Figure 37. Managing existing agreements (per-unit costs, £).

Scheme Payments

A relative comparison between scheme payments under the RBAPS approach and the equivalent mainstream scheme is possible and generates some insight. In making such a comparison it is important to note a number of factors. The RBAPS payment calculations for the arable objectives are artificially inflated because of the short duration of the project and for the grassland objectives a number of optional supplements and capital items which are available in mainstream schemes to support delivery, but are subsumed within the RBAPS payment calculation, further complicate the comparison. Table 33 provides a comparison of the average RBAPS payments with the equivalent mainstream scheme payment.

| Objective | RBAPS Payment Range £ha | Average RBAPS Payment Yr1 £/Ha | Average RBAPS Payment Yr2 £/Ha | Countryside Stewardship Equivalent | Countryside Stewardship Equivalent £/Ha |
|---|---|---|---|---|---|
| Species rich hay meadow | 5 tiers £112-371 | 183 | 210 | GS6 Management of species rich grassland<br>GS15 haymaking supplement | 182<br>85 |
| Habitat for breeding waders | 5 tiers £35-174 | 146 | 147 | UP2 Management of rough grazing for birds<br>GS16 Rush control supplement<br>WN2 (Capital) creation of scrapes and gutters | 88<br>73 |
| Provision of winter bird food | 6 tiers £0-842 | 766 | 789 | AB9 Winter Bird Food | 640 |
| Provision of pollen and nectar resources for pollinators | 10 tiers (6 in year 1) £0-705 | 702 | 629 | AB1 Nectar Flower mix | 511 |

Table 33. Comparison of RBAPS and conventional scheme payments to farmers.

In the case of the species rich hay meadows the payments are significantly lower than equivalent mainstream payments but as noted previously the meadows in the pilot were typically less species rich than the best sites in the area (which would be expected to secure payments nearer the top of the RBAPS range). However, this illustrates the advantage of paying according to results as these RBAPS sites under mainstream payments would receive a significantly higher standard payment provided they complied with the standard management prescriptions, and would have little additional incentive to improve their species richness.

Comparison of the habitat for breeding waders is also complicated by the fact that a number of supplementary payments and capital items are usually associated with this management option in the mainstream scheme. Nonetheless, the average RBAPS payment is very similar to the mainstream scheme payment plus supplements and the RBAPS sites narrowly outscored the mainstream control sites in both years of the pilot.

For the arable RBAPS the payments for both outcomes were significantly higher than those under the equivalent mainstream scheme (20-40%), however, the performance of the measures was also significantly higher with an 81% (winter bird food) and 21% (pollen and nectar provision) increase in scores compared to mainstream scheme control sites. Plots delivering pollen and nectar resources are known to decline in quality with age but are often not replaced frequently enough. It is likely that a key benefit of the RBAPS approach would be to maintain a higher level of delivery for this measure throughout the life of an agreement which

would contribute a further benefit which has not been observed in the pilot because both control and RBAPS plots were newly established.

A particular issue in that can be foreseen in relation to scheme payments under the RBAPS approach is budget management. The potential variability in performance and consequent fluctuations in expenditure raises a potential concern for Managing Authorities. However, for most measures, such as habitat condition, it should be possible to accurately anticipate expenditure based on baseline condition assessments and assumed average rates of habitat quality improvement. Annual measures, such as the arable measures tested here, are potentially more prone to fluctuation but their performance has been broadly consistent across the pilot (even in a challenging growing season affected by drought) which suggests that average performance levels would emerge which could be used for budget planning purposes.

### *Monitoring and evaluation*

The resource needed to undertake robust monitoring of the environmental performance of result-based approaches should be no different to that required for management based approaches at the site, landscape and national levels. Indeed the additional data resulting from farmer self-assessments of result measures may provide opportunities to rapidly gain valuable insights, for example to better understand the precise changes in management practices contributing to significant habitat condition improvements or to identify the use and effectiveness of new and novel practices.

### *Overall Cost-Effectiveness*

A full comparison of cost-effectiveness isn't possible without taking into account all the delivery costs, payments and environmental performance of both result-based and management-based approaches, which has not been possible. However, the estimates suggest that in terms of delivery costs the administrative simplicity of the RBAPS approach, which negates the need for the selection and tailoring to individual sites of multiple management based options and prescriptions, offsets the additional resource required to manage and support the ongoing implementation of RBAPS agreements in terms of advice.

In most other respects the processes involved in scheme delivery, eg expert baseline assessments, payment of claims, compliance monitoring, and environmental monitoring are the same so costs for these elements wouldn't be expected to differ significantly between approaches.

In terms of overall scheme payments the higher scheme payments associated with high levels of results delivery under a result-based approach may be offset against lower payments for under-performance/sites at the lower end of the payment range (which would have received a higher fixed rate payment under a management based approach) so the total value of payments is not necessarily higher for an equivalent area under management. Where payment rates under a result-based approach are somewhat higher on average than those on control sites under management-based agreements (for example the winter bird food and pollen and nectar payments were on average approximately 20% higher under the result-based approach) this corresponds to environmental performance improvements (scores increased by 43% and 15% respectively), which suggests that the additional benefits are likely to be at least proportionate to the higher scheme payments.

# Conclusions

Overall the findings from the project are broadly consistent with the developing body of evidence on RBAPS approaches. However, the project has generated important new insights in relation to the use of proxy indicators which potentially allow the approach to be applied to a wider range of environmental objectives, including those associated with arable farming systems and mobile species, which haven't featured widely in RBAPS to-date. The project has also focused on developing and testing result measures suitable for self-assessment. This is likely to be a significant consideration if the approach is to be implemented in a cost-effective way more widely.

## Environmental Performance of RBAPS

The environmental performance of all the results-based measures was better than their equivalent control sites. The winter bird food plots managed with a results based approach significantly outperformed conventional scheme control plots during both years of the pilot (43% higher scores). Pollen and nectar plots exhibited somewhat less difference but still performed better than the control sites (15% higher scores). The meadows exhibited an average 24% increase in quality score over the 2 years with improvements on all but 2 sites. Quality scores for the habitat for breeding waders declined by 13% on average over the 2 years but this was still less than on comparable control sites (-17%). In the case of both hay meadows and winter bird food the difference in performance between RBAPS and controls was statistically significant (P0.05).

Developing and using simplified result measures means that there is a risk of divergence between the desired outcome, as represented by the result measure, and more sophisticated outcome assessments. Figure38 shows there was a strong relationship between the meadow score in RBAPS meadows and the total number of records for indicator species along a transect i.e. species frequency or abundance. This strong relationship indicates that an increase in the frequency of indicator species is likely to be the main driver behind the increase in meadow score observed from baseline to year 2, rather than a simple increase in the absolute number of different indicator species.

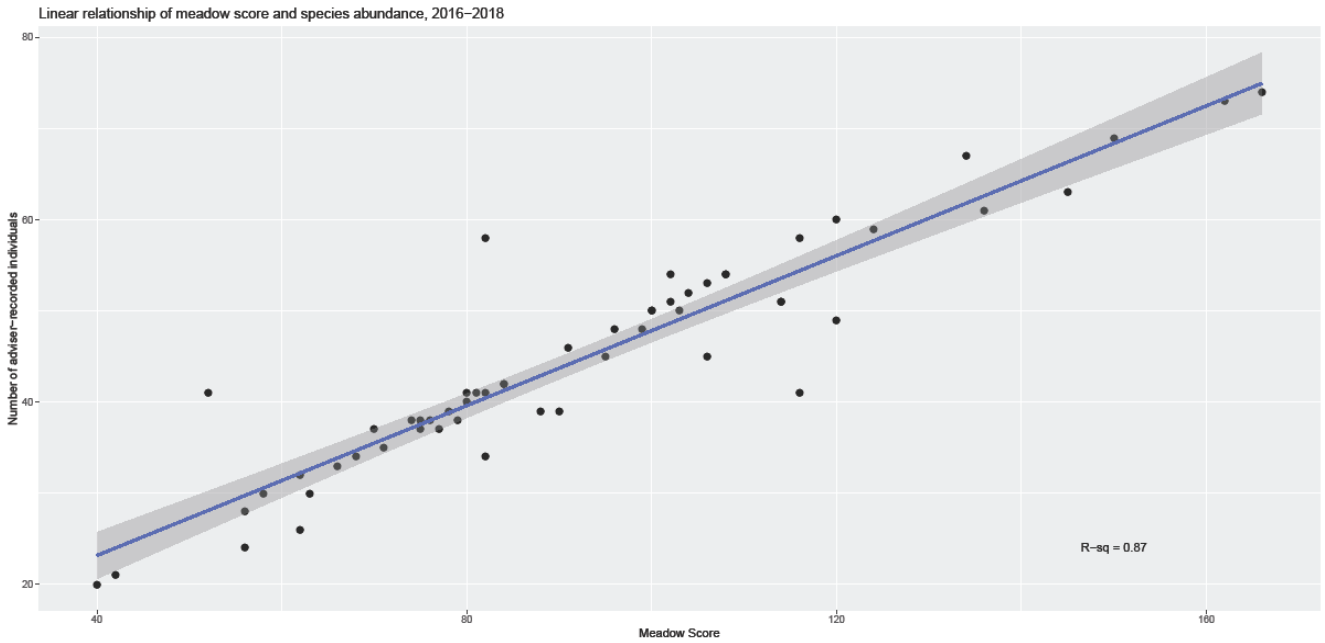


Figure 38. Relationship between meadow score and species frequency.

Similar validation for the other result measures is less straightforward and has not been possible within the pilot resources. For example for winter bird food this would require harvesting and drying samples to establish actual seed yield and seed diversity and surveys of bird utilisation to correlate against plot result scores. Key areas for further work include:

- A need for further validation of result measures using longer time series comparing result scores with traditional habitat condition assessment methodologies/other direct measures of results to confirm that measures are delivering their objectives and that there is no divergence over time.
- The need for ongoing well designed environmental monitoring of outcomes, such as species populations, to confirm the overall effectiveness of schemes (but this is only possible for schemes operating at scale and is a relevant consideration for both management-based and results-based approaches).

## Design and implementation of RBAPS

Developing result measures for the hay meadow outcome was relatively straightforward. Species rich grassland has featured widely in results-based approaches developed elsewhere and these existing examples provided a strong starting point for a measure based on the presence of indicator species. In this case the result measure is a direct measure. However, for the arable outcomes and habitat for breeding waders the result measures are necessarily proxy measures of intermediate outcomes rather than direct measures of bird or pollinator populations or wader breeding success and there are fewer existing examples to draw on. The development of result measures reliant on intermediate/proxy results has highlighted two particular challenges with this approach.

First, when developing the results criteria for winter bird food, seed production was the focus and this is reflected in the payment tiers. As the results show the farmers have delivered exceptionally well even during the very dry, hot season in year 2. However, what has become apparent is that focusing on seed production has resulted in some very tall dense plots that are difficult to assess and potentially may not be ideal for the birds to feed in. For instance, some farmland birds prefer to feed on the ground and so are unable to access the seed in very dense plots. Defining and measuring a good plot is not as simple as the amount of seed produced, other elements such as plot structure and habitat provision need to be considered further if this approach is to be adopted more widely. Another aspect is the level of management required to reach the top payment tier for winter bird food. The farmers have felt that they are managing the plot too intensively for an environmental option, particularly regarding plant protection products, which is another consequence of having a proxy measure narrowly focused on seed production.

A particular difficulty= of developing result measures for species with different habitat requirements has been highlighted in the development of the breeding wader measure where 3 of the target species have broadly similar habitat requirements whereas the 4$^{th}$ (Northern lapwing) shares many similar requirements but also has some significant differences. This highlights the challenge of defining simple habitat condition objectives that can simultaneously satisfy the requirements of multiple target species.

Significant variations in weather conditions during the project have provided valuable testing of the approach under these circumstances and have highlighted two particular challenges. First, result assessments with defined assessment windows can be sensitive to seasonal variations in weather conditions. Second, extreme weather events, outside normal fluctuations, can unfairly expose farmers to risk beyond their control.

In terms of measurement of results famers have picked up survey skills rapidly and their results show a good correlation with the adviser's. Overall the results have shown that farmers have grown in confidence and ability

with surveying techniques and plant identification. Assessment results which showed most differences were typically caused by:

- Species misidentification (both grassland and arable),
- Purposeful or unintended deviation from the fixed transect (Hay meadows),
- Interpretation of the 'representative stops' methodology (Arable),
- Measures based on assessments such as percentage cover were also found to be more subjective (habitat for breeding waders and pollen and nectar provision).

Some minor differences in scores from the fixed transect sampling method used for the hay meadows were to some extent inevitable given the farmer and adviser were unlikely to stop at the same point along the transect line. However, some farmers admitted to surveying areas away from the agreed transect as they wanted to capture plants that were present in the field but not represented on the transect line. This issue was a problem as some felt the process/method was not fair where there were additional positive indicator species in the field which were not present on the transect. A scoring system that recognises additional, off-transect species, could be devised such as scoring them once based on simple presence in the field (not frequency as that would be more subjective if not recorded on the transect line), although this would require extra survey effort. Weather also affects survey results - the early smaller spring species were better recorded during the second survey season due to the fact they were more visible within the shorter sward.

In the arable element in practice the quadrats were randomly placed as it was hard to define where they should be put to be 'representative'. A set route could be considered to improve the accuracy and make the assessments more comparable, although this is subject to the weakness observed above. The assessment methodology also proved to be quite sensitive with the potential for one plant in one quadrat to move the overall result between payment tiers. This was more of a problem in year 2 when the establishment of diverse crops was less even. Further consideration needs to be given to how this could be improved.

Indicators reliant on more subjective assessments of plot/field level characteristics e.g. the percentage cover of a particular feature, exhibited greater variability between adviser and farmer assessment scores to the extent that differences in payment tier have frequently occurred. Further work is required to address this issue, limiting the number of payment tiers for this type of measure might limit the impact of this issue. Another option may be the opportunity to use technology to support more accurate assessments in future.

A number of potential opportunities for the use of technology to assist in the accurate measurement of results have been identified and some preliminary exploration undertaken. Overall, technology may have two specific uses in this context. First, to support more accurate assessments of results by land managers at the field/farm-level. Here it is important that there is scope for real-time or rapid feedback from such tools to inform management decisions. Second is the potential for remote sensing to support effective targeting of site verification visits, recognising that independent verification of results will only be possible for a small proportion of sites.

In relation to the design and implementation of RBAPS measures the following considerations emerge:

- Proxy indicators need to be extensively tested in the field to identify any potential unforeseen/perverse outcomes.
- Result measures require ongoing validation, comparing result scores with traditional habitat condition assessment methodologies/other direct measures using longer time series, to confirm that simplified measures are good proxies for their objectives and that there is no divergence over time.

- To limit the use of result indicators reliant on more subjective assessments, such as percentage of cover, and to recognise the greater variability in scoring that may result if they are adopted (eg by using fewer payment tiers, accepting that this may reduce the incentive effect).
- Weather is a significant factor that affects both agricultural and environmental results. Successful delivery of many biodiversity outcomes is closely linked to characteristics, such as wetness, which are affected by the weather. Result indicators which are very sensitive to weather conditions should only be used where potential management interventions are available to directly influence these characteristics. Provided that this is the case it is not unreasonable to expect farmers to make more interventions in some years to deliver optimum results (or accept a lower level of results, which would be no different to agricultural production affected by weather).
- The need for clear safeguards to apply if truly 'exceptional weather' is experienced so that land managers are not unfairly exposed to risk beyond their control and are aware of this when they enter an agreement. The pilot has explored a number of potential options for this and different approaches may be more suitable for different outcomes.
- Defined assessment windows are important to ensure any independent verification takes place as close to the self-assessment survey date as possible.
- Developing single result measures for species with different habitat requirements is challenging. This has been highlighted in the development of the breeding wader measure where 3 of the target species have broadly similar habitat requirements whereas the 4$^{th}$ (Lapwing) shares many similar requirements but also has some significant differences. This highlights the challenge of defining simple habitat condition objectives that can simultaneously satisfy the requirements of multiple target species.

There are opportunities for further work to support design and implementation, specifically:

- There are opportunities to explore the use of technology, especially to support the process of result assessment undertaken by farmers/land managers. Overall, technology may have two specific uses in this context. First, to support more accurate assessments of results by land managers at the field/farm-level. Here it is important that there is scope for real-time or rapid feedback from such tools to inform management decisions. Second is the potential for remote sensing to support effective targeting of site verification visits, recognising that independent verification of results will only be possible for a small proportion of sites.
- There is a need to develop a better understanding of the impact of annual weather differences, especially in the context of increasing variability driven by climate change, on indicator species visibility/counts through longer time series data.

## Motivation and risk

The link between payment and result focuses farmers on owning and understanding the results, rather than simply following prescriptions. The onus is on the farmer to seek advice, and improve their skills to enable them to deliver the results. Farmers like the freedom to use their own local knowledge and expertise to manage without being 'told what to do'.

Farmers have been motivated to carry out different management practices to improve the biodiversity results. Grassland participants responded to the results-based approach by carrying out around 4 new practices each such as reduced fertiliser, changes to grazing management and adding wildflower seed. Arable farmers have made different management decisions for their plots even compared to their conventional AES plots. These include seed bed preparation, choice of seed mix, fertiliser and plant protection product applications. In short they are paying greater attention to their RBAPS plots and carefully considering how to produce results and secure a higher payment rate. The short duration of the project means that it has not been possible to test

whether the initial motivation wanes as participants develop experience of the approach (and are successful or otherwise).

A range of scores within a payment tier instilled a degree of flexibility into the system so that some year to year fluctuations in score did not necessarily lead to a change in payment tier. The number and value of the steps in a tiered system are important considerations as they are key drivers for encouraging farmers to produce better results and increase their payment. The project used evenly spaced payment tiers, primarily for simplicity and lack of strong evidence for an alternative approach. There is potential to explore how motivation changes with non-linear payment rates.

Depending on participant's attitude to risk a pure results-based approach provides either a positive motivation and/or a negative exposure to risk. The pure results-based approach and consequent £0 payment rate created much discussion, primarily in the arable element of the project where the objectives are delivered through annual measures with significant exposure to risk each year, unlike an established habitat. At the start of the project there was concern about the level of risk it potentially exposed a farmer to; although it could be argued that all commercial crops are also subject to failure and so this is no different. However, the pilot has shown that none of the arable plots, even in the challenging weather of year 2, were anywhere near the £0 payment tier so this concern may be unsubstantiated in the longer-term. However, it might act as a significant barrier to initial scheme uptake, especially for those with lower levels of confidence/experience.

A pure results-based approach provides an important motivation, and also a value-for-money safeguard to ensure payments are only made for performance above a defined minimum level. However, if a pure-results based approach is adopted for annual measures, such as those arable measures tested here, the perception of risk could be a significant barrier to initial uptake and needs to be considered in any scheme design.

