Action: Call for proposals-Pilot on-farm projects to test result-based remuneration schemes for the enhancement of biodiversity

End of Project Technical Synthesis Report



Project Title: Pilot results-based agri-environment measures in Ireland and Navarra

Project Co-ordinator: European Forum on Nature Conservation and Pastoralism

Contact person: Derek McLoughlin, Email: Derek@efncp.org

Period covered by the project: 1st January 2015 - 30th June 2018

Agreement No. 07.027722/2014/697042/SUB/B2

Contents

List of figures 2
List of tables 4
List of plates 6
Executive Summary 10
Acronyms 7
Glossary 8
Introduction 10
Design and implementation of the biodiversity measures 12
Selecting biodiversity targets and spatial targeting 12
County Leitrim 12
Shannon Callows 13
Navarra, Spain 14
Setting payment rates 15
Farmer participation 19
Farmer advice and training 21
Farmer payments 25
Monitoring and evaluation of the measures and biodiversity targets 29
Evaluation of the measures 29
Farm advisors 29
External Evaluations 31
Financial monitoring and budgetary control 32
Monitoring of the biodiversity targets and evaluating the measures 34
County Leitrim 34
Shannon Callows 36
Navarra, Spain 39
Results 41
County Leitrim 41
Shannon Callows 46
Navarra, Spain 58
Databases 63
Dissemination 63
Financial report 66
Conclusions 67
Appendix I Boxplots 68

List of figures

Figure 1. Payment increments per score for each RBAPS measure. 17

Figure 2. Areas of fields (plots) entered under each of the RBAPS measures in Ireland and Spain in 2016 and 2017. Leitrim: Species Rich Grassland (SRG), n= 134; SRG with Marsh Fritillary Butterfly (SRG MF), n=57; Shannon Callows: Breeding Wader Habitat (BW), n=14; Species Rich Flood Meadow (SRFM), n=30; SRFM with Ground Nesting Bird (SRFM GNB), n=19; Navarra: Olive, n=125; Almond, n=94; Vines, n=30. Each boxplots shows the minimum, maximum and median (horizontal line in

each box) value, the 'box' represent the interquartile range (middle 50% of data points) and outliers are marked with asterisks (full explanation of boxplots is provided in Appendix I). 20

Figure 3. Range of payment levels to participants (including NPI payments) in the three pilot areas in 2016 and 2017. Leitrim, n=26 (13x2); Shannon Callows, n=40; Navarra, n=43. 25

Figure 4. Range of scores assessed in 2016 and 2017 across the RBAPS measures in Ireland and Spain. Leitrim: Species Rich Grassland (SRG), n= 134; SRG with Marsh Fritillary Butterfly (SRG MF), n=57; Shannon Callows: Breeding Wader Habitat (BW), n=14; Species Rich Flood Meadow (SRFM), n=30; SRFM with Ground Nesting Bird (SRFM GNB), n=19; Navarra: Olive, n=125; Almond, n=94; Vines, n=30. Each boxplots shows the minimum, maximum and median (horizontal line in each box) value, the 'box' represent the interquartile range (middle 50% of data points) and outliers are marked with asterisks. 26

Figure 5. Ranges in payments made per hectare including Non-Productive Investments (NPI) for the fields/plots entered in RBAPS in 2016 and 2017. Leitrim: Species Rich Grassland (SRG), n= 134; SRG with Marsh Fritillary Butterfly (SRG MF), n=57; Shannon Callows: Breeding Wader Habitat (BW), n=14; Species Rich Flood Meadow (SRFM), n=30; SRFM with Ground Nesting Bird (SRFM GNB), n=19; Navarra: Olive, n=125; Almond, n=94; Vines, n=30. Each boxplots shows the minimum, maximum and median (horizontal line in each box) value, the 'box' represent the interquartile range (middle 50% of data points) and outliers are marked with asterisks. 29

Figure 6. Mean marsh fritillary population estimates (±S.E.) in control sites (n=4) and sites enrolled in RBAPS (n=5) in 2016 and 2017. b) Changes in the marsh fritillary population estimates in the 9 monitoring sites between 2016 and 2017 – RBAPS sites in green 42

Figure 7. Species richness (± S.D.) of the RBAPS County Leitrim monitoring groups for sites categorized as being of high, medium or low ecological integrity (combination of points for number and cover of positive indicators) on the RBAPS scoring assessment 43

Figure 8. Populations of marsh fritillary butterfly on nine monitoring sites in 2016 and 2017 along the RBAPS scoring range. All sites had high ecological integrity (as measured by the number and cover of positive indicators), but overall scores were affected by sub-optimal scrub cover or vegetation structure. 45

Figure 9. Variation across RBAPS scores for (a) plant species-richness (b) Simpson's diversity (c) Evenness and (d) Shannon's diversity. Each box plot displays the minimum, inter-quartile range, maximum and median (horizontal line in each box) 47

Figure 10. NMS ordination diagram of Axis 1 and Axis 3 for relevés (colour and symbol coded for scores) with vector overlays showing correlation between axis scores & environmental variables... 48

Figure 11. Variation in diversity of Annex I positive indicator species for [6510], [6410] and [6430] (O'Neill et al. 2007) recorded across RBAPS scores, showing (a) species-richness, (b) Simpson's diversity, (c) total cover abundance and (d) Shannon's diversity [n =56 relevés] 49

Figure 12. Variation in the total number of breeding wader pairs on a plot according to the sward height of the plot in the breeding season. 54

Figure 13. Comparison of scores for RBAPS and control sites for 2016 and 2017. RBAPS, n = 10; Control, n = 11. 55

Figure 14. Changes in unadjusted end-of-year score from 2016 to 2017. RBAPS (n = 4) and control (n = 5) sites that participated in the measure in both 2016 and 2017. 56

Figure 15. Comparison of scores for RBAPS and control sites for 2016 and 2017. RBAPS, n = 10; Control, n = 11. 57

Figure 16. Predicted flora species richness (S) and Shannon's (H) diversity index (least squares means) for the interaction between group and year. Post hoc statistical significant differences ($P < 0.05$) are indicated with different letters. 59

Figure 17. Predicted flora Simpson's (D) diversity index (least squares means) for the interaction between group and crop. Post hoc statistical significant differences ($P < 0.05$) are indicated with different letters. 59

Figure 18. Predicted butterfly abundance inside the monitoring sites (significant differences between control and RBAPS group), and in the edge and outside the monitoring sites 60

Figure 19. Predicted butterfly abundance inside and in the edge of the monitoring sites for crop. *Post hoc* statistical significant differences ($P < 0.05$) are indicated with different letters. 60

Figure 20. RBAPS output document map illustrating the key project outputs and their relationship to one another. 66

List of tables

Table 1. Summary of threats in each region. 15

Table 2. Payment rates (Euros per hectare) across each of the RBAPS measures. 17

Table 3. Details of participant numbers and areas under RBAPS agreements in 2017 with figures for 2016 in brackets. 19

Table 4. Overview of payments for results-based payments, non-productive investments and their relative % of the total spend in the Shannon Callows for 2016 and 2017. 27

Table 5. Monitoring details in County Leitrim 35

Table 6. Monitoring details in the Shannon Callows. 38

Table 7. Summary of monitoring and evaluation indicators for each measure 40

Table 8. Mann Whitney U test of monitoring sites enrolled in RBAPS versus control monitoring sites (n=13) for observed number of species (Sobs) and abundance of birds at start (2016) and end (2017) of the pilot scheme..... 41

Table 9. Matrix of significant pairwise Spearmans non-parametric partial correlation coefficients between species richness of 4 monitoring taxa, notable species and RBAPS results indicators for 30 grassland sites in north-west Ireland. Area of the monitoring site (ha) was entered as a controlling factor. 44

Table 10. Spearman's correlation coefficients between RBAPS scores and various measures of diversity. 46

Table 11. Correlations between positive Annex I indicator species diversity and RBAPS scores and score result indicators for Species-rich Floodplain Meadows 50

Table 12. Overview of retrospective assessments for each Annex I habitat type across RBAPS scores. 51

Table 13. Summary of the number of whinchat and curlew pairs recorded across the participant Callows..... 52

Table 14. Whinchat breeding success and productivity across RBAPS and control plots in 2016 and 2017. 53