Particular areas for further work to better understand how motivation and risk attitudes affect delivery include:

- The number of payment tiers and the use of non-linear spacing of tiers to either reduce the financial risk from poor performance or to provide a much greater incentive for outstanding performance, merits further exploration and testing.
- A greater understanding of how farmer confidence and expectations develop over time as they engage with the approach is still required. Especially whether their initial motivation wanes as participants develop experience of the approach (and are successful or otherwise), especially for those environmental objectives, such as habitat condition, that are typically very slow to respond to changes in management.
- Specifically for the pollen and nectar resource provision, which is a multi-annual sown mix and prone to deteriorate in quality over time, whether the RBAPS approach will encourage proactive management actions to be taken to maintain a certain quality/payment level.
- A greater understanding of how farmer confidence and expectations develop over time as they engage with the approach. Especially whether their initial motivation wanes as participants develop experience of the approach (and are successful or otherwise), especially for those environmental objectives, such as habitat condition, that are typically very slow to respond to changes in management. Specifically for the pollen and nectar resource provision, which is a multi-annual sown mix and prone to deteriorate in quality over time, whether the RBAPS approach will encourage proactive management actions to be taken to maintain a certain quality/payment level.

## Cost-effectiveness

A full comparison of cost-effectiveness isn't possible without taking into account all the delivery costs, payments and environmental performance of both result-based and management-based approaches, which has not been possible. However, the estimates suggest that in terms of delivery costs the administrative simplicity of the RBAPS approach, which negates the need for the selection and tailoring to individual sites of multiple management based options and prescriptions, offsets the additional resource required to manage and support the ongoing implementation of RBAPS agreements in terms of advice.

In most other respects the processes involved in scheme delivery, eg expert baseline assessments, payment of claims, compliance monitoring, and environmental monitoring are the same so costs for these elements wouldn't be expected to differ significantly between approaches.

In terms of overall scheme payments the higher scheme payments associated with high levels of results delivery under a result-based approach may be offset against lower payments for under-performance/sites at the lower end of the payment range (which would have received a higher fixed rate payment under a management based approach) so the total value of payments is not necessarily higher for an equivalent area under management. Where payment rates under a result-based approach are somewhat higher on average than those on control sites under management-based agreements (for example the winter bird food and pollen and nectar payments were on average approximately 20% higher under the result-based approach) this corresponds to environmental performance improvements (scores increased by 43% and 15% respectively), which suggests that the additional benefits are likely to be at least proportionate to the higher scheme payments.

Further work is required before it will be possible to conclude whether RBAPS represents a cost-effective alternative to conventional management based AE schemes but the early indications suggest that the RBAPS approach is unlikely to be any less cost-effective.

## Mainstreaming

It is clear that the results-based approach has considerable potential to significantly improve the performance of agri-environmental measures and early indications suggest that delivery costs and scheme payments are unlikely to be significantly different to those of management-based measures, suggesting that the approach is more cost-effective. It is also clear that the approach could be applied to a wide range of biodiversity objectives and many other environmental objectives associated with land management practices. Participants in both arable and grassland elements of the pilot were quick to identify a range of other environmental objectives, such as hedgerow management, riparian management, soil health, historic features, that the approach could be applied to. Indeed, 57% of respondents at the final project conferences felt that RBAPS should be the approach adopted in a future agri-environment scheme and 97% felt that RBAPS should be part of a tool box for future AES. Five particular challenges to mainstreaming the approach have been identified.

First, concerns that the time associated with undertaking self-assessment of results by participants on a larger number of plots/fields across a wider range of environmental objectives at a whole farm scale could become unmanageable. The scheme payments include an element for the time required to undertake the assessments so the time itself need not be a barrier. However, if the timing of assessments for different outcomes were coincident and/or the timing of assessments were coincident with peaks of agricultural activities this could be a particular challenge. It would be anticipated that the time spent by participants on self-assessment would reduce as they develop the skills and confidence to undertake the assessments, and there is some evidence from the pilot of this happening. However, this clearly needs further consideration in the context of an overall

scheme design although it might be possible to reduce the frequency of some assessments or to reduce the number of stops per plot, subject to further testing of the repeatability of different survey methodologies.

Second, the need for extensive training and advice, especially in the early stages of implementation to support the self-assessment process. The approach is a big culture change for farmers, changing the scheme risk from non-compliance with prescriptions to non-delivery of results. Experience from the pilot shows the potential need for high levels of support in the early stages of adopting the RBAPS approach as farmers develop the necessary skills and confidence. This would be especially true across a scheme with a wider range of result based objectives. However, indications from the pilot suggest that farmers have developed the necessary skills and grown in confidence quickly and that this would predominantly be a temporary requirement in the initial stages of implementation.

Third, the resource required to verify results. The pilot has necessarily employed 100% independent assessment of results annually. Translating such an approach into a mainstream scheme is unlikely to be feasible because of the volume of assessments required. However, the pilot has demonstrated a high level of accuracy of self-assessment results for most measures which indicates that such a level of verification is probably not necessary. For some measures less frequent independent assessments may be sufficient e.g. at end of agreement (which would also provide a new baseline for any future agreement), in other cases a risk-based approach focused on independently sampling a small proportion of sites each year could be adopted. Selection could be informed by factors such as significant changes in self-assessed scores, evidence from remote-sensed data suggesting a discrepancy between a self-assessed score and actual condition on the ground, or random.

Fourth, budget management. The potential variability in performance and consequent fluctuations in expenditure raises a potential concern for Managing Authorities. However, for most measures, such as habitat condition, it should be possible to accurately anticipate expenditure based on baseline condition assessments and assumed average rates of habitat quality improvement. Annual measures, such as the arable measures tested here, are potentially more prone to fluctuation but their performance has been broadly consistent across the pilot (even in a challenging growing season affected by drought) which suggests that average performance levels would emerge which could be used

Fifth, the development and testing of a much wider range of result measures. The pilot has only developed and tested result measures for 4 biodiversity objectives and following experience and testing some further development of these measures is still required. This is potentially a significant process which requires considerable technical expertise and extensive time for testing, especially for outcomes where the approach hasn't been tested before (although arguably this is little different to the extensive research and testing that has informed the development of management based approaches). Even for outcomes where there may be more experience to draw on, tailoring of proven approaches to specific local circumstances is still likely to be required. However, unlike management-based schemes which tend to develop multiple management options and prescriptions designed to address specific situations, a significant advantage of a results-based approach is that a tiered approach to payments can accommodate a wide-range of baseline starting conditions within a single measure; it can also subsume a range of payment supplements and supporting capital investments. Together these could result in a very significant simplification of the potential number of measures required compared to a management-based scheme.

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# Appendices

# Appendix 1 – Score cards – Arable

### *Pollen and Nectar Score Card and Assessment Methodology*

*Please note for the purposes of the pilot the % cover of flowering sown species will not be assessed during the first assessment in 2017 (year 1). Therefore the Grant payments in year 1 will be based on the number of sown flowering species only and an assumed percentage cover of flowering sown species of 90 – 100% (shaded in grey) will be used. This is primarily to encourage farmers to demonstrate best practice and utilise regular cutting (which would result in a reduced % cover score, performance tier and thence grant payment rate) in the establishment year (typically 12 months after sowing) to control weeds and encourage sown species to tiller and establish better (particularly those flower species that take longer to get established such as bird's-foot trefoil and knapweed). Results and subsequent payments in the first year will therefore reflect successful establishment of the seeds sown.

However, both results criteria shall be assessed during the second plot assessment in summer 2018.

All grant payment rates £/ha.

| Result Criteria: Number of sown flowering species present | Results Criteria: Percentage cover of flowering sown species * and Grant payment rate | | | | | |
|---|---|---|---|---|---|---|
| | 0-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-100 |
| 5+ | Tier 1 (£0) | Tier 6 (£423) | Tier 7 (£494) | Tier 8 (£564) | Tier 9 (£635) | Tier 10 (£705) |
| 4 | Tier 1 (£0) | Tier 5 (£353) | Tier 6 (£423) | Tier 7 (£494) | Tier 8 (£564) | Tier 9 (£635) |
| 3 | Tier 1 (£0) | Tier 4 (£282) | Tier 5 (£353) | Tier 6 (£423) | Tier 7 (£494) | Tier 8 (£564) |
| 2 | Tier 1 (£0) | Tier 3 (£212) | Tier 4 (£282) | Tier 5 (£353) | Tier 6 (£423) | Tier 7 (£494) |
| 1 | Tier 1 (£0) | Tier 2 (£141) | Tier 3 (£212) | Tier 4 (£282) | Tier 5 (£353) | Tier 6 (£423) |
| 0 | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) | Tier 1 (£0) |

*Timing of survey*

Assessments of the Pollen & Nectar (P&N) plots need be carried out between 15th June and 15th October in 2017. This will allow you to cut the plots regularly during the first spring/summer after sowing period to help control weeds and aid the establishment of the sown flower species.

To ensure the majority of sown flower species are flowering at the time of the first plot assessment - to aid with plant identification - it is recommended that all cutting on autumn (2016) sown plots is completed a minimum of 4 weeks prior to completion of the plot assessment. A longer gap of 6-8 weeks is recommended for plots established in 2017.

*What to remember*

The following will be required to complete the plot assessment:

- Copy of the Agreement Map
- Plot assessment record sheet
- Plant ID sheet
- 1 metre square quadrat or materials required to create one
- Camera (or smartphone)

- Copy of seed mixture label

*How to complete the survey*

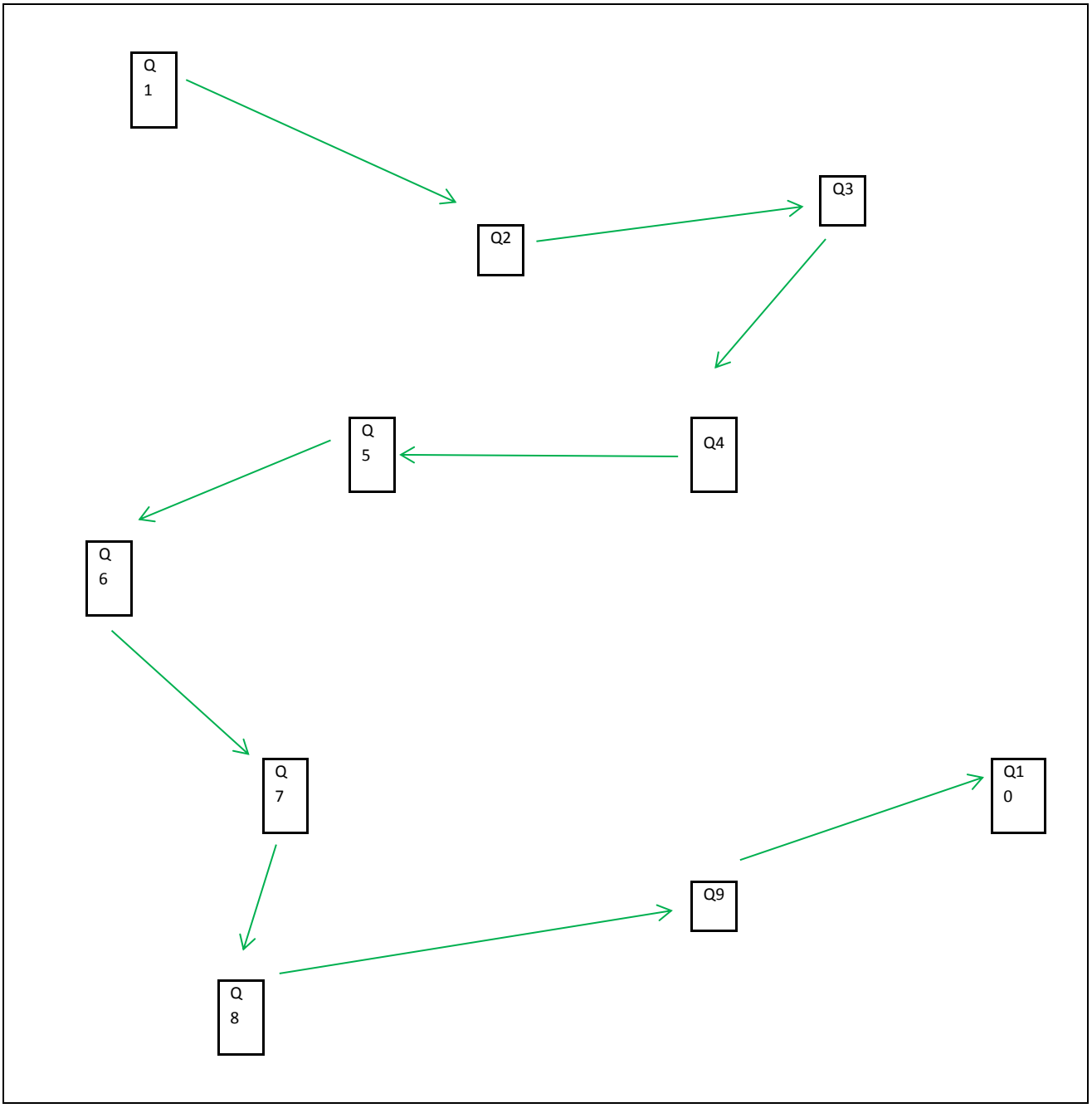
You must complete 10 visual assessments using a 1-metre square quadrat randomly placed across each plot. The plot assessment should be completed by walking across the plot and stopping at regular intervals to ensure the whole plot is sampled.

*Example field survey:*

Each time you stop, place the 1-metre square quadrat immediately in front of you, and record all sown flower species present on the plot assessment record form.

On the record sheet, where a sown flower species is recorded in at least 5 of the 10 assessments (i.e. there are 5 ticks against a particular flower species), record it as being present in the plot as a whole by adding a tick to the final column in the table.

Add up the number of ticks in the final column to work out where the plot fits on the results matrix. This will inform the payment rate for the plot.




*Additional Information*

You must only record those species that were sown in the original seed mixture.

To assess the sward in a fair and consistent manner it is important that the sward surveyed at each of the selected random survey points is representative of the sward across the plot as a whole.

It is recommended that you do not complete any stops within 4 metres of the plot boundary.

A photograph must be taken of each surveyed quadrat and be provided on request.

*Example Plot Assessment Form*

| Agreement holder | | | | | | | | | | | Plot size (ha) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agreement reference | | | | | | | | | | | Assessor | |
| RLR Field Parcel Number | | | | | | | | | | | Date assessment completed<br>Start Time/End Time | |
| Sown flower species present | QUADRAT | | | | | | | | | | Enter a TICK ✓ in this column for all sown flower species present in 5 or more quadrats | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| | Record all sown flower species present in each quadrat by entering X in the appropriate box | | | | | | | | | | | |
| Alsike clover | | | | | | | | | | | | |
| Red clover | | | | | | | | | | | | |
| Crimson clover | | | | | | | | | | | | |
| White clover | | | | | | | | | | | | |
| Sainfoin | | | | | | | | | | | | |
| Lucerne | | | | | | | | | | | | |
| Bird's-foot trefoil | | | | | | | | | | | | |
| Black medick / yellow trefoil | | | | | | | | | | | | |
| Common vetch | | | | | | | | | | | | |
| Black knapweed | | | | | | | | | | | | |
| Yarrow | | | | | | | | | | | | |
| Oxeye daisy | | | | | | | | | | | | |
| Musk mallow | | | | | | | | | | | | |
| Wild carrot | | | | | | | | | | | | |
| Field scabious | | | | | | | | | | | | |
| Sweet clover | | | | | | | | | | | | |
| Fenugreek | | | | | | | | | | | | |
| Red campion | | | | | | | | | | | | |
| Phacelia | | | | | | | | | | | | |
| Borage | | | | | | | | | | | | |
| Number of species recorded in 5 or more stops | | | | | | | | | | | | |
| % cover sown flower species | | | | | | | | | | | | |
| Average % cover | | | | | | | | | | | | |

### *Winter Bird Food Score Card and Assessment Methodology*

All grant payment rates £/ha

| Results Criteria: Number of Established Sown Species Producing Seed* | Grant payment rate where 50% or more of plot assessments reach the required plant or seed head threshold |
|---|---|
| 5+ | Tier 6 (£842) |
| 4 | Tier 5 (£674) |
| 3 | Tier 4 (£505) |
| 2 | Tier 3 (£337) |
| 1 | Tier 2 (£168) |
| 0 | Tier 1 (£0) |

* Results will be measured on the presence of the crops detailed in the assessment methodology

*Instructions*

Assessments of the winter bird food plots (WBF) plots need to be carried out between 1st September and 15th October in 2017 & between 1 September and 30th September in 2018.

Take 10 representative assessments for each plot. The assessments should be taken at regular intervals across the plot ensuring the whole plot area is assessed. Do not take any assessments within 1 metre of the plot boundary. The recordings from all 10 assessments should give an accurate representation of the WBF plot. Do not assess just the best areas. Mark on a map the approximate area where the assessment was carried out. A photograph must be taken of each quadrat area and be provided on request.

At each assessment point, count the number of seed heads/seed producing plants using a 1 metre square quadrat. Only count the crops specified in the table. Do not count naturally occurring plants (e.g. thistles, fat hen, and redshank) or any structural crops like dwarf sorghum or reed millet in the assessment.

To count as 'present' within the quadrat, the seed producing plants need to be clearly visible and either equal or exceed the thresholds stated in the RBAPS Manual and in the table below. Where the crop equals or exceeds the relevant threshold, mark the appropriate box on the scoring sheet. Triticale, wheat, oats or barley count as one crop. Do not record as separate crops. On the record sheet, the final column can be filled in or 'ticked' if the crop has been recorded in at least 5 out of the 10 assessments.

Use the number of species to work out where the plot fits on the results matrix. This will inform the payment rate for the plot.

*Winter Bird Food Assessment Form*

| Agreement Holder: | Agreement Reference: |
|---|---|
| RLR Parcel Number: | Plot Size: |
| Assessor: | Date Assessment Completed: |

| | | Quadrat | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crop | No. of Plants/Seed Heads Required per Quadrat | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Tick if Present in 5 or more Quadrats |
| Cereals | 25 Seed Heads | | | | | | | | | | | |
| Red Millet | 4 Seed Heads | | | | | | | | | | | |
| White Millet | 4 Seed Heads | | | | | | | | | | | |
| Quinoa | 2 Plants* | | | | | | | | | | | |
| Fodder Radish | 1 Plant* | | | | | | | | | | | |
| Dwarf Sunflowers | 1 Plant* | | | | | | | | | | | |
| Linseed | 5 Plants* | | | | | | | | | | | |
| Mustard | 2 Plants* | | | | | | | | | | | |
| Gold of Pleasure | 5 Plants* | | | | | | | | | | | |
| Spring OSR | 1 Plant* | | | | | | | | | | | |
| Buckwheat | 4 Plants* | | | | | | | | | | | |
| Number of Crops Present in 5 or more Quadrats | | | | | | | | | | | | |

* Must be a seed producing plant

# Appendix 2 – Score cards – Grassland

### *Species rich hay meadows score sheet*

*Timing of survey*

Undertake the survey before the hay is cut and once the majority of plant species are in flower; this is usually between late June and late July. This will make identification of the plants significantly easier. Ensure you have a copy of the agreement map, a survey form and ID card with you. It may be helpful to have a camera with you, in case you were unable to identify some of the plants. The plant photos can be sent to your adviser for identification.

*Method*

Using the diagonal route marked on agreement map split it into roughly 10 equal lengths.

For the survey, walk the diagonal route through the field stopping 10 times (at the mid-point of each length). At each stop look at the sward within a 1m radius around you. Using the ID card and survey sheet, tick all the positive and negative plant species seen at each stop.

At the end of the survey, look over the field and make an assessment of the level of damage to the meadow from the following (this is not an exhaustive list):

- Damage to soil and sward from machinery – severe rutting over more than 10% of the field area
- Damage from winter feeding sites that are still clearly seen once the hay meadow have been shut up
- Manure heaps
- Bales of hay that have been left in situ in the field from the previous year

Damaging activities that affect the integrity of the habitat relates to poor management which should be avoided. Severe damage where over 25% of the habitat is affected will void the total meadow score and result in an overall score of 0 and no payment will be made that year.

*Total score matrix*

| Score / Total points | 1<br>40 -79 points | 2<br>80-119 points | 3<br>120-159 points | 4<br>160-199 points | 5<br>200+ points |
|---|---|---|---|---|---|
| £/ha | 112 | 186 | 260 | 334 | 371 |

*Meadow survey sheet*

| **Date of survey:** | **Field Number** | | | | | | **Survey undertaken by:** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STOPS | Species Score | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total species score [1] |
| **Positive plant species (√ )** | | | | | | | | | | | | |
| Betony | 3 | | | | | | | | | | | |
| Lesser/greater birds foot trefoil | 3 | | | | | | | | | | | |
| Bugle | 3 | | | | | | | | | | | |
| Burnet saxifrage | 3 | | | | | | | | | | | |
| Common bistort | 3 | | | | | | | | | | | |
| Common black knapweed | 3 | | | | | | | | | | | |
| Cowslip | 3 | | | | | | | | | | | |
| Eyebrights | 2 | | | | | | | | | | | |
| Fairy flax | 3 | | | | | | | | | | | |
| Globe flower | 4 | | | | | | | | | | | |
| Greater burnet | 4 | | | | | | | | | | | |
| Harebell | 3 | | | | | | | | | | | |
| Hawkbits/cats ear | 2 | | | | | | | | | | | |
| Lady's mantle [2] | 4 | | | | | | | | | | | |
| Marsh marigold | 2 | | | | | | | | | | | |
| Meadowsweet | 2 | | | | | | | | | | | |
| Melancholy thistle | 4 | | | | | | | | | | | |
| Orchids | 4 | | | | | | | | | | | |
| Ox eye daisy | 3 | | | | | | | | | | | |
| Pignut | 2 | | | | | | | | | | | |
| Ragged robin | 3 | | | | | | | | | | | |
| Red clover | 2 | | | | | | | | | | | |
| Ribwort plantain | 2 | | | | | | | | | | | |
| Salad burnet | 3 | | | | | | | | | | | |
| Scabious [3] | 3 | | | | | | | | | | | |
| Sedges - short & tall | 2 | | | | | | | | | | | |
| Sneezewort | 3 | | | | | | | | | | | |
| Vetches | 2 | | | | | | | | | | | |
| Water avens | 3 | | | | | | | | | | | |
| Water mint | 3 | | | | | | | | | | | |
| Wood / Meadow cranesbill | 4 | | | | | | | | | | | |
| Yellow (hay) rattle | 2 | | | | | | | | | | | |
| Quaking grass | 4 | | | | | | | | | | | |
| Sweet vernal grass | 2 | | | | | | | | | | | |

1 Total species score - multiply species score by how many stops the species was seen

2 All species within the Lady's mantle family

3 All species within the Scabious family

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Negative plant species | | | | | | | | | | | | |
| Common dock | -2 | | | | | | | | | | | |
| Cow Parsley | -1 | | | | | | | | | | | |
| Creeping thistle | -2 | | | | | | | | | | | |
| Nettle | -2 | | | | | | | | | | | |
| Ragwort | -2 | | | | | | | | | | | |
| Rush | -1 | | | | | | | | | | | |
| Spear thistle | -2 | | | | | | | | | | | |
| **Meadow score** | | | | | | | | | | | | |
| 2. % cover of field area affected by damaging activities | | | | | | | | | | | | |
| 10 - 25% | -20 | | | | | | | | | | | |
| 5 - 10% | -10 | | | | | | | | | | | |
| under 5% | 0 | | | | | | | | | | | |
| **TOTAL MEADOW SCORE** | | | | | | | | | | | | |

Farmer observations:

Please add any comments regarding the management of the meadows, for example used for lambing, closed up period, hay time date, made into hay or haylage, weather conditions, rough estimate of bale numbers – up or down from previous years.

Management undertaken, for example drains maintained, rushes or weeds treated, fertiliser/muck applications, liming undertaken:

***Habitat for breeding waders score sheet***

| | |
|---|---|
| Survey undertaken by: | |
| Survey Date: | |
| Field number: | |

*Survey time:* May to early June, preferably an early morning visit in order to capture the range of breeding waders using the sites.

1. **Presence and diversity of birds:** a site visit in May could determine which species were present. A rudimentary count could be undertaken, but no need for a formal bird survey.

A good quality habitat should provide suitable breeding conditions for 2 or more species of breeding wader.

| Bird species | Present Y/N | Estimate of number of individual birds using field |
|---|---|---|
| lapwing | | |
| Curlew | | |
| Redshank | | |
| Snipe | | |

Walk around the field ensuring you are able to see all parts of it. Observe the amount of rush cover, tussocks and sward height. At the end of the walk, answer the following questions. Please circle the most appropriate answer.

**2. Vegetation height**

A varied sward height provides cover and nesting habitat for a range of waders and chicks with some preferring to nest in grass tussocks.
Short = below ankle height
Long = between ankle and knee height

| | |
|---|---|
| Mixed sward height where between 25 - 75% of the field is short and the rest varied, grass tussocks frequently seen | 10 |
| Over 75% long. Short swards confined to very small parts of fields (eg gateways, sup feed sites only) Tussocks indistinguishable from other tall vegetation | 5 |
| Over 75% short with little variation in height. Tussocks rare or absent | 5 |
| No difference in height – either all short, or all long with no variation | 1 |

### 3. Cover of rush

A scattered tussocky rush cover of between 10 and 30% across a field with a few denser stands in the wettest areas will cater for the broadest range of species.

| | |
|---|---|
| 10 – 30% cover, well scattered with local areas of dense rush | 10 |
| 30 - 50% rush cover, large areas of dense rush and tall vegetation | 5 |
| Over 50% rush cover | 1 |
| Less than 10% rush cover | 1 [4] |

### 4. Wet features

**4a – Extent of wet features across field**

| | |
|---|---|
| Field is damp across the majority of the area with a number of significantly wet areas – flushes, wet ditches, springs. | 10 |
| Damp areas are contained to approximately 10% of the field, eg springs, remainder of field is dry | 5 |
| Damp areas are rarely seen | 1 |

**4b – Quality of wet features**

| | |
|---|---|
| Wet features contain a mix of shallow pools and wet vegetation, gently sloping edges with less than 25% rush or tall vegetation | 10 |
| A number of wet features on the site but not meeting all criteria above | 5 |
| Steep sided, dense rush cover, inaccessible to birds | 1 |

### 5. Damaging operations

Severe damage where over 25% of the habitat is damaged will result in an overall score of 0 and no payment will be made that year. Less significant damage may also lead to no payment if scores from other categories are low. See general guidance for further information and below for examples. The list is not exhaustive.

1. Damage to soil and sward from machinery
2. Damage from winter feeding sites that are still clearly seen
3. Damage to soil and sward from poaching
4. Damage to sward from inappropriate herbicide use
5. Installation of new field drainage system

[4] If field is used by lapwing this score may be increased at the discretion of the adviser

| | |
|---|---|
| Damage more severe covering between 10 - 25% of field area | -20 |
| Limited areas covering 5 – 10% | -10 |
| Less than 5% | 0 |

| | |
|---|---|
| **TOTAL SCORE:** | |

**Total score matrix**

| Score/Total points | 1<br><9 points | 2<br>10-19 points | 3<br>20 – 29 points | 4<br>30 – 39 points | 5<br>40 points |
|---|---|---|---|---|---|
| £/ha | 35 | 69 | 104 | 139 | 174 |

Farmer observations:

Please add any comments regarding how the birds have faired with breeding, for example a description of the seasons weather conditions, nest numbers, predators observed, chicks seen etc

Management undertaken, for example rush cutting, weed control, creation of wet areas – how has this progressed:

# Appendix 3 – Farmer Payments

| | | Winter Bird Food | | | Pollen and Nectar | | |
|---|---|---|---|---|---|---|---|
| **Number** | **Location** | **Area (Ha)** | **Year 1** | **Year 2** | **Area (Ha)** | **Year 1** | **Year 2** |
| 1 | Dereham | 1.00 | 674 | 674 | 1.00 | 705 | 705 |
| 2 | Woodton | 2.21 | 1,490 | 1,861 | | | |
| 3 | Topcroft | 4.00 | 3,368 | 3,368 | | | |
| 4 | Hingham | 3.25 | 2,191 | 2,191 | 3.25 | 2,291 | 2,064 |
| 5 | Stonham | 1.03 | 867 | 867 | 1.27 | 895 | 895 |
| 6 | Eye | 2.00 | 1,684 | 1,684 | 2.00 | 1,410 | 1,410 |
| 7 | Roydon | 1.00 | 505 | 505 | 1.00 | 705 | 635 |
| 8 | Stowmarket | 1.10 | 556 | 741 | | | |
| 9 | Norwich | 1.25 | 1,053 | 1,053 | | | |
| 10 | Kenninghall | 1.50 | 1,263 | 1,263 | 1.50 | 1,058 | 1,058 |
| 11 | Attleborough | 1.00 | 842 | 842 | 1.00 | 635 | 564 |
| 12 | Harleston | 2.00 | 1,684 | 1,684 | 2.00 | 1,410 | 1,410 |
| 13 | Attleborough | 2.00 | 1,684 | 1,684 | 2.00 | 1,410 | 846 |
| 14 | Shropham | 1.00 | 842 | 758 | 1.00 | 705 | 423 |
| 15 | Stradbroke | 0.80 | 522 | 674 | 0.92 | 663 | 649 |
| | **TOTAL** | **25.14** | **£19,223** | **£19,848** | **16.94** | **£11,887** | **£10,658** |
| | **OVERALL TOTAL** | | | | | | **£61,646** |

| | | Hay Meadows | | | Breeding Wader Habitat | | |
|---|---|---|---|---|---|---|---|
| **Number** | **Location** | **Area (Ha)** | **Year 1** | **Year 2** | **Area (Ha)** | **Year 1** | **Year 2** |
| 1 | Leyburn | | | | 11.26 | 1,959 | 1,959 |
| 2 | West Witton | 2.66 | 298 | 495 | | | |
| 3 | Leyburn | 1.50 | 168 | 279 | | | |
| 4 | Hawes | 1.50 | 279 | 279 | 9.50 | 1,321 | 988 |
| 5 | Gayle | | | | 15.73 | 2,186 | n/a |
| 6 | West Scrafton | | | | 5.88 | 817 | 1,023 |
| 7 | West Scrafton | | | | 14.96 | 2,603 | 2,603 |
| 8 | Askrigg | | | | 9.55 | 659 | 1,327 |
| 9 | Leyburn | 1.00 | 260 | 260 | | | |
| 10 | West Witton | 2.20 | 504 | 504 | | | |
| 11 | Askrigg | 4.13 | 1,002 | 1308 | | | |
| 12 | Burtersett | 5.83 | 1,084 | 1295 | 7.18 | 998 | 998 |
| 13 | Askrigg | 5.43 | 909 | 1010 | 14.12 | 2,344 | 2,053 |
| 14 | Askrigg | 2.25 | 419 | 419 | 6.41 | 1,115 | 1,115 |
| 15 | Hardraw | 1.14 | 128 | 128 | 10.07 | 1,400 | 1,400 |
| 16 | Aysgarth | | | | 1.96 | did not claim | 135 |
| 17 | Hardraw | | | | 9.09 | 1,264 | 944 |
| 18 | Carperby | | | | 13.45 | 1,399 | 1,660 |
| 19 | Hawes | 7.89 | 1,467 | 1,467 | 24.09 | 3,961 | 3,961 |
| | **TOTAL** | **35.53** | **£6,518** | **£7,444** | **153.25** | **£22,026** | **£20,166** |
| | **OVERALL TOTAL** | | | | | | **£56,154** |

# Appendix 4 – Questionnaires

***RBAPS survey for stakeholders***

1. About you and your organisation or company

| | | |
|---|---|---|
| 1 | First Name: | |
| 2 | Last Name: | |
| 3 | E-mail: | |
| 4 | Organisation / Company name: | |

| **2. Your organisation / company** | | |
|---|---|---|
| 1 | NGO | |
| 2 | Government | |
| 3 | Independent consultancy | |
| 4 | Seed merchant | |
| 5 | Farmer | |
| 6 | Other (please specify): | |

| **3. Which previous agri-environment schemes have you been involved with or provided advice for?** | | |
|---|---|---|
| 1 | None / no previous involvement | |
| 2 | Environmental Stewardship (HLS and/or ELS) | |
| 3 | Environmentally Sensitive Area (ESA) | |
| 4 | Countryside Stewardship Scheme (CSS) - to 2005 | |
| 5 | Countryside Stewardship - from 2016 | |
| 6 | Other (please specify): | |

3. Your views on the Results Based Payments approach

| **4. How have you received information on the Results Based Payment Scheme (RBAPS) pilot and how useful was it? Please tick all that apply.** | | | | |
|---|---|---|---|---|
| | **Excellent** | **Good** | **Okay** | **Poor** |
| gov.uk | | | | |
| RBAPS project newsletter | | | | |
| RBAPs Manual | | | | |
| NE/YDNPA hosted event | | | | |
| Press article | | | | |
| Other (please specify below) | | | | |

| 5. If you have experience of other agri-environment schemes, what are your views on the prescriptive approach taken in those schemes (i.e. an agreement that lists the management activities which you must or must not do)? |
|---|
| |

| 6. What do you think are the main positive aspects or advantages of a Results Based Payment (RBAPS) approach? | |
|---|---|
| 1 | For farmers |
| 2 | For the environment |
| 3 | For you as an advice provider or supplier (if applicable) |

| 7. What do you think are the main disadvantages, risks or challenges of a RBAPS approach? | |
|---|---|
| 1 | For farmers |
| 2 | For the environment |
| 3 | For you as an advice provider or supplier (if applicable) |

| 8. What do you see as the main challenges to adopting this approach at the agreement level? | |
|---|---|
| 1 | For farmers |
| 2 | For the environment |
| 3 | For the scheme administrators |
| 4 | For you as an advice provider or supplier (if applicable) |

4. Your views on the design of the RBAPS pilot

| 9. Do you think other criteria to those listed in the Manual should be used to measure results in the field? If yes, please provide more detail on alternatives and why you think they should be used. | | | |
|---|---|---|---|
| | **Yes** | **No** | **Unable to comment** |
| Meadows | | | |
| Habitat for breeding waders | | | |
| Winter bird food | | | |
| Pollen & nectar mix | | | |

| 10. Do you feel the assessment methodology is the fairest way of assessing the habitats and if not have you suggestions of alternative methods? | | | |
|---|---|---|---|
| | **Yes** | **No** | **Unable to comment** |
| Meadows | | | |
| Habitat for breeding waders | | | |
| Winter bird food | | | |
| Pollen & nectar mix | | | |

| 11. There are 5 payment tiers in the pilot scheme. If there were more tiers the difference in payment rates between tiers would be smaller (and vice versa). Do you think the number of payment tiers should be | | |
|---|---|---|
| 1 | Greater (a change in score is more likely to result in a movement from one tier to the next but the change in payment will be smaller) | |
| 2 | Fewer (a change in score is less likely to result in a change from one tier to the next but if it does the change in payment is more significant ) | |
| 3 | The number in the pilot is about right | |

| 12. Compared with the fixed payment rates in existing agri-environment schemes do you think the variable, stepped payment rates in the RBAPS pilot provide farmers with more incentive to succeed, more risk, or both? | | |
|---|---|---|
| 1 | More incentive to succeed | |
| 2 | More risk | |
| 3 | Both | |

| 13. Do you think a zero payment is appropriate if none of the result measures are achieved? | | |
|---|---|---|
| 1 | Yes | |
| 2 | No | |

## 5. Training, guidance and support

| 14. How important do you feel training/guidance is to achieving the results? | Very important | Important | Neither important or not | Unimportant | Very unimportant | Unable to comment |
|---|---|---|---|---|---|---|
| Plant identification | | | | | | |
| Seed choice (arable) | | | | | | |
| Management techniques | | | | | | |
| Carrying out the results survey | | | | | | |
| Other (please specify in comments) | | | | | | |

| 15. What do you think is the best way of providing this training? (Rank 1=best) | |
|---|---|
| **Item** | **Total Score** |
| Group workshops | |
| 1:1 | |
| Manuals / written guidance | |
| Videos | |
| Online / apps | |
| Other (please specify in comments below) | |

***RBAPS Survey for grassland participants 2017***



Natural England (NE) and the Yorkshire Dales National Park Authority (YDNPA) would like to learn more about the land managers who are participating in the Results Based Payments pilot. In particular your motivations, how you feel about this approach as you start your agreement and what type of support you would find most helpful.