Table 15. Field scores on plots that participated in both years of the scheme 56

Table 16. Likelihood ratio test (LR) of group (control, RBAPS), year (2016, 2017), crop (Almond trees, Olive groves, Vineyards) and the interactions group x year and group x crop for flora species richness and diversity indices. Abbreviations of diversity indices: S, species richness; H, Shannon diversity index; D, Simpson diversity index, J, Pielou's evenness. Bold values represent significant differences ($P < 0.05$). Significance levels: $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$ 58

Table 17. Spearman's Rho correlation coefficients among flora and RBAPS scores. Abbreviations of diversity indices: S, species richness; H, Shannon diversity index; D, Simpson diversity index, J, Pielou's evenness. Abbreviations of RBAPS scores: A, diversity of the herbaceous; B1, diversity of natural vegetation; B2, natural and built structures. Bold values represent significant differences ($P < 0.05$). Significance levels: *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$; + $P < 0.1$. 61

Table 18. Spearman's Rho correlation coefficients among maximum relative annual abundance data of butterflies, grasshoppers and dragonflies (individuals minute^{-1}) in the edge, inside and outside monitoring sites, and RBAPS scores. Abbreviations of RBAPS scores: A, diversity of the herbaceous; B1, diversity of natural vegetation; B2, natural and built structures. Bold values represent significant differences ($P < 0.05$). Significance levels: *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$; + $P < 0.1$. 61

List of plates

Plate 1 Species-rich grassland in County Leitrim 13
Plate 2 Participating farmers at training event in Navarra. 23
Plate 3 Marsh fritillary butterfly habitat, with ample food plant devil's-bit scabious in flower..... 27
Plate 4 New hut constructed under the RBAPS project in Navarra in 2017, which the farmer will store farm implements used for carrying out low intensity farming practices on the farm that benefit biodiversity. 28
Plate 5 RBAPS project ecologist (left) and farm advisors discussing RBAPS field assessments, County Leitrim..... 30
Plate 6 Plant monitoring unit (2m x 2m quadrat) in a flood meadow on Shannon Callows 37
Plate 7 The RBAPS team in Navarra discussing monitoring indicator selection 39
Plate 8. Sample pages from the June 2017 edition of Conocer Navarra featuring the RBAPS project.65

Acronyms

AECM	Agri-Environment Climate Measure
ANC	Area of natural constraint
BP	Basic payment
DAFM	Department of Agriculture, Fisheries and the Marine
FBB	Field boundary birds
GAEC	Good agricultural and environmental condition
GGNB	Grassland ground nesting birds
GIS	Geographic information system
HNV	High nature value
ISGS	Irish semi-natural grassland survey
LPIS	Land Parcel Identification System
NBDC	National Biodiversity Data Centre
NFS	National farm survey
NPWS	National Parks and Wildlife Service
NPI	Non-productive investments (capital works)
PAF	Qualifying Interest
QI	Prioritised Action Framework
RBAPS	Results-Based Agri-environmental Payment Scheme
SAC	Special Area of Conservation
SCI	Special Conservation Interest
SPA	Special Protection Area
UAA	Utilizable agricultural area

Glossary

Biodiversity target (for RBAPS)	The specific habitat or species for which farmers are incentivised to manage, and that which is scored, on their farmland. E.g. species rich floodplain meadow habitat, including the Annex I habitats contained therein
Callow	Floodplain area, from the Irish word 'caladh' meaning river meadow
Co-meadow	Large meadow complex comprised of many privately owned, unfenced strips of meadow
Control plot	Management plots not under RBAPS contracts used for the purpose of monitoring and evaluation
Evaluation	Systematic and objective assessment of the measures both individually and collectively, includes their design, implementation and performance according to the following criteria: relevance, effectiveness, efficiency, sustainability, impact, coherence and added-value.
HNV farmland/farming	High Nature Value farmland where agriculture is a major (usually the dominant) land use and supports or is associated with either a high species and habitat diversity, or the presence of species of European conservation concern, or both.
Hybrid approach / model	Agri-environment measure approach that uses a mix of results- and measure (or action)-based approaches
Management unit	A field/plot or group of contiguous fields/plots that are managed as a single unit under an RBAPS measure, often delineated by a physical boundary. It is the management unit which is scored.
(RBAPS) Measure	Individual package for a selected biodiversity target, which includes aims and objectives, scorecard, guidance documents, etc.
Measure objective	The overall aim for the measure for that biodiversity target e.g. to maintain current condition (and score) or to attain optimum quality and condition for the biodiversity target, i.e. 10/10., high quality habitats (including Annex I habitats in favourable conservation status).
Monitoring	Systematic collection of data to provide indications of the performance

	of the scheme: including collection of plant data through relevés, collection of bird data through timed counts, collection of attitudinal data through questionnaires. Data collected provides an indication of the extent of progress and achievement of objectives.
Quality Score	Level of achievement in any given year
Result indicator(s)	Surrogate(s) (direct or indirect) used to assess the quality of the biodiversity target.
Result Indicator threshold	Each Result Indicator is comprised of categories (e.g. on a scale of bad to good) which reflect the extent to which each individual Result Indicator is achieved. A certain threshold must be achieved to attain each category.
Scheme	An overall package of agri-environment measures, designed to meet interacting policies and regulations
Scheme objective	Overall objectives of all the measure designed collectively. Individual measures may have discrete objectives but the scheme as a whole needs to address (national or regional)habitat and population declines
Scoring assessment	Using the scorecard to undertake quality assessment of the biodiversity target
Scorecard	Sheet used for carrying out the scoring assessment, comprised of the results indicators and their thresholds for a particular biodiversity target

Executive Summary

The RBAPS project in Ireland and Spain developed and trialled results-based payment methods for the delivery of biodiversity on farmland. The project partnership consisted of the European Forum on Nature Conservation and Pastoralism, Institute of Technology Sligo, Gestión Ambiental de Navarra, BirdWatch Ireland, the National Parks and Wildlife Service and High Nature Value Services Ltd. The project was 70% funded by the EU Commission with co-funding provided by the project partners and with the support of The Heritage Council, The Department of Agriculture Food and the Marine and Teagasc[1].

The specific objectives of this project were:

- To promote the design, development and use in rural areas of results-based remuneration schemes to conserve and enhance biodiversity;
- To increase the understanding of factors that contribute to the success or failure of such schemes;
- To identify opportunities and conditions for increasing the use of such schemes in the EU and in particular in the context of the Common Agricultural Policy (CAP);
- To explore the potential for such schemes to be applied widely in the rural countryside and beyond grasslands, e.g. for the protection and enhancement of pollinators, soil biodiversity;
- To demonstrate the potential of these schemes to have positive ecological outcomes by developing, testing and using widely applicable monitoring approaches;
- To promote and increase awareness and better understanding of the benefits of results-based remuneration schemes particularly within the rural community.

These objectives were delivered through the design, implementation and evaluation of the following six biodiversity measures across the three pilot regions:

- County Leitrim, Ireland: i) Species-rich grasslands and ii) Marsh fritillary *Euphydryas aurinia* butterfly habitat with species-rich grassland
- Shannon Callows, Ireland: i) Breeding Wader Bird Habitat; ii) Species-rich Flood Meadows and iii) Species-rich Flood Meadows with ground-nesting birds.
- Navarra, Spain: Traditional high nature value perennial crop mosaic.

The project ran from January 2015 to June 2018 and engaged a total of 57 farmers (13 in Leitrim, 22 in the Shannon Callows and 22 in Navarra) over two years of contracts entering a total of 332 hectares across the six measures. The RBAPS teams assessed 501 land parcels, resulting in payments of €187,956.08 to participating farmers over the two years. The average quality score per land parcel equated to 6.4 out of 10 and the average payment per hectare was €307.98, while the average annual payment per farmer under the project was just over €1,722.

Results of evaluation of the measures and monitoring of biodiversity targets support the design of the results-based assessments for the chosen biodiversity targets. There is a significant positive relationship between the assessment score and the biodiversity for the measures. There was for

[1] The views expressed in this report do not necessarily reflect those of the funders

certain measures, some, non-significant, difference in scores and/or biodiversity between 2016 and 2017; due to the relatively short project duration significant changes in the biodiversity targets were not expected.

Attitudinal survey results, in addition to anecdotal information from the project teams' regular interaction with farmers, indicate that farmers find the results-based approach both fair and a meaningful method of farming for conservation.

A large suite of documents accompany this Technical End of Project Synthesis report including a general guidance handbook and for each measure: measure handbooks which act as tools to member states for the development of such measures; scorecards and scoring guidelines; best practice management guidelines to support delivery of the best environmental outcome. Two policy documents have also been produced as outputs in which the use of a range of EU articles and RDP measures are recommended for the delivery of results-based payment schemes.