All responses are confidential and will be used by NE and the YDNPA project staff for the purposes of the pilot scheme only. Any use of the responses in reports will be anonymous.

| About you and your farm | | |
|---|---|---|
| Name, address, agreement ref | Pre populated | |
| Total farm size (Ha)<br>(please list separately any Common Land) | | |
| 2. Is your farm? | Owned %<br>Full Agricultural Tenancy %<br>Short-term rented (FBT or similar) % | |
| 3. What are your main farm enterprises?<br>Please record Ha or average numbers over a year against each category. | Please tick all that apply<br>☐Beef<br>☐ Sheep<br>☐ Dairy<br>☐ Other livestock<br>☐ Permanent grass<br>☐ Temporary grass<br>☐ Cereals<br>☐ Oilseeds<br>☐ Sugar beet/potatoes<br>☐ Other cropping<br>☐Other | Record Ha/number |
| 4. Are any of your farm enterprises registered organic?<br>If so which ones? | ☐ Yes ☐ No | |
| 5. How old are you? | ☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64<br>☐ 65-74 ☐ 75+ | |
| 6. Educational history: please tick any that apply? | ☐ Degree/MSc/PhD in agriculture or forestry<br>☐ Degree/MSc/PhD in other subject<br>☐ Other agricultural course (diploma or certificate)<br>☐ Non agricultural (diploma or certificate)<br>☐ A Levels<br>☐ GCSEs/O Levels<br>☐ Other (specify) | |

| | |
|---|---|
| 7. How would you describe your farm business's future? | ☐ Family farm, successor in place.<br>☐ Family farm, no successor in place<br>☐ Farm manager<br>☐ Other (please specify) |
| 8. Is farming your main business? | ☐ Yes ☐ No |
| 9. How long have you been farming? | ☐ New entrant (less than 1 year) ☐ 2-5 years<br>☐ 5-10 years ☐ 10-20 years ☐ More than 20 years |
| Experience of agri-environment schemes | |
| 10. Have you been in an agri-environment agreement before? (Tick all that apply) | ☐ No<br>☐ Environmental Stewardship (ES)<br>☐ Environmentally Sensitive Area (ESA)<br>☐ Countryside Stewardship Scheme (CSS) (to 2005)<br>☐ Countryside Stewardship (from 2016)<br>☐ Other (please name)<br>If no why not? |
| 11. If you've participated in an environmental scheme before, what are your views on the prescriptive approach taken in that scheme (i.e. an agreement that lists the management activities which you must or must not do) | |
| 12. Have you previously carried out any management action specifically for wildlife on the land in this pilot scheme, independent of or through an agri-environment scheme? | |
| 13. If Yes, please give us brief details of what you did. | |
| Your views on the Results Based Payments (Payment by Results) approach. | |
| 14. What were your main reasons for your initial interest and then application for this pilot scheme? | |
| 15. What do you think are the main benefits of a Results Based Payment (RBAPS) approach?<br>*(For you, for the environment, for the scheme administrators)* | |
| 16. What do you think are the main disadvantages/limitations/risks of a RBAPS approach?<br>*(For you, for the environment, for the scheme administrators)* | |
| 17. What do you see as the main challenges to adopting this approach at the agreement level?<br>*(For you, for the environment, for the scheme administrators)* | |
| Your views on the design of the pilot scheme | |
| 18. Do you think other criteria to those listed in the Manual should be used to measure results in the field? If yes, please provide more detail and why you think they should be used. | |
| 19. Do you feel the assessment methodology is the fairest way of assessing the habitats and if not have you suggestions of alternative methods? | |
| 20. Compared to equivalent options in mainstream agri-environment agreements, do you expect your level of payment for the same option in the pilot scheme to be:<br>*Higher/About the same/Lower/N/A – no previous agreement/similar options* | |
| 21. There are 5 payment tiers in the pilot scheme. If there were more tiers the difference in payment rates between tiers would be smaller (and vice versa). Do you think the number of payment tiers should be: | ☐ Greater (a change in score is more likely to result in a movement from one tier to the next but the change in payment will be smaller)<br>☐ Fewer (a change in score is less likely to result in a change from one tier to the next but if it does the change in payment is more significant)<br>☐ The number in the pilot is about right |
| 22. Do you think a zero payment is appropriate where none of the result measures are achieved?' | Yes/No |
| 23. Do you have any other comments on the design of this pilot scheme? | |

| Training, guidance and support | |
|---|---|
| 24. How important do you feel training/guidance is from NE/YDNPA to achieving the results you are aiming for? | ☐ Very important ☐ Important<br>☐ Neither important or not ☐ Unimportant<br>☐ Very unimportant |
| 25. What training and guidance, if any, do you want Natural England/YDNPA to provide? | ☐ Plant identification ☐ Management techniques<br>☐ Result assessments ☐ Other (please specify) |
| 26. What format would you find most useful? | ☐ 1:1 ☐ Group workshops ☐ Videos ☐ Online<br>☐ Manuals/written guidance ☐ Apps ☐ Other |
| 27. Would you like to be able to discuss/share ideas with other agreement holders in this pilot? | ☐ Yes<br>☐ No |
| 28. If yes how would you like this to be achieved? (tick top 2 preferences) | ☐ Open social media (e.g. Facebook, Twitter, WhatsApp)<br>☐ Closed social media (e.g. Private Facebook group)<br>☐ Electronic Newsletter/email<br>☐ Paper Newsletter<br>☐ Events/workshops<br>☐ Other |
| For grassland agreements: | |
| 1. How confident are you about deciding what management actions are required and when to maintain your habitats at their baseline score?<br>*Very confident/Quite confident/Not at all confident/N/A* | |
| 2. How confident are you about carrying out the self-assessment?<br>*Very confident/Quite confident/Not at all confident/N/A* | |
| 3. Will you be actively working towards improving your baseline score (to move up a payment step/steps)?<br>*Yes/No* | |
| 4. If yes, how confident are you about deciding what management actions are required when to increase your scores?<br>*Very confident/Quite confident/Not at all confident/N/A* | |
| 5. If yes: What will you be doing differently (including for the first time)? | |
| 6. How much improvement from your baseline score do you hope to achieve by the end of your 2 year agreement? | ☐ No change ☐ 1 payment step<br>☐ 2 payment steps ☐ 3 or more payment steps |
| 7. If the agreement was 5 years long instead of 2, how many payment steps would you hope you to have moved up by the end? | ☐ No change ☐ 1 payment step<br>☐ 2 payment steps ☐ 3 or more payment steps |
| Meadows only : | |
| 8. How many of the species on the indicator list can you identify already? | ☐ None ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ >21 |
| 9. Based on the number and variety of wildflowers in your RBAPS meadow, how do you think your meadow compares to a typical hay meadow in Wensleydale?<br>*Better/About the same/Not as good* | |
| Habitat for breeding wading birds only: | |
| 10. Based on the number of curlew/lapwing/redshank/snipe you see regularly using your RBAPS field for waders, how do you think your field(s) compare(s) to other allotments/intakes in Wensleydale?<br>*Better/About the same/Not as good* | |

***RBAPS Survey for arable participants 2017***



Natural England (NE) and the Yorkshire Dales National Park Authority (YDNPA) would like to learn more about the land managers who are participating in the Results Based Payments pilot. In particular your motivations, how you feel about this approach as you start your agreement and what type of support you would find most helpful.

All responses are confidential and will be used by NE and the YDNPA project staff for the purposes of the pilot scheme only. Any use of the responses in reports will be anonymous.

| About you and your farm | | |
|---|---|---|
| Name, address, agreement ref | Agreement ref: | |
| 1. Total farm size (Ha) | | |
| 2. Is your farm? | Owned %<br>Full Agricultural Tenancy %<br>Short-term rented (FBT or similar) % | |
| 3. What are your main farm enterprises?<br>Please record Ha or average numbers over a year against each category. | Please tick all that apply<br>☐Beef<br>☐ Sheep<br>☐ Dairy<br>☐ Other livestock<br>☐ Permanent grass<br>☐ Temporary grass<br>☐ Cereals<br>☐ Oilseeds<br>☐ Sugar beet/potatoes<br>☐ Other cropping<br>☐Other | Record Ha/number |
| 4. Are any of your farm enterprises registered organic?<br>If so which ones? | ☐ Yes ☐ No | |
| 5. How old are you? | ☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64<br>☐ 65-74 ☐ 75+ | |
| 6. Educational history: please tick any that apply? | ☐ Degree/MSc/PhD in agriculture or forestry<br>☐ Degree/MSc/PhD in other subject<br>☐ Other agricultural course (diploma or certificate)<br>☐ Non agricultural (diploma or certificate)<br>☐ A Levels<br>☐ GCSEs/O Levels<br>☐ Other (specify) | |

| | |
|---|---|
| 7. How would you describe your farm business's future? | ☐ Family farm, successor in place.<br>☐ Family farm, no successor in place<br>☐ Farm manager<br>☐ Other (please specify) |
| 8. Is farming your main business? | ☐ Yes ☐ No |
| 9. How long have you been farming? | ☐ New entrant (less than 1 year) ☐ 2-5 years<br>☐ 5-10 years ☐ 10-20 years ☐ More than 20 years |
| Experience of agri-environment schemes | |
| 10. Have you been in an agri-environment agreement before? (Tick all that apply) | ☐ No<br>☐ Environmental Stewardship (ES)<br>☐ Environmentally Sensitive Area (ESA)<br>☐ Countryside Stewardship Scheme (CSS) (to 2005)<br>☐ Countryside Stewardship (from 2016)<br>☐ Other (please name)<br>If no why not? |
| 11. If you've participated in an environmental scheme before, what are your views on the prescriptive approach taken in that scheme (i.e. an agreement that lists the management activities which you must or must not do) | |
| 12. Have you previously carried out any management action specifically for wildlife on the land in this pilot scheme, independent of or through an agri-environment scheme? *Yes/No* | |
| 13. If Yes, please give us brief details of what you did. | |
| Your views on the Results Based Payments (Payment by Results) approach. | |
| 14. What were your main reasons for your initial interest and then application for this pilot scheme? | |
| 15. What do you think are the main benefits of a Results Based Payment (RBAPS) approach? *(For you, for the environment, for the scheme administrators)* | |
| 16. What do you think are the main disadvantages/limitations/risks of a RBAPS approach? *(For you, for the environment, for the scheme administrators*) | |
| 17. What do you see as the main challenges to adopting this approach at the agreement level *(For you, for the environment, for the scheme administrators)* | |
| 18. Do you think changes in weather patterns are affecting your ability to establish and manage options in your existing agri-environment scheme? *Yes/No* | |
| 19. If 'Yes' to 18, in what way have you been affected by the weather? | |
| 20. Do you think the results based approach in this pilot would help overcome the problems you've experienced caused by changing weather patterns? Please provide a short explanation of your answer. | |
| Your views on the design of the pilot scheme | |
| 21. Do you think other criteria to those listed in the Manual should be used to measure results in the field? If yes, please provide more detail and why you think they should be used. | |
| 22. Do you feel the assessment methodology is the fairest way of assessing the habitats and if not have you suggestions of alternative methods? | |
| 23. Which of the winter bird food crops on the Plot Assessment Record Sheet can you identify already? (Please tick those you can identify) | ☐ Barley<br>☐ Buckwheat<br>☐ Dwarf sunflowers<br>☐ Fodder radish<br>☐ Gold of pleasure<br>☐ Linseed<br>☐ Mustard<br>☐ Oats |

| | |
|---|---|
| | ☐ Quinoa<br>☐ Red millet<br>☐ Spring oilseed rape<br>☐ Triticale<br>☐ Wheat<br>☐ White millet |
| 24. When you delivered Winter Bird Food plots in the past, how do you think your plots compared to plots on other farms in your area? *Better/About the same/Not as good/Don't know* | |
| 25. How much flexibility do you have in locating your Winter Bird Food plot? | ☐ None - there's only one location where it can go<br>☐ Some flexibility - I have a number of places to choose between<br>☐ Completely flexible - I can choose between the majority of my arable fields |
| 26. Which of the Pollen and Nectar species on the Plot Assessment Record Sheet can you identify already? (Please tick those you can identify) | ☐ Alsike clover<br>☐ Bird's-foot trefoil<br>☐ Black knapweed<br>☐ Black medick/yellow trefoil<br>☐ Common vetch<br>☐ Crimson clover<br>☐ Lucerne<br>☐ Musk mallow<br>☐ Oxeye daisy<br>☐ Red campion<br>☐ Red clover<br>☐ Sainfoin<br>☐ White clover<br>☐ Wild carrot<br>☐ Yarrow<br>☐ Other (please specify): |
| 27. When you delivered Pollen & Nectar plots in the past, how do you think your plots compared to other Pollen & Nectar plots on farms in your area? *Better/About the same/Not as good/Don't know* | |
| 28. How much flexibility do you have in locating your Pollen & Nectar plots? | ☐ None - there's only one location where it can go<br>☐ Some flexibility - I have a number of places to choose between<br>☐ Completely flexible - I can choose between the majority of my arable fields |
| 29. Compared to equivalent options in mainstream agri-environment agreements, do you expect your level of payment for the same option in the pilot scheme to be: *Higher/About the same/Lower* | |
| 30. There are 6 payment tiers in the pilot scheme for Winter Bird Food and 10 payment tiers for Pollen & Nectar mix. With more tiers the difference in payment rates between tiers is smaller (and vice versa). Do you think the number of payment tiers should be | ☐ Greater (a change in score is more likely to result in a movement from one tier to the next but the change in payment will be smaller)<br>☐ Fewer (a change in score is less likely to result in a change from one tier to the next but if it does the change in payment is more significant )<br>Other: |
| 31. Do you think a zero payment is appropriate where none of the result measures are achieved?' *Yes/No* | |
| 32. Do you have any other comments on the design of this pilot scheme? | |

| Training, guidance and support | |
|---|---|
| 33. How important do you feel training/guidance is from NE/YDNPA to achieving the results you are aiming for? *Very important/Important/Neither important or not/Unimportant/Very unimportant* | |
| 34. What training and guidance, if any, do you want Natural England/YDNPA to provide? | ☐ Plant identification ☐ Seed choice (arable)<br>☐ Management techniques ☐ Result assessments<br>☐ Other (please specify) |
| 35. What format would you find most useful? | ☐ 1:1 ☐ Videos ☐ Online ☐ Apps<br>☐ Other (please specify)<br>☐ Group workshops ☐ Manuals/written guidance |
| 36. Would you like to be able to discuss/share ideas with other agreement holders in this pilot? *Yes/No* | |
| 37. If yes how would you like this to be achieved? (tick top 2 preferences) | ☐ Open social media (e.g. Facebook, Twitter, WhatsApp)<br>☐ Closed social media (e.g. Private Facebook group)<br>☐ Electronic Newsletter/email<br>☐ Paper Newsletter<br>☐ Events/workshops<br>☐ Other |
| 38. How confident are you about deciding what management actions are required when to maintain your habitats at their baseline score? *Very confident/Quite confident/Not at all confident/N/A* | |
| 39. How confident are you about carrying out the self-assessment? *Very confident/Quite confident/Not at all confident/N/A* | |
| 40. Will you be managing your pilot plots differently to the equivalent plots in your existing CS/ES scheme? *Yes/No* | |
| 41. Will you be managing your pilot plots differently to the equivalent habitats in your existing ES/CS scheme? *Yes/No - If no, why?* | |
| 42. If Yes, please give details of what you will do that's different and why | |
| 43. Have you any other feedback or comments on your experience to date in the RBAPS pilot scheme? | |

***RBAPS Survey for grassland participants 2018***



Natural England (NE) and Yorkshire Dales National Park Authority (YDNPA) would like to learn more about you, the farmers who are participating in the results-based payments pilot. In particular how you feel about this approach given your involvement to date.

All responses are confidential and will be used by NE and the YDNPA project staff for the purposes of the pilot scheme and future environmental land management schemes. (Natural England's privacy notice.)

Your views provide invaluable information on the practicalities of this approach and its feasibility for future schemes. Any use of the responses in reports will be anonymous. The results will form part of the end of project report produced for the EU.

The survey should take approximately 30 minutes to complete.

If you have any questions about this survey please contact Annabelle LePage on telephone 07990 550838 or email Annabelle.LePage@naturalengland.org.uk.

| **About you and your farm** | |
|---|---|
| Your name: | |
| **Your views on the results-based payments (Payment by Results) approach** | |
| Q1. What do you think are the main benefits of a results-based payment approach? *For you/For the environment/For the scheme administrators* | |
| Q2. What do you think are the main disadvantages / limitations / risks of a results-based payment approach? *For you/For the environment/For the scheme administrators* | |
| Q3. Are there other habitats or features on your farm you feel would be suitable for a results-based payment approach? | |
| Q4. If you were to add more land into your results-based payment agreement, who would be most likely to do the self-assessment? | ☐ I or a family member would continue to do it<br>☐ I would pay someone to do it<br>☐ Other (please specify) |
| Q5. Do you think variability in the weather is affecting your ability to establish and manage options in your existing agri-environment scheme (i.e. Environmental Stewardship or Countryside Stewardship)? *Yes/No/N/A* | |
| Q6. In what way have you been affected by the weather? | |
| Q7. Do you think the results-based approach in this pilot will help overcome the problems you've experienced? *Yes/No – Please explain your answer* | |
| Q8. Do you think it's appropriate to get no payment if you do not achieve a minimum level of results? *Yes/No* | |
| Q9. Could you say why you answered no? | |
| Q10. If the payment level identified by the expert assessor (YDNP) is different to your own assessment, how do you think this should be resolved? (Use any real-life examples where you are happy to.) | |
| Q11. Do you believe the scheme administrators deal with external risks (such as unexpected adverse weather conditions) in a fair and proportionate manner? *Yes/No – if no how could this be improved?* | |

| **Training and support** | |
|---|---|
| Q1. Training and guidance have been made available in different formats. Please rank in order of preference how useful the different formats have been, where 1=most useful. | ☐ Management techniques meeting at Wensleydale Pantry and Thornton Rust<br>☐ The farm walks covering results assessments and plant ID<br>☐ 'Top-up' training during adviser visits<br>☐ Manual<br>☐ Written guidance<br>☐ Picture-based guidance<br>☐ Other (please specify) |
| Q2. Has the training provided during your involvement in the project been adequate (both quality and quantity)? *Yes/No – give feedback* | |
| Q3. Ongoing support and advice has been made available in different formats. Please rank how useful you found the different types of training / support you received, where 1 = most useful. | ☐ One to one discussions with advisers/phone support from your adviser<br>☐ The end of year group meeting at Wensleydale Pantry<br>☐ Manual<br>☐ Written guidance provided by the pilot<br>☐ Picture-based guidance provided by the pilot<br>☐ Videos (from sources other than the pilot)<br>☐ Apps (from sources other than the pilot<br>☐ Another organisation's online content (please specify)<br>☐ Other (please specify) |
| Q4. How important do you believe on-going support and advice is to the success of your results-based agreement? *Very important/Quite important/Neither important or unimportant/unimportant – give feedback* | |
| Q5. Have you obtained advice or support or shared your learning / experience with any of the other participant farmers on the way to improve results'? *Yes/No* | |
| Q6. Please give more details about the advice / support / shared learning you've had with other participant farmers on the way to improve results. | |
| Q7. Did you get advice from non-scheme sources on how to manage the land in the scheme? *Yes – it was free/Yes – I had to pay for it/No* | |
| Q8. If your results-based payment agreement continued, who would you prefer to go to for on-going support and training? 1= top preference. | ☐ National delivery organisation (for example, Natural England)<br>☐ National charity (specify in box below)<br>☐ Local delivery organisation (for example, Yorkshire Dales National Park Authority)<br>☐ Independent farm wildlife advisers<br>☐ Farmer based organisation (for example, a support group derived from the pilot scheme)<br>☐ Online forum<br>☐ Other (please specify) |
| Q9. If on-going training and support / advice for results-based payment was not provided for free by Natural England, would you be prepared to pay? *Yes/No/Not sure* | |
| **Your views on the design of the pilot scheme** | |
| Q1. After 2 years of experience, do you think the assessment criteria or methodology should be changed? You only need to comment on those relevant to the option you are involved with. *Yes/No/N/A – if yes, please suggest changes or additions* | |
| Q2. How confident are you about deciding what management actions are required and how to maintain your habitats at their baseline score? *Very confident/Quite confident/Not at all confident/N/A* | |

| | |
|---|---|
| Q3. How confident are you about carrying out the self-assessment? *Very confident/Quite confident/Not at all confident/N/A* | |
| Q4. Have you been actively working towards improving your score (to move up a payment step/steps)? *Yes/No – if no why* | |
| Q5. How confident are you about deciding what management actions are required to increase your scores? *Very confident/Quite confident/Not at all confident/N/A* | |
| Q6. What are the main motivating factors for you to do this work? Please number your response in order of preference, with 1 being your top preference: *Passion for improving the environment/Pride/Increasing payment/Adviser recommendation/I wanted to experiment/Other* | |
| Q7. How do you feel about the amount of environmental change you've achieved over the 2 years? *Greater change than I expected/No change – what I expected/ Less change than I expected/ Other* | |
| Q8. Has the speed of environmental change in your agreement: *Put you off the approach/Made you more determined/Surprised you/Other* | |
| Q9. Select the words which best describe how you feel about the amount of change you've achieved during your 2 year agreement. (Tick all that apply): *Pleased/Ambivalent/Surprised/Disappointed/Proud/As expected/Other* | |
| Q10. Meadows option only How many of the species on the indicator list can you now confidently identify? *None/1-5/6-10/11-15/16-20/>21* | |
| Q11. There are 5 payment tiers in the pilot scheme. If there were more tiers the difference in payment rates between tiers would be smaller (and vice versa). Do you think the number of payment tiers should be: | ☐ Greater (a change in score is more likely to result in a movement from one tier to the next but the change in payment will be smaller)<br>☐ Fewer (a change in score is less likely to result in a change from one tier to the next but if it does the change in payment is more significant)<br>☐ The number in the pilot is about right<br>Other (please specify) |
| Q12. Do you think the payment rate you received in 2017 was about right? Consider the time inputs and costs incurred for managing the land, carrying out surveys and training etc. *Generous/Appropriate/No enough/N/A* | |
| **Your experience of the pilot scheme** | |
| Q1. How do you feel about what you have achieved through the scheme? | |
| Q2. What do you think is the most important thing you will take away from this experience? | |
| Q3. Have you been motivated to do anything differently on the rest of your farm as a result of being engaged in this pilot scheme? | |
| Do you have any other comments, questions or concerns about this pilot scheme? | |

***RBAPS Survey for arable participants 2018***



Natural England (NE) would like to learn more about you, the farmers who are participating in the Results Based Payments pilot. In particular how you feel about this approach given your involvement to date.