Introduction

The Results-based Agri-environmental Payment Scheme (RBAPS) project trialled modes of paying farmers for the quality of biodiversity on their farms in three differing pilot locations of County Leitrim and the Shannon Callows (including parts of Counties Galway, Roscommon and Offaly) in Ireland, and the Navarra region of Spain.

These three pilot locations were chosen because they are set within High Nature Value farmland areas and offer contrasting legislative requirements, farming methods, climate and physical challenges. Each region focused on different biodiversity targets. In County Leitrim the focus was on semi-natural grasslands and habitat suitable for the rare marsh fritillary butterfly. Breeding wader habitat, ground nesting birds and flower-rich hay meadows were tested along the Shannon Callows. In Navarra in northern Spain, the results-based payments system was tested in HNV mosaic of traditional vines, almonds and olive cropland.

This document provides a technical summary of the outcomes of the project from project design and implementation, to monitoring and evaluation.

Design and implementation of the biodiversity measures

Selecting biodiversity targets and spatial targeting

Biodiversity targets were selected to reflect legislative requirements and conservation concerns, as well as the potential for the target to respond to agricultural practices. These biodiversity targets also had the potential to be supported under current Agri-environment Climate Measure (AECM) regulations. The selection was also informed by existing biodiversity datasets.

County Leitrim

In the HNV landscape of County Leitrim, species-rich grasslands were chosen to trial a results-based approach, and the marsh fritillary butterfly was identified as a threatened species dependent on extensive farming practices.

County Leitrim Species-rich Grassland

The Species-rich Grassland measure was designed to reward farmers for the quality of species-rich grasslands present on their land. Under this measure the number and cover of plant species which are indicators of good quality grasslands were assessed as part of the scoring system, along with indicators for current habitat condition. Spatial targeting was informed by Ireland's national semi-natural grassland survey (O'Neill *et al.,* 2013) to ensure the measure was trialled on a number of soil types, representative as far as possible of the range of grassland types found in Ireland.

Marsh Fritillary Butterfly Habitat and Species-rich Grassland

The Marsh Fritillary Butterfly Habitat and Species-rich Grassland measure rewarded farmers for the condition of the habitat for marsh fritillary and the number and cover of plant species which are indicators of good quality grasslands. This measure was offered to participants where previous records of marsh fritillary butterfly and sufficient cover of the butterfly's food plant (Devil's-bit Scabious, *Succisa pratensis*) existed.



Plate 1. Species-rich grassland in County Leitrim.

Shannon Callows

The site has a dual designation of both Special Area of Conservation under the Habitats Directive and Special Protection Area under the Birds Directive. The Qualifying Interests (QIs) for the SAC and the Special Conservation Interests (SCIs) for the SPA were given first consideration in the selection of biodiversity targets. Lowland Hay Meadow [6510] and *Molinia* meadow [6410] plant communities are QIs for the SAC. Hydrophilous Tall Herb [6430], an Annex I habitat was also included as a target as it occurs in a mosaic with the other plant communities in the meadows. One of the SCIs of the SPA (corncrake, *Crex crex*) was formerly present but is now locally extinct; another (lapwing *Vanellus vanellus*), although listed as SCI because of its important wintering populations recorded in the site, is included as a biodiversity target as it's breeding population is also of high conservation importance. The project area also includes parts of the River Little Brosna Callows SPA as the SCIs of this site comprise a similar list to the Shannon Callows. In both areas, other birds of high conservation importance and Prioritised Action Framework (PAF) priority species in Ireland include the breeding waders snipe *Gallinago gallinago*, curlew *Numenius arquata* and redshank *Tringa totanus*. Whinchat *Saxicola rubetra,* a ground nesting meadow bird which has undergone severe declines in Ireland was also included as a biodiversity target as the Shannon Callows is a national stronghold for the species.

Shannon Callows Breeding Wader Habitat

The Shannon Callows Breeding Wader Habitat measure rewarded farmers for the quality of breeding wader habitat produced on areas of wet grassland to support breeding populations of lapwing, snipe, curlew and redshank. Result indicators being scored included the vegetation structure, extent and suitability of feeding areas for chicks (wet features) and presence of scrub and trees (which may provide habitat for predators). Spatial targeting for the Breeding Wader measure was based on the areas of highest concentrations of breeding pairs within the project area (derived from the most recent population data). To be eligible for entry into the Breeding Wader measure, plots were required to be grazed by cattle and under this measure, machinery operations at critical periods, inappropriate grazing intensity and planting of trees are discouraged. Also, under this measure non-productive investments (NPI) are undertaken by farmers if/when necessary (and paid for in addition to the area-based payment) as a hybrid model of results-based and action-based payments. The NPI elements of this measure complemented the management actions undertaken by the farmer and were collectively aimed at delivering high quality habitat for breeding waders.

Shannon Callows species-rich floodplain meadow

Under this measure the number and cover of plant species which are indicators of high quality flood meadows were assessed, as were the cover of negative indicators (e.g. agricultural weeds, competitive species and woody plants) and the amount, if any, of damaging activities. Targeting of the species-rich floodplain meadow measure prioritised areas of callow meadows where suitable numbers of participants were eligible.

Shannon Callows species-rich floodplain meadow with ground-nesting birds

This measure rewards farmers for both the protection of ground-nesting birds (GNB) and the quality of species-rich meadows present. This measure was only offered to those farmers participating in the species-rich flood meadow measure (above) when the presence of curlew and /or whinchat was confirmed in that breeding season. Under this measure, the same scoring indicators were used as for the species-rich floodplain meadow measure. Mowing dates were prescribed under this measure, with mowing delayed until after 15th July for curlew and after 26th July for whinchat.

Navarra, Spain

The pilot area in Navarra is located in an upland part of the Mediterranean region. This region is characterised by a heterogeneous farming landscape, comprising numerous small farmed plots, many of which are still managed extensively, and with high boundary and natural vegetation density. The mosaic of land uses in the area (perennial crops - especially those under low-intensity management, cereal crops, pastures and scrublands) creates a landscape of high heterogeneity which supports a wide range of flora and fauna species that are associated with low intensity farming practices. Generally, intensification processes threaten the biodiversity of some of the crop types (in particular, vines and olives), and for others (primarily almonds) abandonment is the main threat, although there is variation and olives and vines may be abandoned on the slopes also.

Biodiversity-related agri-environment approaches in these areas are in general not well developed. Targeting for this pilot focused on the typical mosaic farmed landscape of the municipalities of Viana, Aras and Bargota.

Navarra mosaic perennial crops measure

The overarching biodiversity goal of the project in Navarra is to maintain the biodiversity of the traditional farmed mosaic. The results-based payments under the pilot focus on the small perennial crop plots of olive, almond and vineyard, as these are eligible for AECM payments (open areas of natural vegetation along the hilltops are owned by municipalities and as such do not qualify for either Pillar 1 or Pillar 2 payments) with traditional management supporting high biodiversity. Under this measure assessment indicators relate to herbaceous cover under the crops (including the floral diversity of the cover, as well as the extent and duration of the herbaceous cover), evidence of livestock grazing, cover of scrub, damaging activities, quality of areas of natural vegetation and the condition of natural and built structures.

Setting payment rates

For each of the measures, all known threats (agricultural intensification, conversion to an alternative land-use and abandonment of farming practices) to the biodiversity targets were considered and the associated cost of achieving the target was calculated with respect to each threat separately. The main threats in County Leitrim are conversion to forestry and agricultural intensification; while in the Shannon Callows and in Navarra the main threat to the biodiversity targets is agricultural intensification. In Navarra, conversion to forestry is of decreasing threat in recent years and was not considered in the calculations for the pilot. In the Shannon Callows as alternative land uses are not possible due to flooding and regulation.

Table 1. Summary of threats in each region.

Region	Primary threat	Secondary threat	Tertiary threat
County Leitrim	Conversion to forestry	Intensification	Abandonment
Shannon Callows	Intensification	Abandonment (rare)	-
Navarra, Spain	Intensification	Abandonment	Conversion to forestry (now rare)

For each scenario, the cost of achieving the highest quality biodiversity target possible was calculated based on income forgone and additional costs under the threat of intensification, opportunity costs for conversion to alternative land-use (e.g. forestry) and the full cost of management for abandonment. Forestry in Ireland, in particular, is highly incentivised due to traditional low uptake by the farming community. If the payment cannot compete with the returns from these landuses then it is unlikely to offset threats in the long term, which may undermine the development of a market that rewards the quality of biodiversity.