All responses are confidential and will be used by NE project staff for the purposes of the pilot scheme and future Environmental Land Management schemes. (Natural England's privacy notice.)

Your views provide invaluable information on the practicalities of this approach and its feasibility for future schemes. Any use of the responses in reports will be anonymous. The results will form part of the end of project report produced for the EU.

The survey should take approximately 30 minutes to complete.

If you have any questions about this survey please contact Vicky Robinson on telephone 07881 846611 or email vicky.robinson@naturalengland.org.uk.

| **About you and your farm** | |
|---|---|
| Your name: | |
| **Your views on the results-based payments (Payment by Results) approach** | |
| Q1. What do you think are the main benefits of a results-based payment approach? *For you/For the environment/For the scheme administrators* | |
| Q2. What do you think are the main disadvantages / limitations / risks of a results-based payment approach? *For you/For the environment/For the scheme administrators* | |
| Q3. Are there additional habitats or features on your farm you feel would be suitable for a results-based payment approach? | |
| Q4. If you were to add more land into your results-based payment agreement, who would be most likely to do the self-assessment? | ☐ I or a family member would continue to do it<br>☐ I would pay someone to do it<br>☐ Other (please specify) |
| Q5. Do you think variability in the weather is affecting your ability to establish and manage options in your existing agri-environment scheme (i.e. Environmental Stewardship or Countryside Stewardship)? *Yes/No* | |
| Q6. In what way have you been affected by the weather? | |
| Q7. Do you think the results-based approach (this pilot) will help overcome the problems you've experienced? *Yes/No* | |
| Q8. Do you think it's appropriate to get no payment if you do not achieve a minimum level of results? *Yes/No* | |
| Q9. If the payment level identified by the expert assessor (NE) is different to your own assessment, how do you think this should be resolved? (Use any real-life examples where you are happy to). | |
| Q10. The dry weather this year created challenges with regards to establishing your winter bird food plots. What are your views on how payments could be calculated in years when severe weather has the potential to impact results? | ☐ Pay based on an averages informed by previous years performances<br>☐ Pay on results achieved<br>☐ Pay the same as ES or CS winter bird food option<br>☐ Pay a base rate covering income foregone and cost of operations |

| | |
|---|---|
| | ☐ Pay 50% of the top payment rate |
| Q11. Do you believe that the scheme administrators deal with external risks (such as unexpected adverse weather conditions) in a fair and proportionate manner? *Yes/No – if no how could it be improved* | |
| **Training and support** | |
| Q1. Training and guidance have been made available in different formats. Please rank how useful the different formats have been, where 1=most useful: | ☐ Management techniques meeting at Shotford<br>☐ The farm walks covering results assessments and plant ID<br>☐ 'Top-up' training during adviser visits<br>☐ Manual<br>☐ Written guidance<br>☐ Picture-based guidance<br>☐ Other (please specify) |
| Q2. Has the training provided during your involvement in the project been adequate (both quality and quantity)? *Yes/No* | |
| Q3. Ongoing support and advice has been made available in different formats. Please rank how useful you found the different types of training / support you received, where 1 = most useful. | ☐ One to one discussions with advisers<br>☐ Phone support from your adviser<br>☐ The end of year group meeting at Old Buckenham<br>☐ Manual<br>☐ Written guidance provided by the pilot<br>☐ Picture-based guidance provided by the pilot<br>☐ Videos (from sources other than the pilot)<br>☐ Apps (from sources other than the pilot)<br>☐ Another organisation's online content (please specify)<br>☐ Other (please specify) |
| Q4. How important do you believe on-going support and advice is to the success of your results-based agreement? *Very important/Important/Neither important or unimportant/Unimportant* | |
| Q5. Have you obtained advice or support or shared your learning / experience with any of the other participant farmers on the way to improve results'? *Yes/No* | |
| Q6. Please give more details about the advice / support / shared learning you've had with other participant farmers on the way to improve results. | |
| Q7. Did you get advice from non-scheme sources on how to manage the land in the scheme? *Yes – it was free/Yes- I had to pay for it/No. If yes, who gave the advice?* | |
| Q8. If your results-based payment agreement continued, who would you prefer to go to for on-going support and training? 1= top preference. | ☐ National delivery organisation (for example, Natural England)<br>☐ National charity (specify in box below)<br>☐ Local delivery organisation (for example, Yorkshire Dales National Park Authority)<br>☐ Independent farm wildlife advisers<br>☐ Farmer based organisation (for example, a support group derived from the pilot scheme)<br>☐ Online forum<br>☐ Other (please specify) |
| Q9. If on-going training and support / advice for results-based payment was not provided for free by Natural England, would you be prepared to pay? *Yes/No/Not sure* | |
| **Your views on the design of the pilot scheme** | |
| Q1. After 2 years of experience, do you think the assessment criteria or methodology should be changed? You only need to comment on those relevant to the pilot you are involved with. *Yes/No/N/A. If yes, suggest changes* | |
| Q2. How confident are you about carrying out the self-assessment? *Very confident/Quite confident/Not at all confident/N/A* | |

| | |
|---|---|
| Q3. Which of the winter bird food crops on the plot assessment record sheet can you identify? (Please tick all that apply) | ☐ Barley<br>☐ Buckwheat<br>☐ Dwarf sunflowers<br>☐ Fodder radish<br>☐ Gold of pleasure<br>☐ Linseed<br>☐ Mustard<br>☐ Oats<br>☐ Quinoa<br>☐ Red millet<br>☐ Spring oilseed rape<br>☐ Triticale<br>☐ Wheat<br>☐ White millet |
| Q4. How do you think your winter bird food plot compared to others on your farm / in the area? *Better/About the same/Not as good/Don't know* | |
| Q5. If you moved your winter bird food plot this year, please explain why. | |
| Q6. Which of the pollen and nectar crops on the plot assessment record sheet can you identify? (Please tick all that apply) | ☐ Alsike clover<br>☐ Bird's-foot trefoil<br>☐ Black knapweed<br>☐ Black medick/yellow trefoil<br>☐ Common vetch<br>☐ Crimson clover<br>☐ Lucerne<br>☐ Musk mallow<br>☐ Oxeye daisy<br>☐ Red campion<br>☐ Red clover<br>☐ Sainfoin<br>☐ White clover<br>☐ Wild carrot<br>☐ Yarrow<br>☐ Other (please specify): |
| Q7. How do you think your pollen and nectar plot compared to others on your farm / in the area? *Better/About the same/Not as good/Don't know* | |
| Q8. Compared to equivalent options in mainstream agri-environment agreements (Environmental Stewardship and Countryside Stewardship), do you expect your level of payment for the same option in the pilot scheme to be: *Higher/About the same/Lower* | |
| Q9. There are 6 payment tiers in the pilot scheme for winter bird food and 10 payment tiers for pollen and nectar mix. With more tiers the difference in payment rates between tiers is smaller (and vice versa). Do you think the number of payment tiers should be: | ☐ Greater (a change in score is more likely to result in a movement from one tier to the next but the change in payment will be smaller)<br>☐ Fewer (a change in score is less likely to result in a change from one tier to the next but if it does the change in payment is more significant)<br>☐ The number in the pilot is about right<br>Other (please specify) |
| Q10. Do you think the payment rate you received in 2017 was about right? Consider the time inputs and costs incurred for managing the land, carrying out surveys and training etc: *Generous/Appropriate/Not enough/N/A* | |
| Q11. Have you managed your pilot plots differently to the equivalent plots in your existing Countryside Stewardship / Environmental Stewardship scheme? *Yes/no* | |
| Q12. Please give details of what you will do that is different, and why: | |

| |
|---|
| Q13. Do you have any other suggestions about how the scheme could be improved? |
| **Your experience of the pilot scheme** |
| Q1. How do you feel about what you have created through the scheme? |
| Q2. What do you think is the most important thing you will take away from this experience? |
| Q3. Have you been motivated to do anything differently on the rest of your farm as a result of being engaged in this pilot scheme? |
| Do you have any other comments, questions or concerns about this pilot scheme? |

# Appendix 5 – Communications

This appendix contains a summary of key features and presentations provided by the RBAPS project members to publicise the project and disseminate results, plus various articles published in local and national media by 3rd party organisations.

**Project website**

https://www.gov.uk/government/publications/results-based-agri-environment-payment-scheme-rbaps-pilot-study-in-england

**Newsletters** (published on the RBAPS project website)

Newsletter 1: Spring 2017

Newsletter 2: Summer 2017

Newsletter 3: Spring 2018

**Agri-environment Stakeholder Group:**

This national group, chaired by Natural England, was used to engage and keep stakeholders informed about progress of the project. Membership as follows:

National Farmers Union, Central Association of Agricultural Valuers, Country Land and Business Association, Royal Society for the Protection of Birds, Wildlife Trusts, National Trust, Game and Wildlife Conservation Trust, Moorland Association, Institute of Agricultural Secretaries and Administrators, Rivers Trust, Woodland Trust, Linking Environment And Farming, H&H Land and Property Group, Agricultural Development and Advisory Service, Tennant Farmers Association, Council for Protection of Rural England, Foundation for Common Land, Yorkshire Dales, Buglife, Gloucester County Council, Historic England, Countryside & Community Research Institute, Association of Local Government Archaeological Officers, National Parks Association, Organic Research Council.

**Dissemination Conferences**

Conferences to disseminate the findings from the project were held in late November/early December 2018. Further details can be found here:

http://publications.naturalengland.org.uk/publication/6186745217679360

**Presentations Given to the Following Organisations (in no particular order)**

EU Member States, RBAPs Ireland conference, Defra, Natural England, Yorkshire Dales National Park Authority, National Farmers Union, Countryside Land and Business Association, Farming and Wildlife Advisory Group, Game and Wildlife Conservation Trust, Royal Society for the Protection of Birds, Natural England's Scientific Advisory Committee, Centre of Ecology and Hydrology, Floodplain Meadows Grassland Conference, Forest of Bowland Area of Outstanding Natural Beauty – meadow group, Northern Upland Chain Local Nature Partnership board, Northern Hill Farmer Forum, Dartmoor Higher Nature Value Farming Link project, Border Uplands Demonstrator steering group, North York Moors PLUG, RBAPS conference in Wales – European Forum Nature Conservation Pastoralism, Policy Development Forum, YDNPA Farming and Land management Forum, Lake

District National Park Partnership board, Myerscough College, Peak District National Park Land managers group, Cumbria commoners association and several farmer group meetings in the Lake District, English National Parks Agri-environment and Rural Development Group, Campaign for National Parks, Cumbria Wildlife Trust, Farming and Wildlife Partnership

**Press Releases**

| | | |
|---|---|---|
| *Wensleydale farmers pioneer new "agri-environment" payment scheme* | 6/3/2017 | https://www.yorkshiredales.org.uk/living-and-working/other-services/press-office/news/recent/wensleydale-farmers-pioneer-new-agri-environment-payment-scheme |
| *Minister visits Yorkshire Dales to see pilot farm payment scheme* | 20/3/2017 | https://www.yorkshiredales.org.uk/living-and-working/other-services/press-office/news/recent/minister-visits-yorkshire-dales-to-see-pilot-farm-payment-scheme |
| *'Payment by results' farm pilots a 'success'* | 30/11/2018 | https://www.yorkshiredales.org.uk/living-and-working/other-services/press-office/news/recent/payment-by-results-farm-pilots-a-success |

**Press Articles [not exhaustive]**

| | | |
|---|---|---|
| *Payment by results: Piloting a revolution in agri-environment schemes* | | https://www.cla.org.uk/advice/payment-results-piloting-revolution-agri-environment-schemes# |
| *Wensleydale to Pioneer New "Agri-environment" Payment Scheme* | 6/03/2017 | http://www.stackyard.com/news/2017/03/environment/02_ydnp_wensleydale.html |
| *Farmers are given free rein to preserve land under new scheme* | 7/03/2017 | https://www.yorkshirepost.co.uk/news/environment/farmers-are-given-free-reign-to-preserve-land-under-new-scheme-1-8426347 |
| *Dales farmers pilot new habitat scheme* | 7/03/2017 | https://www.thenorthernecho.co.uk/news/15139356.dales-farmers-pilot-new-habitat-scheme/ |
| *Wensleydale farmers champion new 'agri-environment' payment scheme* | 8/03/2017 | https://www.fginsight.com/news/wensleydale-farmers-champion-new-agri-environment-payment-scheme-19335 |
| *Pilot agri-environment scheme could mean less red tape* | 17/03/2017 | https://www.fwi.co.uk/news/pilot-agri-environment-scheme-could-mean-less-red-tape |
| *Farming minister visits Coverdale farms to see new agri-environment scheme in action* | 20/03/2017 | http://www.richmondshiretoday.co.uk/farming-minister-visits-coverdale-farms-see-new-agri-environment-scheme-action/ |
| *'Payment by results' nature farming scheme gets £540,000 Government boost* | 2/08/2018 | https://www.itv.com/news/2018-08-02/payment-by-results-nature-farming-scheme-gets-540-000-government-boost/ |
| *Payment by Results trial extended* | 2/08/2018 | https://www.nfuonline.com/cross-sector/environment/agri-environment-schemes/agri-environment-news/payment-by-results-trial-extended/ |
| *Farmers trusted to do what's best: Our letter published in the Farmers Guardian* | 3/08/2018 | https://www.gwct.org.uk/blogs/news/2018/august/farmers-trusted-to-do-whats-best-our-letter-published-in-the-farmers-guardian |
| *Scope for 'payments by results' approach* | 4/12/2018 | https://www.fginsight.com/news/news/scope-for-payments-by-results-approach-75675 |
| *"Amazing" results from Wensleydale payments by results farm scheme* | 4/12/2018 | http://www.richmondshiretoday.co.uk/amazing-results-wensleydale-payments-results-farm-scheme/ |

| | | |
|---|---|---|
| *Putting Farmers in Control Can Enhance the Environment* | 5/12/2018 | http://www.stackyard.com/news/2018/12/environment/02_ydnpa_environment.html |
| *Could East Anglia's farmers achieve more for wildlife if they were only paid by results?* | 7/12/2018 | https://www.edp24.co.uk/business/farming/payment-by-results-arable-farming-pilot-scheme-east-anglia-1-5810505 |
| *Payment by results: a blueprint for farm support post Brexit* | 14/12/2018 | https://www.fwi.co.uk/business/payments-schemes/payment-by-results-a-blueprint-for-farm-support-post-brexit |
| *Results Based Agri-environment Payment Scheme (RBAPS)* | 20/12/2018 | https://www.frontierag.co.uk/blog/results-based-agri-environment-payment-scheme-rbaps |

# Appendix 6 – Delivery and cost calculations

The general process for deriving the unadjusted per-unit costs of mainstream delivery is as follows:

- Information on[9]: the number of applications and managing existing agreements in a year; the standard time spent (hours) on processing applications and existing agreements in a year; how time per application/existing agreement is allocated to different (pay) grades (team leader, lead adviser, adviser, support adviser); the average cost per FTE for the different pay grades is available.
- The total time spent on processing applications and managing existing agreements is derived by multiplying the number of applications/existing agreements by the standard time per application.
- The total time is converted to FTEs by dividing total time by the standard number of hours in a working day and the standard number of working days in year. This gives total FTEs spent on processing applications and existing agreements.
- FTEs are allocated to different pay grades to provide total FTEs spent by a pay grade on processing applications and managing existing agreements.
- FTEs per grade are multiplied by average cost per FTE and grade. This gives total costs per grade for processing applications and managing existing agreements.
- The total costs per grade are summed over all grades to get total costs for processing applications and managing existing agreements.
- Total costs for processing applications and managing existing agreements are derived by respectively the number of applications and existing agreements to get per-unit costs.

***Adjustments***

It was necessary to adjust the RBAPS data. This is because RBAPS is a pilot, whereas Environmental Stewardship is an established scheme which has been in operation from 2005 to 2014.[10] Without adjustment, it is impossible to say whether cost differences are due to differences between the two schemes (results-based approach vs management-based approach) or due to the fact that RBAPS is a pilot, whereas HLS is an established scheme. Steps a – f below explain the adjustment process.