For three of the measures in the pilot (Leitrim species-rich grassland, Shannon callow species-rich flood meadow and species-rich flood meadow with GNB) the maximum payment rates were initially capped below the level calculated for a number of reasons. In Leitrim the payment level was reduced to incorporate stakeholders' opinions in relation to cost-effectiveness and value for taxpayers' money, and also to maximise the number of participants in the pilot. The basis of the payment rate for species-rich meadows in the Shannon Callows was also influenced downwards by Annex II of Regulation 1305/2013, which sets a €450/ha limit, and further reduced to ensure room for ground nesting bird bonus payments. The payment rates for each of the measures are presented in Table **2**. The decision on final payment rates for this pilot was based on; projected income foregone and (additional) costs incurred, resources available, discussions with stakeholders, value for money, and wider acceptance.

There is sometimes cultural resistance to delivery under a measure even when payments cover potential loss of income and additional costs. Farmers often strive to increase agricultural productivity (with limited success) or simply adhere to familiar practices or are reluctant to try something new due to unfamiliarity and unknown risks. This reluctance may be encountered even when financial gains are possible. Adequate time for farmer engagement (including farmer training and knowledge transfer) is important both to gain the trust of farmers and to ensure that the measure objectives and requirements of the biodiversity target are clearly communicated.

In terms of payment increments for each level of achievement (i.e. score), payments rates for the low-medium quality scores were set at levels sufficient to cover the costs of farmers' participation in the scheme, whilst also incentivising further progression towards delivery of higher quality outputs (Figure 1). The chosen structure aimed to achieve a balance between incentivising farmers to deliver highest possible score in their particular farm setting, while also giving a clear signal that higher quality warrants higher financial reward.

Table 2. Payment rates (Euros per hectare) across each of the RBAPS measures.

	Score	0	1	2	3	4	5	6	7	8	9	10
Leitrim	Leitrim species-rich grasslands	-	-	-	-	€50	€ 110	€ 170	€ 230	€ 280	€ 320	€350
	Leitrim SRG with marsh fritillary	-	-	-	-	€50	€ 110	€ 170	€ 230	€ 280	€ 320	€350
Shannon Callows	Breeding wader habitat	-	€ 43	€ 86	€ 129	€ 172	€ 215	€ 258	€ 301	€ 344	€ 387	€ 430
	Species-rich flood meadows (SRFM)	-	-	-	-	€ 100	€ 160	€ 220	€ 280	€ 330	€ 370	€ 400
	SRFM with curlew	€ 50	€ 50	€ 50	€ 50	€ 150	€ 210	€ 270	€ 330	€ 380	€ 420	€ 450
	SRFM with whinchat[2]	€120	€120	€120	€120	€220	€280	€340	€400	€450	€490	€520
Navarra	Perennial crops	-	-	€ 120	€ 180	€ 240	€ 300	€ 360	€ 420	€ 480	€ 540	€ 600

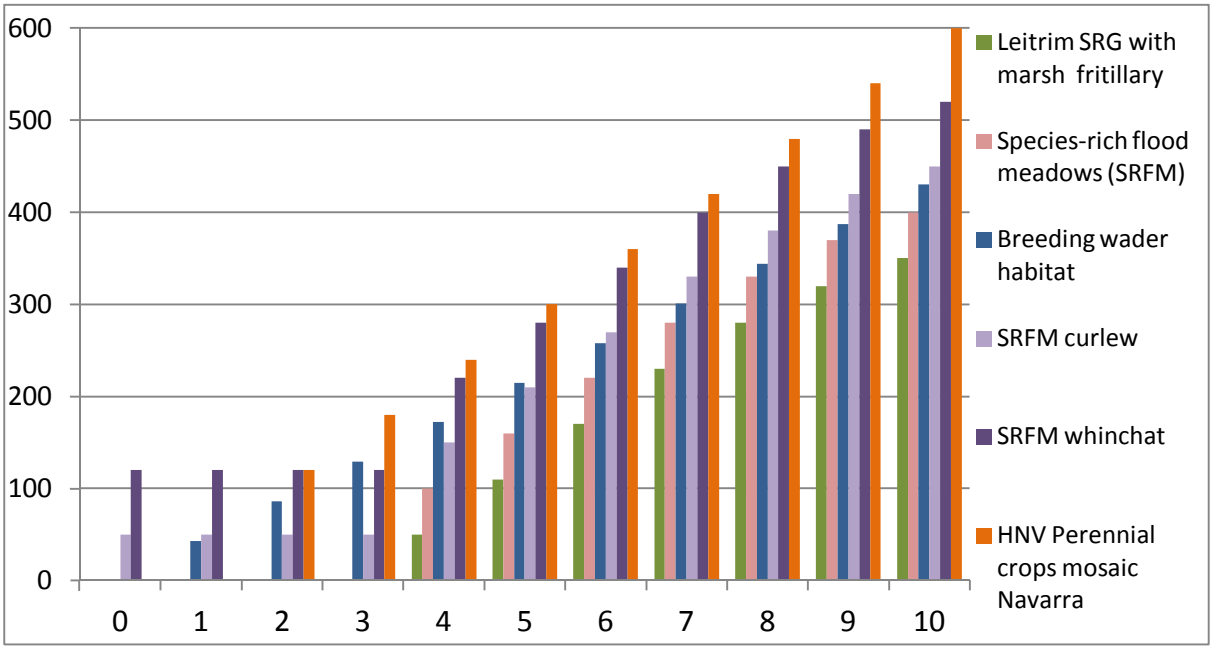


Figure 1. Payment increments per score for each RBAPS measure.

[2] This is the payment rate for whinchat in 2017, which includes the increase of ú70/ha for all scores from 2016.

Payment for results versus payment for non-productive investment (NPI)

The assumption may be made that as farming and biodiversity co-existed in the past, some alteration to the current management the associated biodiversity target can achieve such a co-existence once more. However, in some instances, the wider landscape, environment or culture may have been altered to such an extent that some key features either no longer exist, or occur in degraded form, or are no longer maintained (e.g. dry stone structures). Creation, maintenance, or rehabilitation of these features may benefit the biodiversity target and this requires an initial investment. This is a non-productive investment (NPI) for actions over and above what is covered in the costing of annual results-based payments and their inclusion gives rise to blended/hybrid model of delivery.

The variation in the cost of NPIs in relation to the area based-payments, and the frequency with which the NPI is necessary, are both important in order to produce an equitable and attractive measure, and it is important to keep separate the two types of cost in the payment structure.

An example regarding a species-rich flood meadow is where long-term fertiliser use has resulted in species-poor (low scoring) meadows with depleted seed bank. Adjusting the timing of the mowing of the meadow (or other annual management) is unlikely to benefit poor quality meadows, particularly when they have been of poor quality for a number of years and the seed bank of the soil is also depleted. In this instance, if conservation importance is considered sufficient to justify the additional costs, substantial restorative actions (such as spreading seeds or green hay) may be undertaken to increase the floral diversity of the meadow. In this instance including the cost of this action in annual payments to all participants fails to adequately remunerate the (few) farmers needing to carry out the restoration works and needlessly increases the annual cost of the measure.

Cost-benefit analysis, weighing any potential conservation benefits against the costs of actions, needs to be undertaken in each case. The restoration of species-rich grasslands using green hay as a donor seed source is an example of a considered intervention. The costs of such an action may include harrowing of the recipient site, and the purchase, transport, spreading, turning and re-baling of high-quality green hay from a suitable donor site. This requires initial substantial investment by the farmer and if included in the annual results-based payment may over-pay farmers where these activities are not required. It also may result in the risk that the farmer, where the NPI is required, does not receive the desired signal from the payment mechanism and does not carry out an essential action.

It is essential when including NPI that the farmers fully understand when, where and why they may be appropriate and necessary. Adequate advice and training needs to be provided for the farmer and/or contractor in order to carry out the work in the appropriate way.

Farmer participation

A total of 57 farmers participated in the scheme in Ireland and Spain in 2016 and 2017, entering over 332 hectares of land across 501 land parcels (including enclosed fields and unenclosed plots). Three participants left the Shannon Callows RBAPS in January 2017 to enter the national agri-environmental scheme (Green Low Carbon Agri-environmental Scheme, GLAS) in Ireland. Details of the number of farmers and areas entered under each measure are given in

Table 3 and Figure 2.