*Grade allocation*

RBAPS is a pilot and as such was administered and delivered mainly by those who developed the pilot. If RBAPS was a national scheme, some tasks would be done by people at different (pay) grades. To correct for this, we assume the same proportion of time spent on processing applications and managing existing agreements between staff grades as under HLS. The table below provides further details.

| | **TST % of Total Time per agreement** | **LMT % of Total Time per agreement** |
|---|---|---|
| **Team Leader** | 2.50 | 7.18 |
| **Lead Adviser** | 8.00 | 64.57 |
| **Adviser** | 20.00 | 28.25 |
| **Support Adviser** | 69.50 | 0.00 |
| *Total* | *100.00* | *100.00* |

[9] For Environmental Stewardship, the number of applications and existing agreements as well as the standard time spent per application/existing agreement is for the year 2013/14. For RBAPS, this data is for the year 2017/18. The cost figures per FTE for both schemes are for the year 2018/19. IT system costs are excluded.

[10] Environmental Stewardship is now closed and new applications are no longer accepted, however, large number of Environmental Stewardship agreements are still in operation.

Table 34 Allocation of total time to grades (%) for Environmental Stewardship.

After this adjustment, RBAPS costs per application and existing agreement are as follows.

| | **Per Application (£)** | **Managing existing agreement (per year)(£)** |
|---|---|---|
| **TST** | 143.37 | 153.94 |
| **LMT** | 230.75 | 582.01 |
| ***Total*** | *374.11* | *735.95* |

Table 35 Per-unit costs after Step a.

*Specialist support*

Under HLS, the Land Management Team (LMT) received specialist support when processing applications. This equated to 15 FTEs for 2284 applications, or 0.0066 of an FTE per application. This is currently not the case in the RBAPS pilot but would be if RBAPS was a national scheme. To correct for this, we assume the same amount of specialist support per application as under ES. After this adjustment, costs per RBAPS application and existing agreement are as follows.

| | **Per Application (£)** | **Managing existing agreement (per year)(£)** |
|---|---|---|
| **TST** | 143.37 | 153.94 |
| **LMT** | 463.99 | 582.01 |
| ***Total*** | *607.35* | *735.95* |

Table 36 Per-unit costs after Step b.

*Efficiency gains*

The HLS data is from 2013/14, at this time the scheme had been in operation for several years and benefited from efficiency gains (time spent per application and existing agreement fell between 2007/08 and 2013/14). The RBAPS per-unit costs, have been adjusted accordingly assuming the same evolution of time spent per application and existing agreement as for HLS. Tables 2 – 5 below provide information on the evolution of hours spent on processing ELS/HLS applications and managing ELS/HLS agreements from 2007/8 to 2013/14.

| 2007/8 to 2013/14. | **Resource Per Application (%) compared to baseline** | **Resource for Managing existing agreement (per year)(%) compared to baseline** |
|---|---|---|
| **TST** | 29 | 42 |
| **LMT** | 103 | 83 |
| ***Total*** | *82* | *54* |

After this adjustment, costs per RBAPS application and existing agreement are as follows.

| | **Per Application (£)** | **Managing existing agreement (per year)(£)** |
|---|---|---|
| **TST** | 41.32 | 52.96 |
| **LMT** | 513.70 | 488.14 |
| ***Total*** | *555.02* | *541.10* |

Table 37 Per-unit costs after Step c.

*Tasks*

There are several tasks that were not completed in the RBAPS pilot but would be required if it was a national scheme. This is corrected as follows:

- *Identification of relevant tasks:* The information provided in the workflow model[11] is used to identify the individual tasks that are involved in processing HLS applications and managing HLS agreements. For each of these tasks are assessed to check whether this task was done in the RBAPS pilot and, if not, whether it would be done if RBAPS was a national scheme.[12]
- *Correction of relevant tasks:* The time spent on a additional tasks is identified from the workflow model.[13] It is assumed that the same amount of time would be spent on this task if it was done under RBAPS.

After this adjustment, costs per application and existing agreement are as follows.

| | **Per Application (£)** | **Managing existing agreement (per year)(£)** |
|---|---|---|
| **TST** | 196.41 | 253.91 |
| **LMT** | 1336.02 | 626.42 |
| ***Total*** | *1532.43* | *880.33* |

Table 38 Per-unit costs after Step d.

*Higher complexity of Environmental Stewardship*

HLS agreements cover on average 16.49 management options and 199.93ha. This is compared to 1.7 options and 2.8ha per RBAPS agreement. As a result, the time recorded for the RBAPS pilot may not be representative for some tasks as more (or different) options and a larger area are covered in mainstream agreements. We correct for this as follows:

- *Identification of relevant tasks*: For each task recorded for the RBAPS pilot an assessment of whether it would be affected in a larger more complex agreement was made. Meaning, whether hours spent on this task per application/agreement would be significantly higher if more options and/or a larger area of land was covered by an RBAPS agreement.
- *Correction of relevant tasks*: For the tasks identified above it is assumed that the time recorded in the pilot is not representative and the equivalent HLS figure is used instead.

After this adjustment, costs per application and existing agreement are as follows.

| | **Per Application (£)** | **Managing existing agreement (per year)(£)** |
|---|---|---|
| **TST** | 196.41 | 253.91 |
| **LMT** | 1428.88 | 664.93 |
| ***Total*** | *1625.29* | *918.83* |

[11] The Heedra Mouchel workflow model breaks down total time spent on processing HLS applications and managing existing HLS agreements into their individual tasks. This is done separately for TST and LMT.

[12] We are not aware of any tasks that were neither done in the RBAPS pilot nor for HLS agreements and applications but would be relevant for a national RBAPS scheme.

[13] The Heedra Mouchel workflow model is for the year 2008/9. To calculate the time spent on individual tasks in 2013/14 we use the 2008/9 data to calculate, for each task, the share of the total time that is spent on a task in 2008/9. We then multiply the total time recorded in 2013/14 by these shares to get the time spent on individual tasks in 2013/14. This relies on the assumption that the share that is spent on a task has not changed significantly between 2008/9 and 2013/14.

Table 39 Per-unit costs after Step e.

*Cost smoothing*

Certain tasks only occur at the beginning of an agreement (e.g., within the first year). In the HLS data, hours spent per existing agreement reflect this (x% of agreements are in their first year, y% of agreements are in their second year ...). In the RBAPS pilot, however, all agreements are new agreements. This inflates the costs. To correct for this, it is assumed that these 'one-time costs' are relevant for only 15% of existing agreements (this corresponds to the percentage of new HLS agreements in 2013/14).

After this adjustment, costs per application and existing agreement are as follows.

| | **Per Application (£)** | **Managing existing agreement (per year)(£)** |
|---|---|---|
| **TST** | 196.41 | 253.91 |
| **LMT** | 1428.88 | 266.88 |
| ***Total*** | *1625.29* | *520.79* |

Table 40 Per-unit costs after step f.

*Detailed breakdown of tasks*

The following tables break down 'Processing applications' and 'Managing existing agreements' in their individual tasks. This information comes from the Heedra Mouchel Workflow model. For each task the table identifies

- The standard time spent on the task under HLS. To identify this time we proceed as follows. The Heedra Mouchel workflow model is for the year 2008/9. To calculate the time spent on individual tasks in 2013/14 we use the 2008/9 data to calculate, for each task, the share of the total time that is spent on a task in 2008/9. We then multiply the total time recorded in 2013/14 by these shares to get the time spent on individual tasks in 2013/14. This relies on the assumption that the share that is spent on a task has not changed significantly between 2008/9 and 2013/14.
- The standard time spent on the task under RBAPS, separately for arable and grassland. This data was recorded for the pilots. The data in the table is before any adjustments were made.
- For the RBAPS data, whether and how time spent on a task was adjusted: d ('tasks'), e ('higher complexity of ES'), f ('cost smoothing'). Adjustments a, b and c are done for all tasks and are thus not identified in the table. Where a task is not relevant for the RBAPS pilot this is indicated by n/a.

*Processing applications*

| Tasks identified in the Heedra Mouchel workflow model | | Standard time HLS | Standard time RBAPS (arable) | Standard time RBAPS (grassland) |
|---|---|---|---|---|
| Pre-application | Pre-application enquiry CSU | 0.87 | 6.5 | 6.5 |
| | General HLS enquiries into CSUs | 0.14 | | |
| Application | FEP Data Entry | 0.41 | | |
| | eFEP Upload | 0.26 | | |
| | Application Data entry ELS | 0 | | |
| | Application Data entry HLS | 0.89 | | |
| | Finalise Agreement | 0.06 | | |
| Document Management | Access Mapboard production - technical, carto - type work | 0.08 | d | 0.5 |
| | All Scanning and indexing of case file documents/agreement | 5.46 | d | d |
| | Despatch of Genesis correspondence | 1.84 | d | d |

Table 41 Detailed breakdown of 'Processing applications' (TST).

| Tasks identified in the Heedra Mouchel workflow model | | Standard time HLS | Standard time RBAPS (arable) | Standard time RBAPS (grassland) |
|---|---|---|---|---|
| Technical Advice | Pre-application enquiry advisors | 1.5 | d | d |
| | Promotion, events, 1:1 meetings | 0.38 | 1.53 | 2.2 |
| | Proactive management of application pipeline through partner | 1.38 | d | d |
| | pre FEP Approval | 0.36 | d | d |
| | HLS pre-application visits | 10.39 | 4, e | 8.79, e |
| | NE generated FEPS (SSSI-dominated FEPs) | 1.84 | d | d |
| | Initial Checks | 6.07 | Not recorded separately | Not recorded separately |
| | Technical Assessment | 12.08 | n/a | n/a |
| | Moorland management plans | 3.44 | d | d |
| | Approval | 4.42 | d | d |
| | Internal specialist advice | 0.18 | d | d |
| | HLS FEP QC visit | 2.08 | d | d |
| | HLS technical assessment visit | 22.31 | n/a | n/a |
| | Additional consultation with third parties/partners | 1.61 | d | d |
| | Agreements returned for amendments prior to signature | 0.46 | n/a | n/a |
| Miscellaneous | Digitise HLS map using GI Toolkit) | 12.33 | d | d |
| | Exception Ag Mapping | 0.3 | d | d |
| | Access Mapboard | 0.44 | d | d |
| | Panel Preparation | 0.91 | d | d |
| Application | Application Data entry of HLS options | 1.09 | d | d |

Table 42 Detailed breakdown of 'Processing applications' (LMT).

Managing existing agreements

| Tasks identified in the Heedra Mouchel workflow model | | Standard time HLS | Standard time RBAPS (arable) | Standard time RBAPS (grassland) |
|---|---|---|---|---|
| Changes | Land transfer | 0.29 | d | d |
| | Request early closure ELS for upgrade to HLS | 0.03 | d | d |
| | Request early closure HLS | 0 | d | d |
| | Recoveries | 0.01 | d | d |
| | Record suspect breach | 0 | d | d |
| | Process RLR/minor amendment | 0.98 | d | d |
| Claims | Process mid-year claim | 0.5 | d | d |
| | Process capital interim claim | 0.51 | d | d |
| | Process end of year claim | 2.69 | 7 | 7.5 |
| Document Management | All Scanning and indexing of case file documents/agreement | 5.22 | d | d |
| | Despatch of Genesis correspondence | 1.83 | d | d |
| | Prepare for (EU) compliance inspection dossiers | 0.12 | d | d |

Table 43 Detailed breakdown of 'Managing existing agreements' (TST).

| Tasks identified in the Heedra Mouchel workflow model | | Standard time HLS | Standard time RBAPS (arable) | Standard time RBAPS (grassland) |
|---|---|---|---|---|
| Manage agreements | Advice (office based) | 4.93 | 2, e | d |
| | Care & Maintenance visits & reports | 1.09 | 18.13, f | 22.87, f |
| | Process derogation request | 0.26 | n/a | n/a |
| | Process major amendment | 2.24 | d | d |
| Inspection | Dealing with (EU) compliance inspection | 0.16 | d | d |
| Changes | Land Transfer | 0.33 | d | d |

Table 44 Detailed breakdown of 'Managing existing agreements' (LMT).

# Appendix 7 - Case Studies

### *Arable - Manor Farm, Shropham: Andy Thornton.*

Farming on the edge of the Brecks Andy is the third generation to farm at Shropham after his grandfather moved down from the borders. After renting various farms his grandfather moved to Manor Farm which was bought in 2000 from the landlord.

Operating as a family farming partnership the 289ha, mainly owner occupier farm is mixed growing combinable crops together with sugar beet and maize for Attleborough's Anaerobic Digester (AD) plant. Some land is also let; irrigated land for vegetables - onions, parsnips and potatoes and non- irrigated for outdoor chickens and pigs.

However, a major restructure is underway. All the equipment has been sold and there are no longer any employees on the farm with all work being done by contractors. This includes the neighbouring farm which Andy contract farms. Since this change it has been easier to make decisions and the plan is for the majority of the farm to enter into a Mid-Tier Countryside Stewardship (CS) scheme and convert much to organic.

Coupled with this change is the a move away from traditional farming towards agri-environment and tourism on the main area of the farm with outlying land being put to maize or miscanthus which will be sold to a local straw burning power station.

In addition to the arable the farm has 30 Ha of lakeside gravel pits of which 12 Ha are fenced with the surrounding grassland grazed by Welsh Mountain ponies. Operational until 2015 the gravel pits have been landscaped and left to their own devices. In addition to the ponies the plan is to get some Belted Galloways which will be sold directly to customers.

Reactions to this change have been varied with some supportive and others questioning the need to produce food. But issues with pest build up and soil structure has driven the rethink.

**What is your previous experience of agri-environment schemes?**

The first agri-environment scheme entered into was Countryside Stewardship Scheme (CSS) in 1998. Since then the farm has always been involved with a Higher Level Stewardship ending in October 2018. An extensive Mid Tier CS application is in the pipeline with a range of arable options including cultivated plots, low input grassland, winter bird food and flower rich areas. This application is the most ambitious to date and will complement the agri-tourism (glamping) venture with the aim of sharing the conservation work with visitors.

There is a wealth of wildlife on the farm due to it's location and wide variety of habitats including rare species such as lapwing, skylarks, brown hares. Tree sparrows have been known and stone curlew nest nearby, all species Andy is keen to encourage on the farm.

**Why did you apply to take part in the RBAPS Project?**

"Happy to take part in something that will influence schemes of the future. Would have been interested irrespective of FWAG (Trustee and Director of Norfolk FWAG) role. Good idea to have farmers involved in making decisions and they know the land."

**How has it gone for you? What are the best bits about being in this scheme?**

"It enables you to tailor what you are doing to your own land as your know it well and it provides the freedom to do that. There are no constrictions on being told what to do which may not be right thing anyway. Prescriptions have prevented things been done in the past."

"Can experiment a bit; we have tried different seed combinations. We tried irrigating this year, but the plots weren't as good as those areas not irrigated. The irrigated bit encouraged the sunflowers to grow too well and outcompeted the plant. The plot which wasn't irrigated all grew at the same rate resulting in a more diverse mix."

**What are the worst bits about being in this scheme?**

"Element of risk around the payment, but this is a risk you take in all combinable crops."

"Self-assessment – how would this roll it out nationally and the need to educate people as the pilot has provided support and training. How practical would this be on a national scale. "

"With the winter bird food option the practicalities of getting out and measuring the plots, getting into them can be challenging."

**Has it changed your attitude towards your farm/land management?**

"Yes, gets you thinking about what you are trying to achieve and whether what you are doing actually delivers for birds, in particular the hungry gap. Tried to put more millet in after seeing all the yellowhammers feeding on a friend's plot who is also participating in the pilot. Trying to tailor to meeting what you want to achieve."

"There is a small 5 day a year shoot and this has kept habitats in place with extra covers. These are mainly maize but we are now reducing the maize element."

"Attention to detail which will roll into everything that we do. Previously did what was told or what was needed to do to comply."

**Has it changed your view of the particular habitat?**

Andy feels that wildflower margins would deliver longer term benefits than pollen and nectar. Pollen and nectar would now only last for 2 years before re-drilling, but before the pilot he would leave them longer. In the RBAPS plot the number off species in the pollen and nectar plot have unexpectedly dropped off after the first year and some species have dominated such as alsike clover.

**Would you like to be involved in similar future projects or Schemes?**

Yes, and would consider different approaches if presented and fitted in.

**Are there any other comments you would like to make?**

The current group are all interested in conservation and doing their best to deliver, other farmers may take the payment and not pay so much attention to detail and could claim for something that's not there.

How do farmers justify and quantify what we are doing for the money? Thinks that RBAPS is easier to justify than MBAPS as can show results that are being achieved. But would need to do proper bird counts.

Inspections at the moment are stringent and hard and are in place to target the 5% and the remaining 95% pay the price for those who are doing it properly.

One real plus – getting together with other farmers and the team and everybody learns. Bit of competitiveness has been a real positive.

The Formation of Farmer Cluster Groups might well be a way of providing support, training, and monitoring plots/options i.e. the group 'polices' the farmers within that group overseen by NE.

### *Arable - Flimworth Hall Farm, Eye: Dominic Drummond.*

Dominic farms 300 acres of arable in partnership with his father at Eye in Suffolk. With a medium to heavy clay loam and a lot of small fields (average size 9 acres) the farm isn't great for arable so they are very conservation minded. Combinable crops and sugar beet are grown with all work done in house apart from lifting the sugar beet. Originally from Scotland the family has farmed in the area for at least 5 generations with Dominic is the 4th generation at Flimworth Hall. The farm is owned with Dominic returning after college and travelling 6 years ago. Since his return the farm has moved away from ploughing to reduced tillage operations.

**What is your previous experience of agri-environment schemes?**

The farm is in the final months of an HLS agreement; the first agri-environment scheme undertaken. However it has a long history of conservation:

"Grandad never took out hedges as he loved wildlife, wouldn't allow a flail hedge cutter, only coppiced."

The farm has a 7 acre (2.8 Ha) rough meadow which has not been grazed for 45 – 60 years and is rewilded. It is now scrub dominated with deteriorating blackthorn and an old water course in the middle. Red deer like the area and Dominic is keen to do some bird ringing to see what uses it. The farm already has 3 pairs of turtle doves. The shoot on the farm complements the conservation work and the habitats managed are important in a wider landscape of more intensive arable farms.

The plan is to apply for Higher Tier, but Dominic will be looking to deliver more realistic outcomes as well as taking into consideration the level of payment. Options will be put in more optimum places and the hope is to do some capital works on the moat; an ancient monument.

**Why did you apply to take part in the RBAPS Project?**

"I felt like I wanted to get involved as it is the way things are going so if had some experience of it I would know if it was achievable. And I am interested in conservation. Dad and I are as passionate as Grandad on conservation".

**How has it gone for you? What are the best bits about being in this scheme?**

The best bits have been the education on the 2 options, how to achieve it, far more than what we previously received, pollen and nectar in particular. It has made Dominic and his Dad realise why their ES plots are not doing well. Freedom and flexibility, "the more you put in the more you get out, rather than if you don't achieve you risk getting fined." It provides incentive to do better. Talking to other farmers and how they did it, including the farm walk. The plant identification has been useful as Dominic couldn't identify any of the pollen and nectar species before the pilot. He has to think a bit differently on how to establish it, it has been a learning curve.