Table 3. Details of participant numbers and areas under RBAPS agreements in 2017 with figures for 2016 in brackets. These do not include three farmers that left the scheme in the Shannon Callows in 2017.

(The Navarra measure is separated into the three crops for comparison).

Measure / Region	Number of farmers	Area under agreement (hectares)	Number of fields/plots	Average field/plot size (hectares)
Leitrim species-rich grassland (SRG)	13 (13)	137.81 (121.26)	72 (62)	1.91 (1.96)
Marsh fritillary habitat and SRG	2 (2)	28.74 (14.39)	36 (20)	0.80 (0.72)
County Leitrim total/average	**13 (13) farmers**	**166.55 (135.65) hectares**	**108 (82) fields**	**1.54 (1.65) hectares**
Breeding Wader Habitat	7 (5)	61.35 (29.55)	9 (5)	6.81 (5.91)
Species-rich Flood Meadow	13 (11)	23.94 (18.97)	18 (13)	1.33 (1.46)
SRFM with ground nesting birds	6 (7)	16.44 (13.54)	8 (9)	2.05 (1.05)
Shannon Callows total/average	**22 (18) farmers**	**101.73 (62.06) hectares**	**35 (27) plots**	**2.9 (2.30) hectares**
Navarra Olive	17 (16)	23.83 (21.51)	72 (53)	0.33 (0.41)
Navarra Almond	17 (17)	28.60 (28.60)	47 (47)	0.61 (0.61)
Navarra Vineyards	6 (6)	11.33 (11.33)	15 (15)	0.76 (0.76)
Navarra total/average	**22 (21) farmers**	**63.76 (61.44) hectares**	**134 (115) plots**	**0.48 (0.53) hectares**
RBAPS Ireland and Spain	**57 (52) farmers**	**332.04 (259.15) hectares**	**277 (224) fields/plots**	**1.2 (1.16) hectares**

As would be expected in many HNV landscapes, the plot sizes were relatively small (the average area of land parcels across the three regions was 1.2 ha). The plot size was larger on average for those lands entered to the Breeding Wader Habitat measure and a small number of larger parcels were entered in County Leitrim (Figure 2). The maximum plot size for perennial crops entered in Navarra was 2.97 ha, and the average size was 0.48 ha. It is important to bear in mind that the project focused only on the HNV portion of the farm and that in Navarra and the Shannon Callows in particular the land parcel sizes across the remainder of the farm are likely to be larger.

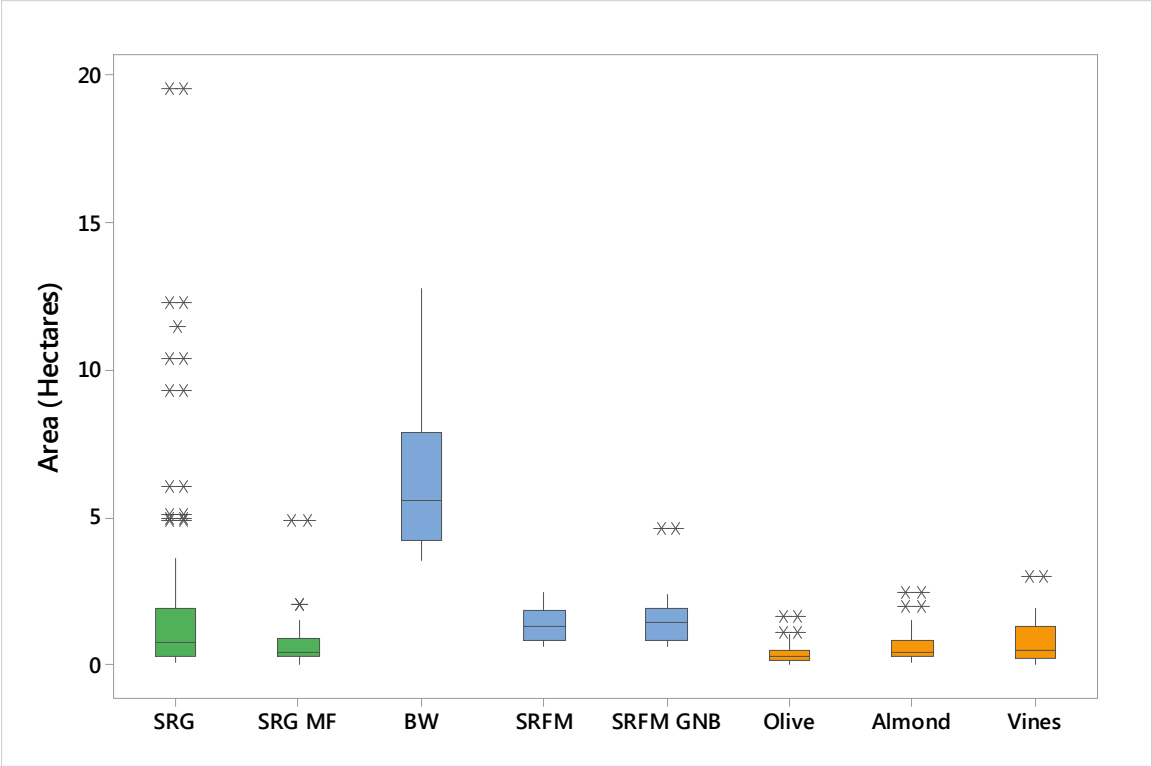


Figure 2. Areas of fields (plots) entered under each of the RBAPS measures in Ireland and Spain in 2016 and 2017. Leitrim: Species Rich Grassland (SRG), n= 134; SRG with Marsh Fritillary Butterfly (SRG MF), n=57; Shannon Callows: Breeding Wader Habitat (BW), n=14; Species Rich Flood Meadow (SRFM), n=30; SRFM with Ground Nesting Bird (SRFM GNB), n=19; Navarra: Olive, n=125; Almond, n=94; Vines, n=30. Each boxplots shows the minimum, maximum and median (horizontal line in each box) value, the 'box' represent the interquartile range (middle 50% of data points) and outliers are marked with asterisks (full explanation of boxplots is provided in Appendix I).

Farmer advice and training

One-to-one liaison

Once contracted to the scheme, members of the RBAPS team met with the participating farmers on a number of occasions. Initial engagement focused on explaining the principles of the measure(s) and also to build trust with the farmers in order to facilitate knowledge sharing and communication over the course of the project.

To inform baselines for evaluations, details on current and past management were gathered informally throughout the year and advice given on best practice for the biodiversity target. Any potential NPIs were agreed and discussed in detail with the farmer and whoever was to carry out the works (if not the farmer themselves) to ensure they would be carried out appropriately. Time resources necessary for this aspect of results-based AECMs are an important consideration, as with action-based measures (particularly those with higher level biodiversity targets). Time resources for this pilot project totalled *c.*2.4 days per farmer per year.

Scoring Guidance documents

In order to deliver to the new biodiversity market a full understanding of the both scoring system and the mechanisms of delivery high quality are required. Guidance documents for farmers, farm advisors, external evaluators, auditors and anyone who may need to understand or use a measure, have been prepared to accompany the scorecards for each of the biodiversity measures, including:

1) Full length guidance document for carrying out field assessments (scoring). This provides photographic plates to illustrate each of the positive and negative indicator species (if applicable) and all thresholds for assessment indicators with full explanations for each category.
2) Brief technical summary of guidance document (for quick reference, i.e. in the field).
3) A coloured identification guide (tractor cab guide) with coloured pictures of positive and negative indicator species and thresholds with minimal text included.

Best practice management guidance documents

Once the farmers understand how the scoring system works they then need to understand the management practices which will deliver the best results for the biodiversity target. Guidance documents for best practice management of the biodiversity targets have been developed for farmers as guidance to achieving the highest quality outputs.

The scoring guidelines and best practice management guidelines for each measure are available on the RBAPS project website[3].

Training and feedback

One-day classroom and field-based workshops were held for participating farmers for each of the biodiversity measures (see Plate 2) in both 2016 and 2017. These workshops included an introduction to results-based schemes, an overview of the other regions in the pilot project and each of their measures, as well as a description of how the assessment process for the measure relevant to them was developed. A very important element of the training days has been the opportunity for farmers in the scheme to meet and share their views on participation in the pilot with each other. This 'peer-to-peer' interface is considered an important element in roll-out, whereby the knowledge of how to achieve the best scores can be shared among farmers. Farmer views on each of the results-based scoring systems and on the training provided was evaluated.