**What are the worst bits about being in this scheme?**

Worst bits have been the weather, 2018 in particular and insect issues. Luckily flea beetle has not been an issue. Weather majorly affected seed production of winter bird food in 2018 and it was not as good as it could have been.

**Has it changed your attitude towards your farm/land management? Has it changes your view of the particular habitat?**

The habitats are already doing a lot but larger areas are easier to manage and achieve than smaller more awkward corners. Limit to how big you want a plot of winter bird food as thought needs to go into proximity to hedges when the birds aren't feeding.

It has made Dominic and his Dad think about where to locate pollen and nectar and they will move those in HLS into some of the smaller fields in their CS.

Winter bird food - Dominic wonders whether this could this tie in with conservation agriculture as cover crops. Could it then be taken one step further and establish cover crops, leave overwinter and direct drill a spring crop into it. Cover crops are established too late to produce seed at the moment. However, Dominic is not sure field scale would work due to need to be close to hedges.

**Would you like to be involved in similar future projects or Schemes?**

"Yes, I like being involved at the forefront and representing how a farmer would feel and at the same time do your best for conservation. Feel as a group we are making a difference."

Friends and neighbours are not really interested in doing this type of thing as they are more intensive and have larger field sizes, but Dominic feels that's not the type of farmer going to get into it anyway. Although maybe the financial reward could be what it takes to get the non-conservation minded farmers into this sort of scheme to change that mind-set. At the end of the day, we all still need to make money.

"If you farmed properly you don't have to do silly things like this." one of Dominic's friends said to him about his involvement in the pilot!

**Are there any other comments you would like to make?**

For winter bird food a base payment to help cover seed costs to encourage a greater area on every farm across the country. One way of doing this could be to offer a prescriptive approach with a minimum payment but also offer a RBAPS option with higher payments.

### *Grassland - Widdaleside, Hawes: J & JH Whaley*

Widdaleside is a 300 Ha hill farm located on the edge of Widdale, a tributary dale to Wensleydale. Andrew and his cousin David are the fourth generation on the farm after taking on the farm from Andrew's father and uncle. The farm is run in a very similar way to how it was 20 years ago, there has been no diversification. They currently run 800 sheep, with 20 Beef cattle and followers.

Andrew and Rachel have two sons, the eldest enjoys farming but is an apprentice electrician and it is still undecided if he will be more involved in the future. David's youngest son is very keen on farming.

Up until 2016 the farm managed an Environmental Stewardship Upland Entry Level scheme (ELS). When Andrew and David took on the farm it was part of the farming business they knew no different.

When the ELS scheme concluded in 2015 they began applying for a Higher Tier Countryside Stewardship scheme to commence in 2016. The scheme was very complicated "It (the agreement) became too restrictive or you had to commit to too many changes to the existing farm business to make it worthwhile to be in."

Very low stocking rates during the winter and no allowance for supplementary feeding made it impossible to go forward into an agreement. "Higher Tier included a lot of paperwork but this was not off-putting, if the agreement had worked out that would not have been a problem."

**Why did you apply to take part in the RABPS Project?**

"Honestly, because it was an opportunity to get some income. Our ELS scheme was coming to an end and we were not going into Higher Tier Stewardship. We were lucky enough to try something new, it was a "no brainer". "We thought we would try it, if we didn't we would have lost £20,000 of income to the farm and had nothing to replace it."

"We knew we had to do certain things for the scheme, which was fair enough. It wasn't prescriptive, so if you needed to cut your rushes or your meadow early you are not going to get penalised. It's honest and straight forward; you know what you are getting into. We wouldn't have gone into it if you didn't assume you could deliver but there was reassurance if circumstances change you are not going to get penalty letters. It wasn't risky."

"It's flexible with the seasons, you don't have to file paperwork or explain to an adviser if you want to cut hay meadows earlier or later. In the first year the weather was tremendously wet, we couldn't do any rush cutting at all as we couldn't get on the land. The habitat didn't change and we didn't get an increase in score. This year it was dry, so we could do the rush cutting."

**How has it gone for you? What are the best bits about being in this scheme?**

"The best things include, receiving an income. If you don't have an income you don't have a business."

"We have more appreciation for the habitats. We took more of an interest in it, we took more of an interest in the flowers, wildlife and birds. Rachel and our youngest son went out with the flower ID pack - he was very good at identifying the flowers as it suited his mind. It was really pleasurable to go out and it helped us to learn more because he was interested."

"Because we had to do the surveys ourselves, it made us appreciate the habitat more as it forces you to stop and take notice. It makes you engage and gives you a connection."

“The scores were very similar to the adviser scores - it made you feel like you were doing it correctly. Jane (our adviser) visited 3 weeks later, it was encouraging to know we had very similar scores. We now know what advisers are looking at and how they assess the habitat and we know what to do and feel we are doing it well.”

**What are the worst bits about being in this scheme?**

“To be honest when we have filled out the attitudinal surveys and chatted about this we have always come up with something in order to be balanced. We have said ‘having to make time to do the survey’ but really it was a pleasure (apart from when it was raining). We haven’t found many negatives with it.”

“You could say paperwork is a negative but given the amount of paperwork we deal with for other aspects of the farm it was really straightforward, it’s not complicated.”

“Slightly different scores for wader fields, it was good because as a farmer and an adviser we could sit down and talk about it. Went with our score as Jane agreed if she had gone out earlier the field would have been better. Last year we accepted a lower score it was a mutual decision. It was good to sit down and discuss it and work it out together.”

“Position of transect lines, maybe there should be a way of including rare species off the transect line because you are being paid for the whole field e.g Jane found a butterfly Orchid away from the transect line in the meadow field.”

**Has it changed your attitude towards your farm/land management? Has it changed your view of the particular habitat?**

“We’ve always known that hay meadows are important; you can’t live round here and not know hay meadows are important. We learned the wet, boggy, scrubby rushy fields that don’t look very pretty are actually really important for the birds. Cutting the rushes and putting some ruts in can make a huge difference. I don’t think we would have appreciated that if we hadn’t have had that level of involvement with the scheme.“

“At the meetings there were people who knew their birds, knew where they nested, knew everything about them, and this time I’m taking more notice of it because of the scheme. Life’s that busy if it’s not important you don’t do it.”

**Would you like to be involved in similar future projects or Schemes?**

“Yes, we have applied for the scheme extension and have submitted lots of extra land.”

**Are there any other comments you would like to make?**

“If you’re going to get something, whoever pays you, you should do your best to get the best results and go and listen to what someone has to say.”

### *Grassland - Hill Top Farm, West Scrafton: Caroline Harrison*

Hill Top Farm, West Scrafton has been owned by the Harrison family for over 100 years. The farm buildings have remained a constant whilst land has been added or sold over time. The farm covers approximately 200acres (80Ha) with a small amount of lowland grazing at Middleham. Caroline took on the farm from an uncle and made great efforts to "put it into better heart" by improving farm infrastructure and boundaries. Presently the Harrisons are downsizing. In the future their grandson will likely take on the farm, he currently works as an agricultural contractor. The farm business has changed over the years and now has a number of income streams. It currently manages 80 sheep and 250 store lambs, rents out housing and land to neighbouring farmers and sells surplus haylage.

Caroline has a long history of being involved with conservation schemes and payments and speaks very positively about them. She first received the Hill Farm Allowance, then went into a Countryside Stewardship scheme. Following that, she entered into a five year Entry Level Environmental Stewardship Scheme, which concluded in 2015. More recently Caroline applied for a Mid Tier Countryside Stewardship scheme to commence in January 2019, she is awaiting a response.

It is clear through discussions that contributions to wildlife and habitat conservation are something Caroline takes pride in. Over her lifetime they have planted 500 new trees on the farm through various schemes. She has worked with the Rivers Trust fencing off water courses and improving riparian woodland by both adding and removing trees, Salmon have since returned to the river.

**Why did you apply to take part in the RBAPS Project?**

"Because I am a believer that we should look after our birds. I love birds; a world without any birds would be a very sad place. Breeding waders are one thing on our farm that we can help with."

**How has it gone for you? What are the best bits about being in this scheme?**

"The positives are… the management is up to my discretion. I want to make the birds breed. I try and do exactly the right thing for them which is basically keeping cattle out when the chicks are running around. They hatch at different times depending on the weather and I can react accordingly. This year the birds arrived a lot later, therefore you could leave some sheep grazing a bit longer. I had the flexibility to change my management to suit the birds."

Caroline talked frequently about how locally tailored advice was something she valued in this scheme "I knew a bit about birds already but I wouldn't have liked to have done the project without the National Park's input, they have been really, really helpful in opening my eyes to new things."

"Overall National Parks are looking after nature, which I really agree with, because with being local people on the ground they know what they are talking about. If you go with the Mid Tier (Countryside Stewardship Scheme) you (speak to) somebody sat in an office miles away, who has no idea what Coverdale is like. So it's nice to be able to talk to somebody who is local and appreciates (the area)."

**What are the worst bits about being in this scheme?**

When asked what she thought the negative aspects of the scheme were she indicated the difference between farmer and adviser scores.

“I assessed the wetness of the land in March… it was extremely wet that month, Helen (the adviser) came a month later and it had dried out. So when it came to the scoring it was highlighted as a discrepancy and Helen pointed out it was because of the difference in time.”

Caroline said she was happy with the conversation to discuss the difference in score “absolutely, fine, there’s nothing like talking.”

**Has it changed your attitude towards your farm/land management? Has it changed your view of the wader habitat?**

When asked if she would have taken on the new management works she undertook e.g. creating a scrape without being in the scheme she says probably not “It focuses one’s mind does a little cash.”

Overall Caroline thinks carefully about all aspects of management on her agreement site. During conversation she considers the impact of wetness, liming, bracken, and pest control. It is interesting to note some of these are management issues outside those measured on the scheme score sheet.

“I have another field I would like to put in that I would like to improve the habitat on… Curlews do like it, but I can’t say Peewits (lapwings) particularly like it. It needs more water, more soggy patches. It will be very interesting to know why the Peewits don’t nest up there. Is it because it’s nearer the moor? Is it because on the moor there are more raptors, so the Waders move further away? That field has quite a bit of bracken down one side. There are certain things that like to live in bracken, maybe vermin. We are removing the bracken - it will be interesting to see if that helps.”

She considers the impacts of soil quality and if liming might improve Wader habitat “we have to test all our land now, so we’ve not had the field we are adding into the agreement tested yet…I wonder if the Waders like it more if it has lime on it.”

The site that is currently in the scheme is looked after by a Game keeper, Caroline’s grandson. He has recently taken a new job and pest control on the land will cease. She wonders how this will affect bird numbers. “It will be interesting to see if there is an impact on the Peewits, because the vermin are not trapped anymore.” She also wonders if the increasing numbers of birds of prey “There are more now here than I’ve ever seen in my life” will also impact on wading bird chicks. “There needs to be a balance - we need birds of prey, because I don’t want to see them go, but too many might be a bad thing.”

**Would you like to be involved in similar future projects or Schemes?**

“Yes, definitely!” Caroline has submitted her application for the continuation of the project with both the existing agreement field and an extra field. These fields were left out when she applied for the National Mid Tier Countryside Stewardship scheme because “it was too prescriptive.”

# Appendix 8 – Image Recognition Case Study (CEH)

## Case Study: Supporting Natural England's Payment-by-Results pilot

### Background

Natural England has been running the EU funded Results-Based Agri-environment Payment Scheme (RBAPS) in partnership with the Yorkshire Dales National Park Authority since 2016. The project is looking at a payment by results approach to agri-environment schemes, undertaken by farmers in the UK. The three year project is assessing four existing agri-environment options in two locations in England. Through funding from Defra, the Centre for Ecology and Hydrology (CEH) was asked to work with Natural England to explore the potential uses of computer vision to aid RBAPS. The pilot is asking farmers to record the results of the interventions they use so that those whose interventions perform best can be rewarded with higher payments. One of the options in the arable pilot is focused on nectar and pollen mixes, sown to promote biodiversity. This option was believed to be the most amenable to augmentation with computer vision tools.

The pollen and nectar option requires farmer to sow plots of a mix of legume and perennial flowering plants in order to provide a source of nectar for insects during the summer and autumn. Payment rates to farmers depend on the performance of these plots. Performance is assessed using a standardised survey, requiring the farmer to survey 10 quadrats, each 1m x 1m, in their pilot plot. Within each plot the farmer is asked to record which species of plant they observe from the species they have sown. Their feedback has provided a list of 17 sown species (see figure 5).

Through discussion with Vicky Robinson at Natural England the following aims were developed:

1. **Collate an image database** for use in training a neural network to identify flower species.
2. **Produce an identification aid** for distinguishing flowers present in wildflower margins.
3. Test the potential for a tool to **automate the process of identifying species in images of plots collected by farmers**.

An image library is key for any computer vision task and so this was seen as the first priority. For this pilot we focussed on the species that the farmers were expected to report on, though a production version would also need images of all flowers the farmers are likely to see, not just those they are meant to report.

Second, it was highlighted through discussions that some farmers found it challenging to identify all the species present. This could be addressed by creating a tool that identifies a flower species from a close up image. This identification aid should allow a farmer to take an image of an individual flower in the field and receive a probable identification. This classifier should be able to identify the species farmers are expected to report on as a part of the pilot.

Finally, images are currently taken of each quadrat in the plot (each column in figure 5). These images were collected to gather evidence on the usability of images to check that the species reported by the farmer on the survey form are present in the quadrat images. This could be automated by creating a computer vision tool that could classify the species present in each plot image.

| Sown flower species present | QUADRAT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | Record all sown flower species present in each quadrat by entering X in the appropriate box | | | | | | | | | |
| Alsike clover | X | X | X | X | X | X | X | X | X | X |
| Crimson clover | X | X | X | X | X | | X | X | X | X |
| Red clover | X | X | X | X | X | X | X | X | X | X |
| White clover | | | | | | | | | | |
| Sainfoin | X | X | X | X | X | X | X | X | X | X |
| Lucerne | X | | | X | X | X | X | X | X | X |
| Bird's-foot trefoil | X | X | X | X | X | X | X | X | X | X |
| Black medick | X | | X | X | X | X | X | X | X | X |
| Common vetch | | X | X | X | X | X | X | X | X | X |
| Black knapweed | X | | | X | X | | X | X | X | X |
| Yarrow | | | | | | | | | | |
| Oxeye daisy | | | X | | | | | | | |
| Musk mallow | | | | | | | | | | |
| Wild carrot | X | X | | | X | X | X | X | | X |
| Red campion | | | | X | | X | X | | X | X |
| White campion | | | X | X | | | X | X | | X |
| Phacelia | X | X | X | X | X | X | X | X | X | X |

Figure 5 – An example of the data collected by farmers when assessing their nectar/pollen mix plots

## Collating an image database

The image database for this project was compiled from three data sources; 1) iRecord, 2) Flickr, and 3) Google image search.

**iRecord** images were sourced by querying the in-house Indicia database for all images of the required species of flower. The resulting output table contained tags which were used to create URLs for downloading the images required. The scripts for performing this are available on github[14].

While the iRecord database is very large, the number of images of wild flowers is quite small. Therefore, more images needed to be sourced from Flickr and Google. The code provided currently only works when run within the iRecord system and is not externally accessible.

**Google images** were obtained by manually performing searches of the wildflowers of interest (using common and binomial names), saving the resulting html files, and running a script written for this project to extract

[14] https://github.com/BiologicalRecordsCentre/DEFRA_image_recognition/tree/master/Image_Retrieval/iRecord

images from the html files. The script for extracting images from Google has been made freely available on github[15].

**Flickr images** were extracted using the FlickR R-package[16] combined with additional scripts[17] to utilise this package to download images of interest.

After image extraction, all the images were examined individually to ensure they were of the correct species and of suitable quality. A number of images contained multiple flowers; these were removed to prevent confusing the image recognition algorithm.

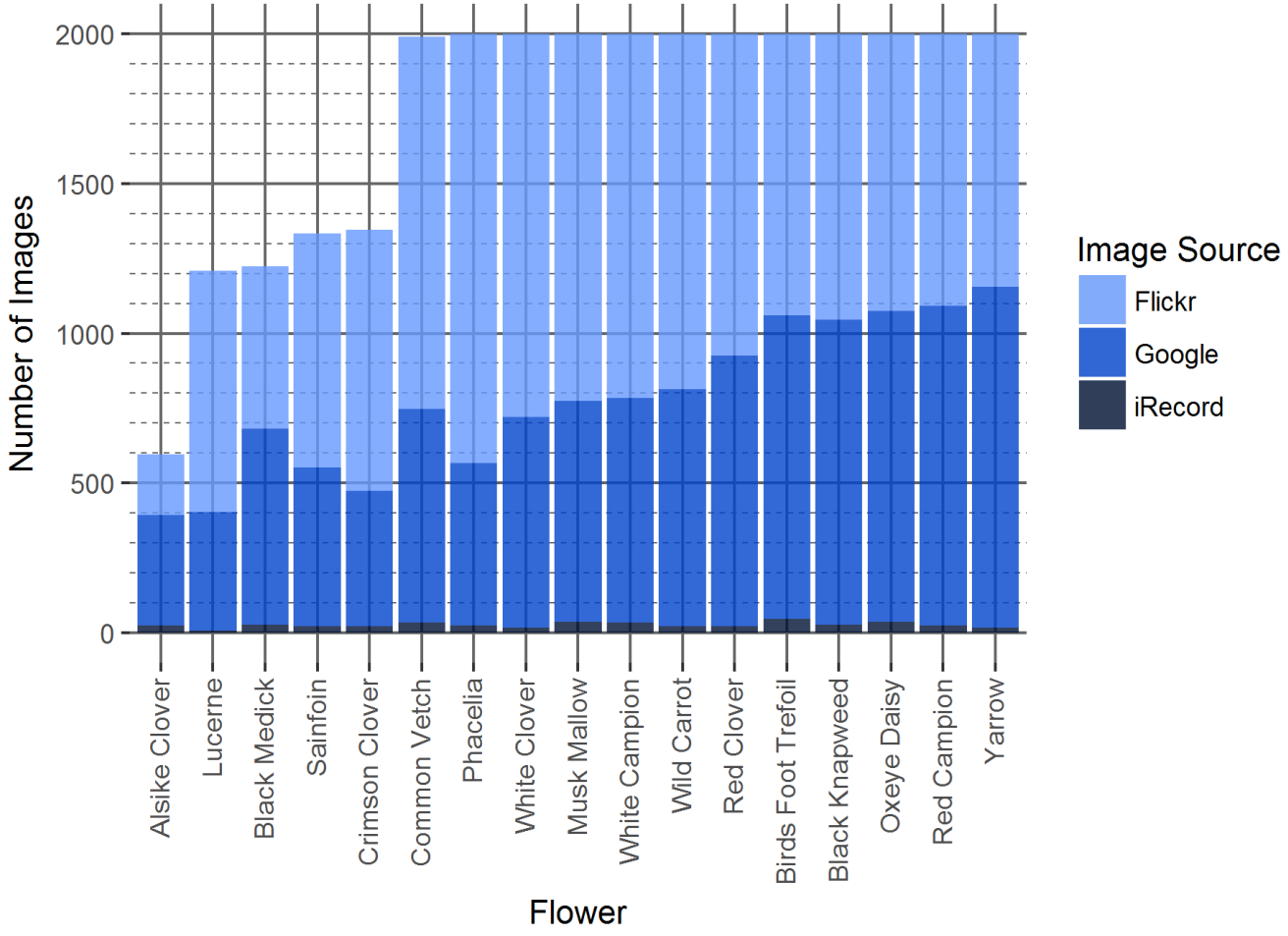



Figure 6 - The number of images collected for each of the target flower species (n=17), from three different data sources: iRecord, Google and Flickr

The number of images acquired from each source, after quality assurance, is shown in figure 6. Note, the number retained for each species was capped at 2000, a cap which only 5 of the species did not reach. There were two reasons for applying a cap. Firstly, it was important to ensure the image groups were balanced. Uneven numbers of images between species can skew results as discussed previously. Secondly, there were a few species for which there were over 5,000 images obtained from Flickr. Sorting through these images was very time consuming and it was deemed that there were significantly diminished returns once 2000 images were obtained per class.

[15] https://github.com/BiologicalRecordsCentre/DEFRA_image_recognition/tree/master/Image_Retrieval/Google
[16] https://github.com/FrancescaMancini/FlickrAPI_EABhackathon
[17] https://github.com/BiologicalRecordsCentre/DEFRA_image_recognition/tree/master/Image_Retrieval/Flickr

## Creating an identification aid

### Training model

Once the image database had been compiled, the CNN classifier was created. This was written in Python, using the Keras package. The model is based on the Inception-V3 pre-trained image classification model. The full code for building the model is available in the GitHub repository for this project[16].

For building this model, 80% of the images were randomly selected from each set of images (1600 images in the case of flowers with 2000 images) for training, and the remaining 20% used for validation. The batches of images were randomly augmented with minor stretch, rotation and flip in order to reduce the chance of overfitting.

In the case of this model, the validation accuracy was not used to inform the image recognition model, but was purely used to report back on the current accuracy of the model for each epoch. For this reason, the validation images have been used for both validation and for testing once the model completed running. If instead the best model accuracy within each epoch had been selected based on the best performing model for the validation images, these images could not have been used for testing. The code used for running the image classifier can be found on GitHub[18].

### Model evaluation

The average precision for the model after testing is 82%, which was the peak after 100 epochs. This precision varied from flower to flower. To show how the performance varied between species, below is a graph showing the F1 score for all flowers (figure 7). The F1 score is defined as the average of the precision and recall, where precision measures the confidence that a given prediction is correct and recall measures the proportion of images of a given flower which were correctly assigned to that category.

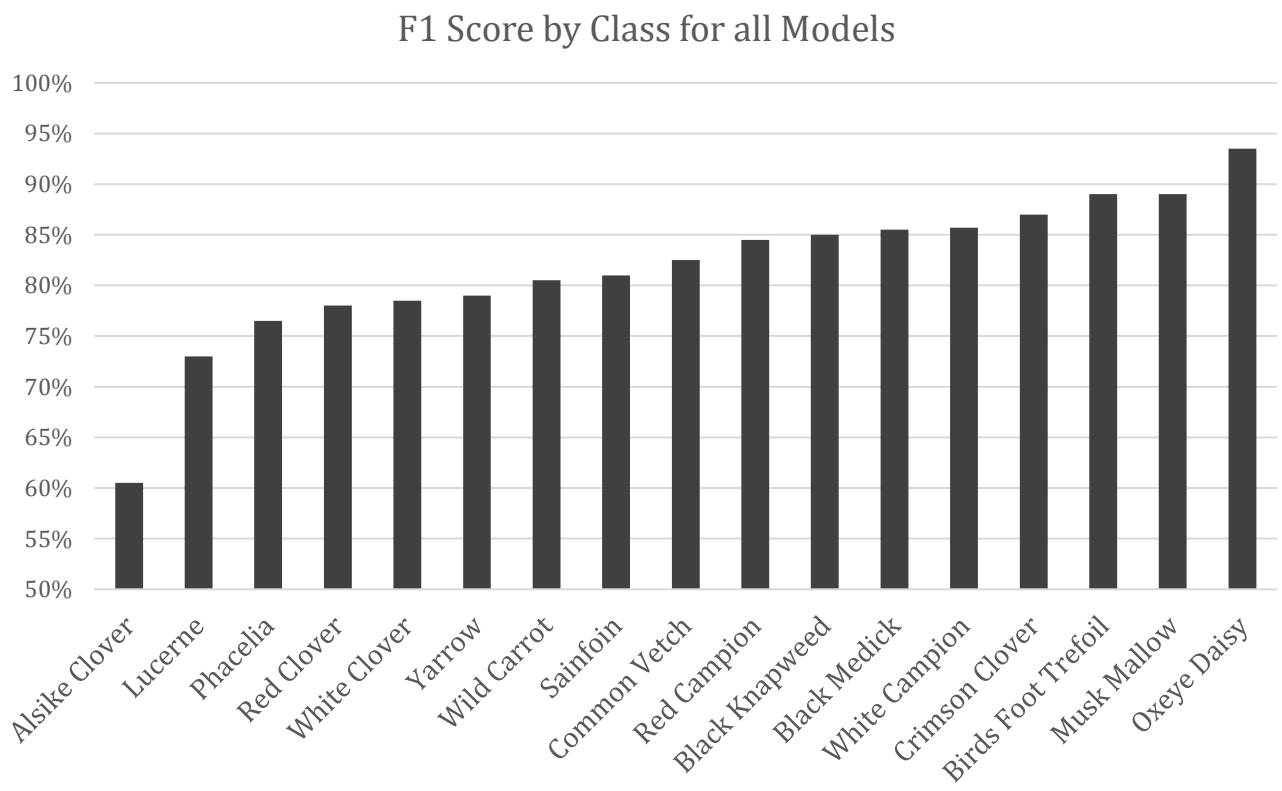



Figure 7 - The F1 score for the 17 flowers in the dataset.

[18] https://github.com/BiologicalRecordsCentre/DEFRA_image_recognition/tree/master/ImageClassifier

The F1 score varies from 61% for Alsike Clover to 93% for Oxeye Daisy. The second lowest score is 73% for Lucerne. We believe that Alsike Clover performs so poorly as it had the fewest images (600, compared to Lucerne, the second least represented species, with 1200 images), and it can be difficult to tell apart from white and red clover.

There are programs available which perform a similar task to the model we have developed. Most are available as an App, such as the PictureThis App[19], PlantSnap[20] and PlantNet[21]. Comparing the performance of these apps to the performance of our model is difficult. The best performing of these apps appears to be PictureThis. Testing in the field suggests that PictureThis correctly identifies common species around 80-90% of the time. However, when passed the images we have been testing on, performance drops to around 50%, depending on species. This app also does not differentiate between different species of clover.

This informal testing suggests that for the quality of images we are dealing with, and for the list of species we are interested in, our model out-performs other tools available.


Figure 8 - The 8 images most poorly classified in our test data. The classifier thought these images had a low chance of being the species that was in fact in the image.

The error in classifying some images is understandable (figure 8). The flowers are all either difficult to make out, poorly photographed, or feature the presence of other flowers which have confused the classifier. Most of these images are also only given a score of 60-70% for the most confident classification. In such a case one would typically want the classifier to return an answer of 'unknown' or display its level of confidence so that users were aware of the fact the classifier was able to make a confident species assignment.

[19] https://www.picturethisai.com/
[20] https://plantsnap.com/
[21] https://identify.plantnet-project.org/


Figure 9 - The 8 images best classified in our test data. The classifier correctly identified the species present and was very confident in its assignment.

When looking at images that were confidently, and correctly identified (figure 9) we can see that all these flowers are clearly photographed and are the only flower in the image. Assessing which images are classified well and which are classified poorly is an important process to identify ways in which the classifier might be improved, for example adding more training images. Additionally this is key to providing users of the classifier with guidance on the sort of image that should be taken to ensure a confident classification.

In order to assess whether the model was consistently confusing species, a confusion matrix (figure 10) was produced for the 17 classes.

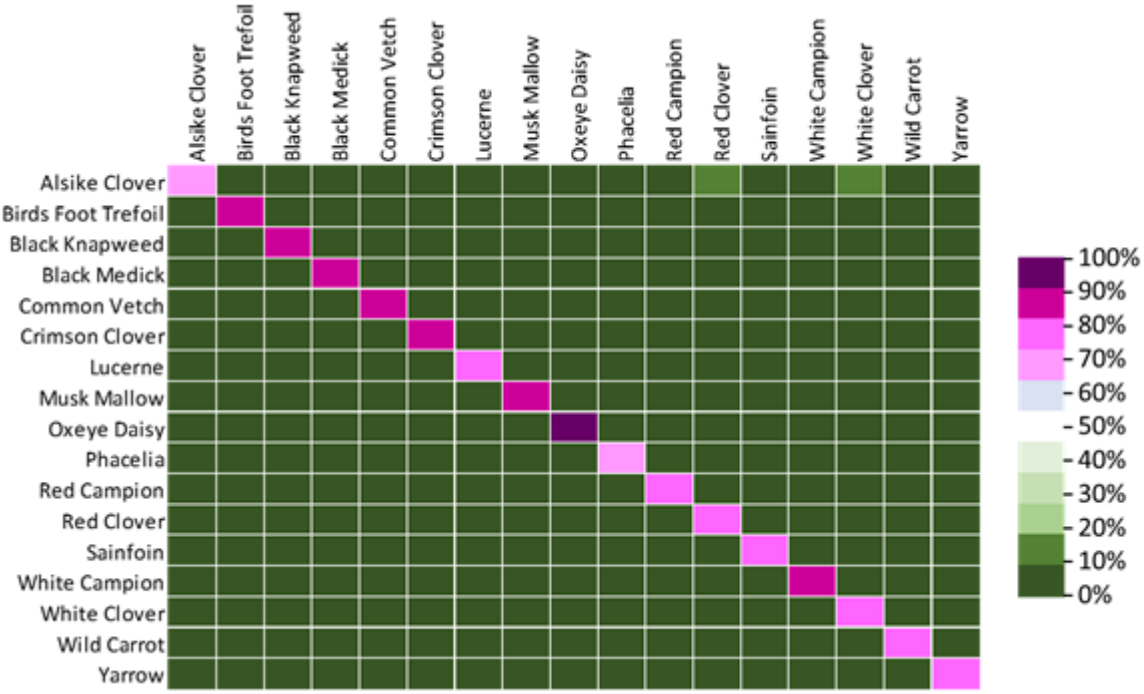



Figure 10: Confusion matrix for the 17 flower species of interest. The shading shows the recall or chance of classifying an image of Flower X as Y, where X is a flower on the x-axis and Y is a flower on the y-axis.

The figure above shows that images of alsike clover are commonly misidentified as red clover and white clover (figure 10, top row). This is understandable as alsike clover looks like a cross between a red and white clover (in fact the binomial name for alsike clover is *trifolium hybridum* as Linnaeus supposed it to be a hybrid of red and white clover). This would suggest that if the clover taxa were grouped into one, the performance of these species, and the model as a whole, would improve. Interestingly the reverse confusion (i.e. white clover being misclassified as alsike clover) is not commonly observed. This may be a result of the unbalanced dataset as shown in figure 6. This imbalance could result in the model hedging its bet by classifying clovers as predominantly white or red. This could be addressed by balancing the dataset (i.e. sourcing more images of alsike clover), or weighting the algorithm to penalise this behaviour of hedging bets.

## Automated quadrat assessment

The third aim of this project was to Test the potential for a tool to automate the process of identifying species in images of plots collected by farmers, to evaluate what level of grant the farmer should be entitled to, or provide a metric for checking likely compliance.

The flower identification aid, above, is a useful tool to aid farmers in their self-evaluation, but it does not facilitate automatic evaluation of quadrats. For this task, a further model was created to attempt to automatically classify quadrats, by tagging every plot image with whether or not each flower species was present.

### Training model

In order to ascertain whether a flower species was present, a binary classifier model for that species had to be produced. Each model's sole job was to say 'present' or 'not-present' for one species of flower, and as such 17 models were produced.

The images used for training and testing for the 'is present' dataset were the images of the flower. The images used for the 'not-present' dataset were a random selection of all 16 other flower species, selected so as to balance the number of images in each dataset. The reason for balancing the datasets is because without this balance, there would be 16 times as many 'not-present' images as 'present'. This would mean that a model that always predicted 'not-present' would be correct 94% of the time (16/17). Images of quadrats were not used in training initially as the 300 images of quadrats was deemed too small a dataset for an effective classifier. Before testing this model we hypothesised that the results would be poor as the images used to train the classifiers, close ups of flowers, are different from the images the classifier will be used to asses, quadrat images

### Model evaluation

These models were assessed on images of quadrats provided by Natural England, collect as part of the RBAPS project. All these quadrat images were then tagged with whether each flower in the list of 17 was present or absent. Each image was then passed into every binary classifier, and the results passed back as a table (Figure 11).

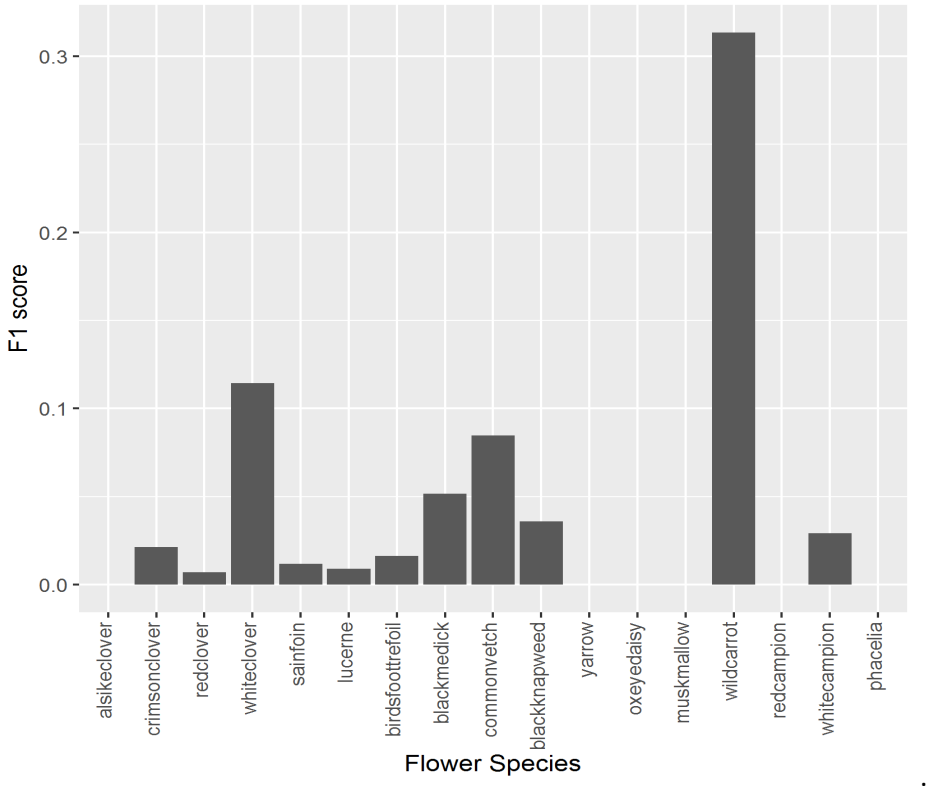



Figure 11 - The F1 score (a composite measure of accuracy) for classifier of each plant species in quadrat images

The performance of the classifiers on quadrats was poor (figure 11), as was hypothesised. The images these classifiers have been trained on do not look like the images of the flowers being identified (compare figure 8 with figure 12). Training images are close-ups of flower heads, while test images contain many flowers, all of which form a small part of the image. For this reason, a second round of binary classifiers were produced, using the small number of quadrat images for training and testing. Only flower species with at least 80 images in both the 'present' and 'not-present' category were considered for this trial. This is a very small training dataset by usual image recognition standards, where 1000 is considered to be a typical threshold, and a few hundred being approximately the minimum[22]. There were only 5 flowers which met even this low threshold (80 present and 80 absent).

Figure 12 - Two examples of plot images taken as part of the RBAPS project.

[22] https://petewarden.com/2017/12/14/how-many-images-do-you-need-to-train-a-neural-network/

The average precision and recall for the 5 flowers tested was 60%. As there were 100 images in the test set, and the 'present'/'not-present' categories were equally weighted, the expected results from random chance would be 50%. Our value of 60% success is not statistically better than chance (*p*-value 0.16).

While the automatic identification of quadrat images was not successful, we believe that if tagged images of quadrats are collected throughout the project, the image database for building a classifier will grow very quickly. We anticipate such a classifier performing well if it had a large image database to draw from. For this reason, we recommend that if quadrat images are submitted, they be submitted in such a way as to be easily tagged with flowers present, for example submitted with a spreadsheet which shows which flowers were present in which images. This task may also be better addressed with an object detection algorithm since there are many species present in each image. To create such a tool would require a dataset of images where the location of each species in each image has been tagged. This can be a labour intensive task but once the initial tagging has been completed the algorithm can be used to tag new images with human verification ensuring the new tags are accurate.

# Appendix 9 – Summary of statistical tests

| | | Kruskal-Wallis rank sum test | | | Wilcoxon rank sum test | | |
|---|---|---|---|---|---|---|---|
| **treatment** | **scoring** | chi-squared | df | p | p: baseline - group 1 | p: baseline - group 2 | p: group 1 - group 2 |
| pollen and nectar | no. of species | 11.099 | 2 | 0.003 | 0.191 | 0.002 | 0.087 |
| pollen and nectar | payment tier | 5.045 | 2 | 0.08 | - | - | - |
| winter bird food | no. of species | 22.119 | 2 | <0.001 | 0.712 | 0.002 | <0.001 |
| winter bird food | payment tier | 26.138 | 2 | <0.001 | 0.92 | <0.001 | <0.001 |
| meadow | adviser | 5.944 | 2 | 0.051 | 0.398 | 0.044 | 0.398 |
| meadow | control | 0.604 | 1 | 0.437 | - | - | - |
| waders | adviser | 0.419 | 2 | 0.419 | - | - | - |
| waders | control | 0.105 | 1 | 0.746 | - | - | - |

## Appendix 10 – Grassland Manual and Guidance – published separately

## Appendix 11 – Arable Manual and Guidance – published separately

## Further information

Natural England evidence can be downloaded from our **Access to Evidence Catalogue**. For more information about Natural England and our work see **Gov.UK**. For any queries contact the Natural England Enquiry Service on 0300 060 3900 or e-mail **enquiries@naturalengland.org.uk** .

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