Overall, the participants expressed a lot of interest in the various measures and most participated willingly and openly at the farmer training events, with some requesting additional training as they found it both helpful and enjoyable. However, despite their interest, many of the participating farmers were reluctant to submit their own scores ahead of payments. This was due to both a lack of confidence in correctly assessing individual result indicators (e.g. identifying plant species) and a concern that incorrectly scoring their site may negatively impact upon their payment rate. For those who had difficulty attending training, it was mainly due to off-farm work commitments and additional days were arranged to facilitate them, with evening time suiting many farmers better. On roll-out of a larger scale scheme with mandatory attendance at training events, it is anticipated that fewer requests for alternative times would be made. An increased understanding was evident in 2017, both in the scoring system and the management desirable to achieve high quality results (including the need for NPI). In some instances more accurate scores were submitted in 2017 compared to 2016, however, having been provided with the breakdown of their score in 2016, the increased accuracy in 2017 may in some cases reflect the possibility for farmers to submit the verified 2016 score on their 2017 scorecard.

[3] Project web-site: www.rbaps.eu/documents



Plate 2. Participating farmers at training event in Navarra.

Although the overwhelming majority of Irish farmers use the services of a farm advisor in some capacity (a comparable farm advisor role does not exist in Navarra) and indeed this is a requirement of the national agri-environment scheme-GLAS), the project assessed the ease with which farmers could assess and score their own fields. This proved a useful training tool in engaging farmers in fully understanding both the scoring system and the management required to improve the biodiversity target. Increased understanding has the potential to increase the effectiveness of any measure on roll-out.

Sufficient time needs to be factored in, to ensure farmers can gain familiarity with agri-environment schemes in general (if they are not already familiar with them), and to gain an understanding of results-based schemes in particular. There are a number of factors that contribute to the amount of time needed: meeting new people (including the RBAPS team and other participants), becoming familiar with details of measure(s), digesting any general advice and best practice guidelines. Talking with other farmers in their area is an important part of the process, allowing them to learn from what was done already, and helping to make unfamiliar practices (i.e. NPIs for conservation rather than agricultural benefit) more acceptable. One training day is not sufficient to communicate everything, at least not in the first year. Both time and patience are required and it is suggested that two staggered training days are required in the first year in particular, one for general information and familiarisation and a second day to cover specific measures.

Payments for farmers' time

It also needs to be considered whether costs for participation in training should be factored in as an additional payment. Acknowledging the importance of farmers' time can be done in a number of ways *i.e.* through separate payments or incorporation into transaction costs in annual payment calculation. It was demonstrated in the pilot under the Species-Rich Flood Meadow Measure where total farmers payments were low (due to small average plot size of 1.5 ha, and low number of eligible plots per farm, typically only one or two plots) that annual payment transaction costs would only cover a couple of hours of the farmers' time. To acknowledge this, meadow-only farmers were paid a flat rate of €100 (calculated at €12.50/hour for 8 hours) to cover additional participation time. On roll-out farmers would typically enter more lands into a scheme and the issue would be less pronounced, nonetheless adding a percentage transaction cost for this may underpay certain farmers with low payments and overpay others with high payments. Offering a choice of days, times and local venues can assist in keeping costs down for farmers (e.g. through loss of off-farm earnings to attend training events).

Farmer payments

Total spending on farmer contract for 2016 and 2017 was €187,956.08 of the €240,000 initially allocated, including €72,748.2 in Leitrim, €58,870.53 in the Shannon Callows and €56,761.24 in Navarra (Figure 3). The average payment per participant was highest in Leitrim at €2,798 where the average field size was 1.59 ha and the average score per field was 6.9. In the Shannon Callows, the average payment per participant was €1,471.76 while the average plot size was 2.61 ha and the average score was 7.2. In Navarra, the average payment per participant was €1,214.97 in 2016, and €1,207.58 in 2017 (payment only related to scores) , where the average plot size was 0.53 in 2016 and 0.48 in 2016, and the average score was 6.4 in 2016 and 6.0 in 2017.

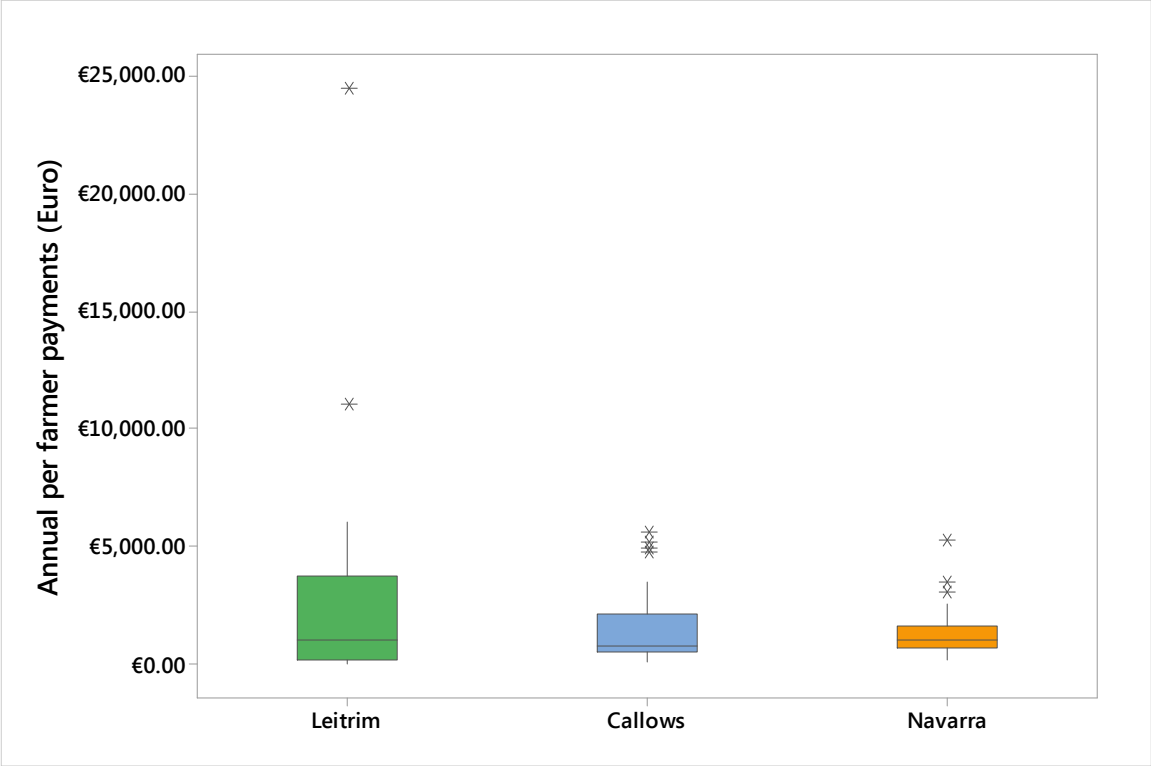


Figure 3. Range of payment levels to participants (including NPI payments) in the three pilot areas in 2016 and 2017. Leitrim, n=26 (13x2); Shannon Callows, n=40; Navarra, n=43.

Across the 501 land parcels under contract in 2016 and 2017 the average score was 6.4 out of 10 and the average payment per hectare was €307.98. For most of the measures being trialled, land parcels with a broad range of scores have been included in the pilot (**Figure 4**) reflects the fact that payments are limited to sites where the butterfly (the best assessor of its own needs) has been present in recent years and that the species chooses only high quality wet grasslands which attracts high scores under the result indicators. The occurrence of the butterfly on high scoring grasslands

(see Plate 3) supports the hypothesis that paying for habitat for the Marsh Fritillary butterfly offers good value for money to the taxpayer through the co-delivery of species-rich grassland.

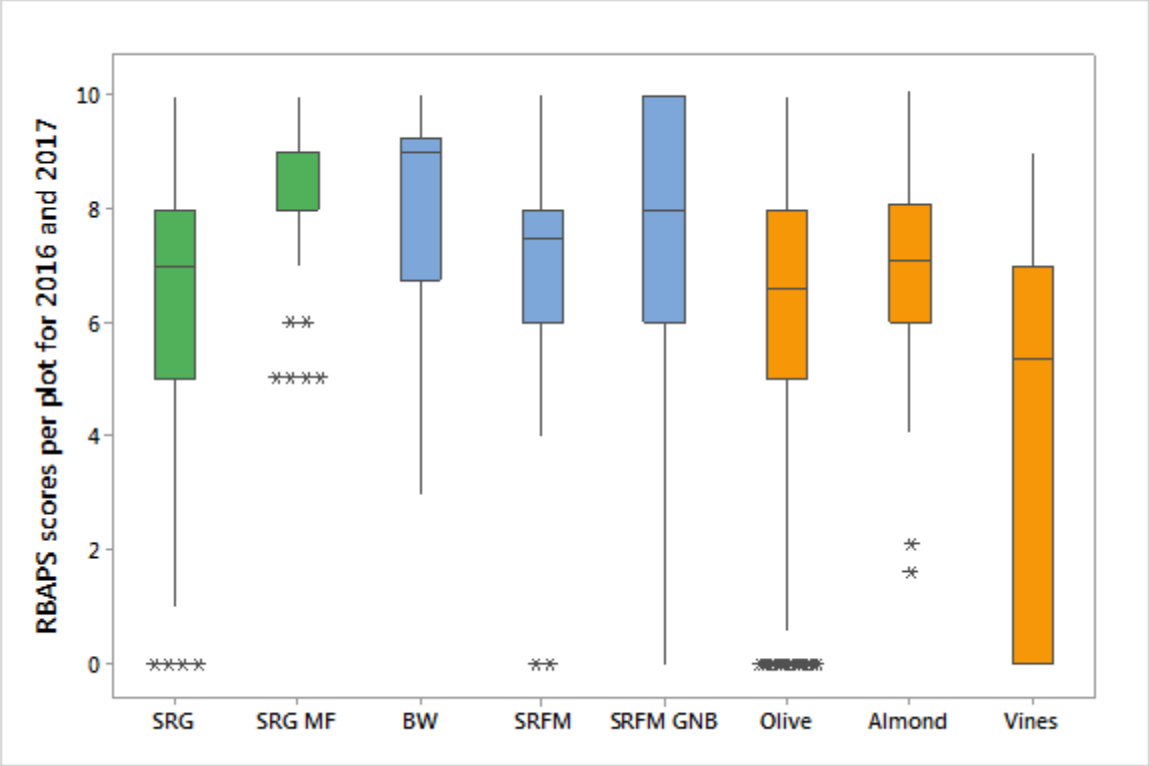


Figure 4. Range of scores assessed in 2016 and 2017 across the RBAPS measures in Ireland and Spain. Leitrim: Species Rich Grassland (SRG), n= 134; SRG with Marsh Fritillary Butterfly (SRG MF), n=57; Shannon Callows: Breeding Wader Habitat (BW), n=14; Species Rich Flood Meadow (SRFM), n=30; SRFM with Ground Nesting Bird (SRFM GNB), n=19; Navarra: Olive, n=125; Almond, n=94; Vines, n=30. Each boxplots shows the minimum, maximum and median (horizontal line in each box) value, the 'box' represent the interquartile range (middle 50% of data points) and outliers are marked with asterisks.



Plate 3. Marsh fritillary butterfly habitat, with ample food plant devil's-bit scabious in flower

Spend on Non-Productive Investments (NPI)

The payments per hectare illustrated in Figure 5 include payments for NPI payments (under the Shannon Callows breeding wader habitat measure, the Shannon Callows species-rich flood meadow measure and each of the perennial crops in Navarra). Table 4 gives an overview of the breakdown of payments in the Shannon Callows in terms of results-based payments and payments for non-productive investments.

Table 4. Overview of payments for results-based payments, non-productive investments and their relative % of the total spend in the Shannon Callows for 2016 and 2017.

RBAPS option	Total Result-based spend (Euro)	Total spend (Euro) on Non-productive investment	Total spend (percentage of spend on that measure)
Breeding wader habitat (BWH)	**€32,173.53**	**€2,940.00**	**€35,113.53**
Percentage of BWH spend	*91.63%*	*8.37%*	*100.00%*
Species-rich floodplain meadow (SRFM)	**€10,474.00**	**€150.00**	**€10,624.00**
Percentage of SRFM spend	*98.59%*	*1.41%*	*100.00%*
SRFM with ground nesting birds (SRFM-GNB)	**€12,866.60**	**€266.40**	**€13,133.00**
Percentage of SRFM-GNB spend	*97.97%*	*2.03%*	*100.00%*

In 2017, in Navarra three farmers undertook NPIs amounting to €4,680 (15.18%) of the €30,823 spent in 2017 (no NPI were undertaken in Navarra in 2016). NPIs undertaken n 2017 included:

- Farmer 1: hut construction in an olive plot, costing €2,000 (funding was capped at €2,000 per plot).
- Farmer 2: hut repair in a vineyard, costing €2,000.
- Farmer 3: scrub clearing (1.67 ha) on five almond plots costing €590.04 (funded at 80%) and adding three nest boxes in the almond plot, at a total cost of €90 (3 x €30).



Plate 4. New hut constructed under the RBAPS project in Navarra in 2017, which the farmer will store farm implements used for carrying out low intensity farming practices on the farm that benefit biodiversity.

Some NPIs, such as scrub removal, were proposed for County Leitrim in 2016 but farmers chose not to undertake them for a range of reasons including, physical inability, lack of equipment, lack of trained and insured contractors, and wanting to adhere to existing farm management.

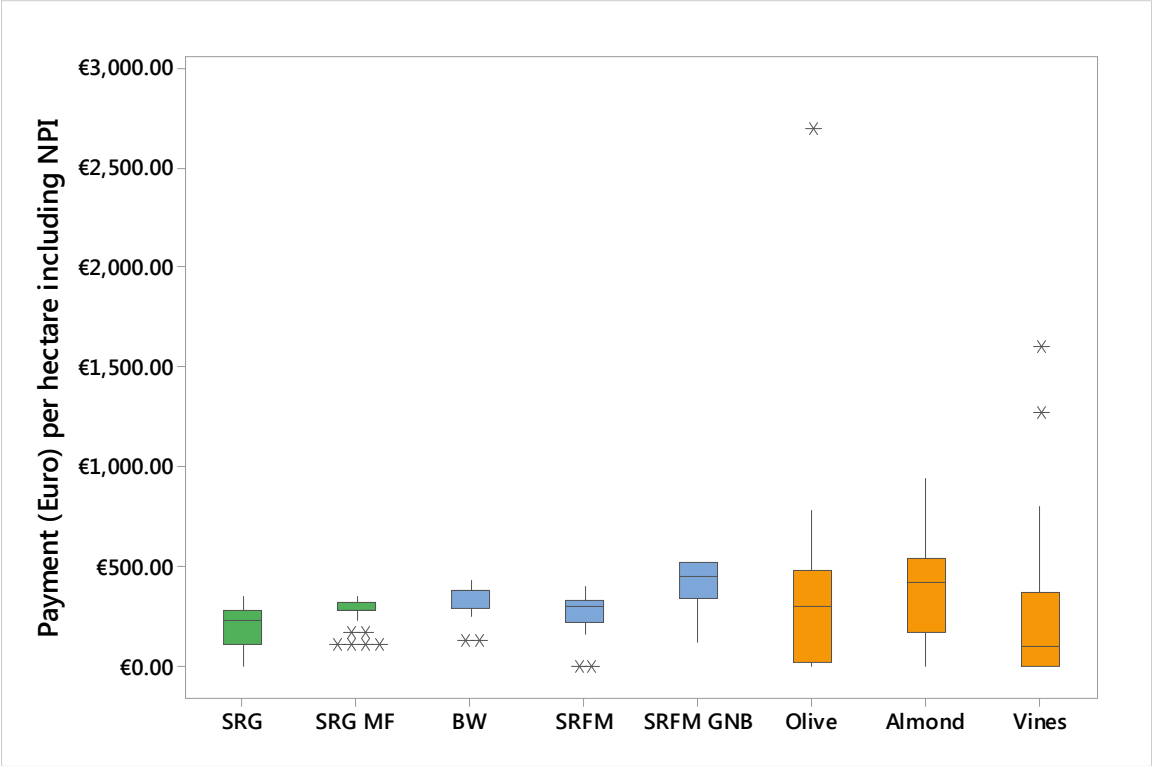


Figure 5. Ranges in payments made per hectare including Non-Productive Investments (NPI) for the fields/plots entered in RBAPS in 2016 and 2017. Leitrim: Species Rich Grassland (SRG), n= 134; SRG with Marsh Fritillary Butterfly (SRG MF), n=57; Shannon Callows: Breeding Wader Habitat (BW), n=14; Species Rich Flood Meadow (SRFM), n=30; SRFM with Ground Nesting Bird (SRFM GNB), n=19; Navarra: Olive, n=125; Almond, n=94; Vines, n=30. Each boxplots shows the minimum, maximum and median (horizontal line in each box) value, the 'box' represent the interquartile range (middle 50% of data points) and outliers are marked with asterisks.

Monitoring and evaluation of the measures and biodiversity targets

Evaluation of the measures

Farm advisors

For the roll-out of any AECM (including RBAPS) to be successful, it is important that the farm advisory services are able to implement it competently. In Ireland, as part of the RBAPS project a half day of training and a half day of subsequent assessments were carried out for each measure (see Plate 5).

The results obtained by the farm advisors (relative to those assessed by the RBAPS team) vary between and within measures. There is variation in the skill sets of agricultural advisors engaged to carry out the evaluations, with some having no difficulty in the identification of the positive indicator plants and others being familiar with only two or three species.

Generally, the farm advisors indicated that they found the scoring systems easy to understand but would need more training and practice in order to feel confident to assess such measures at field level. Due to time constraints, only a small number of sites were visited as part of the training. For comprehensive training, a range of scores and issues would need to be experienced and discussed.



Plate 5. RBAPS project ecologist (left) and farm advisors discussing RBAPS field assessments, County Leitrim.

Process on roll-out

The process should involve a suitably skilled farm advisor walking the land with the farmer both to get familiar with the farm and to explain the process and the scoring system to the farmer. The farm advisor at this point advises the farmer on best practice for obtaining the best quality biodiversity output(s) and highlight any potential problems that may lower the farmers score. In the first year of a scheme this process needs to be sufficiently resourced to ensure that the farm advisor is fully familiar with the farm and that the farmer fully understands both what (s)he is being asked to deliver and how best (s)he can do so. The advisor returns at the appropriate time of year (typically, during the summer) to score the fields, ideally in tandem with the farmer. More time is necessary in the first year of a results-based AECM (as with any AECM) to ensure adequate familiarity with the process and details of the measures from the outset.

There are farm advisory services in place in Ireland but, for a results-based approach to be widely and successfully implemented, it would be necessary to improve the ecological skills of advisors. We recommend at least two days of training in small groups for each separate measure (where similarities occur between measures, time may be reduced), with indoor and field sessions (across a range of sites). Refresher training would need to be carried out each year of contracts also, typically one day per measure per year.

RBAPS is more challenging to roll-out in regions with no comprehensive AE advisory service available to farmers, which would be the case for any AE scheme with higher level biodiversity targets. In Navarra the role of agri-environmental scheme farm advisor does not exist *per se*, and such a service could be addressed to GAN due to its experience in this topic. In Navarra, GAN has provided advice in relation to the application of agri-environment measures working directly with the farmers in "agri-environment measures for steppe birds" and it has a long experience in this topic. It provides advice to the Government of Navarra related with agri-environment measures, biodiversity, Natura 2000, HNV systems, etc. For that reason, GAN, or a similarly resourced organisation, could be a good reference to develop the role of agri-environmental scheme farm advisor.

External Evaluations

Ireland

In both 2016 and 2017, HNVS (Sharon Parr, Burren Programme) evaluated the measures being delivered in Ireland from both an ecological and administrative perspective, with particular emphasis on how it might be open to misinterpretation by farmers, advisors and auditors. These evaluations involved scoring plots under RBAPS agreements and evaluating the guidelines for administering the measures. This included extensive feedback on the structure of the scoring system and the associated guidelines. All scorecards and associated guidelines for scoring each measure were subsequently revised to incorporate the feedback received, which related primarily to technical details regarding the definition of thresholds and clarification of language used communicate in the scoring and best practice guidelines.

Spain

External evaluation was completed in Navarra in 2017 only. Four evaluators were involved in the assessment of the measure in Navarra in 2017. The four external evaluators belong to different organizations: 1 member of the Department for Agriculture. Plans and Program Section of the regional Government; 2 members of both the most important agrarian unions of Navarre: one from Unión de Agricultores y Ganaderos de Navarra (UAGN) and another from Euskal Herriko Nekazarien Elkartasuna (EHNE); and 1 independent environmental consultant.

The four evaluators were provided with one day of training and then asked to independently assess some plots. The information collected included 14 scorecards from 6 different plots (3 plots of almond trees, 2 olive groves and 1 old vineyard).

In general, the external evaluators' score was an average of 2 points lower than the RBAPS staff score. Although the results suggest that a single day of training can provide external evaluators with a strong understanding of the scoring system and that the measure is easy to apply, to improve their confidence in making the assessment and their scoring accuracy additional training events are recommended.

Financial monitoring and budgetary control

Baseline economic questionnaires were carried out, which examined income from farming, direct costs, and contribution of direct payments and subsidies in 2015 and again in 2018.

County Leitrim

All of the 13 participant farmers in Leitrim receive agricultural subsidies in the form of Basic Payment and Area of Natural Constraints payments. The majority of farmers indicate weekly working hours of 18 to over 36 hours on their farms of which over half have assistance from family or hired help. Five farmers are full-time farmers for whom the farm provides 90-100% of the farm income. The remainder have off-farm jobs for a small number it forms 25-50% of net income. The farming-related income is derived primarily from direct payments and selling of farm products (primarily livestock and wool). Estimated annual farm costs range from ú2,500 to ú27,000 and include supplementary feeds, machinery, maintenance and construction of farm buildings, veterinary bills and agrochemicals. Five of the thirteen participants were enrolled in national agri-environment schemes.

Shannon Callows

A total of 18 farmers participated in the Shannon Callows Species Rich Flood Meadow measure. All of the farmers are in receipt of payments through the Basic Payment Scheme (BPS). The Area of Natural Constraints scheme (ANC) is paid to 12 of the 18 farmers, while two are in receipt of payments for forestry and one is in receipt of another, unspecified payment. Half of the farmers are in receipt of an off-farm income, including farm assist, pensions as well as off-farm jobs. The majority of farmers indicated that direct payments and farm income accounted for less than 50% of the total household income. A total of eight farmers worked in excess of 36 hours per week on the farm. One is assisted by a family member who also contributes over 36 hours per week. There are eight farmers working less than 17 hours per week on the farm, four of whom spend less than 9 hours per week on the farm. There are three family members involved with the farming enterprise. The average costs (in running the farm enterprise) per hectare is €390, however the costs associated with veterinary, machinery etc is much higher than for supplementary feeds and agrochemicals, €245 versus €145. The highest recorded total costs per hectare is €1124.

A total of 4 farmers participated in the Shannon Callows Breeding Wader measure. All farmers are in receipt of payments through the Basic Payment Scheme (BPS). Also, all farmers receive payments under the Area of Natural Constraints scheme (ANC). Only one is in receipt of payments through an agri-environment scheme. Only one farmer has an off-farm job; however two farmers have another source of income (pensions). Three of the farmers indicated the farm generated less than 25% of the household income, while one farmer suggested it contributed between 90% and 100%. Two farmers spend more than 36 hours per week on average working on the farm. One farmer spends between 18 and 26 hours working on the farm while one farmer spends no time working on the farm. Another family member is involved on three farms, this assistance amounts to less than 9 hours per week on two farms and between 9 and 17 hours per week on one farm. The average costs (in running the farm enterprise) per hectare is €751, however the costs associated with veterinary,

machinery etc is much higher than for supplementary feeds and agrochemicals, €472 versus €279. The highest recorded total costs per hectare is €1737, the lowest €130.

Navarra

In Navarra, most of the 22 participating farms comprise mixed crops of cereals, vineyards and olive and almond trees. Farmers generally had an off-farm job or receive state payments, e.g. retirement pension, and have received funds from CAP related to Basic Payment Scheme in the previous year. In general, they work more than 36 hours on their farms. Most farm expenses are related to fertilizers, phyto-sanitary products, pruning and other actions, harvesting and agricultural machinery. These farms produce grapes, olives, almonds and cereals.

Monitoring of the biodiversity targets and evaluating the measures

Summaries of the monitoring sites, monitoring taxa and methodologies, results and conclusions are synthesised in the sections below with additional detail on each pilot area given in separate end of project reports. In the following sections, we present background information then results on the evaluation questions, including: Have there been any changes in the status of the biodiversity target?; To what extent can changes in the biodiversity target, if any, be attributed to the RBAPS option?; and Does the current scoring system suitably reflect the quality of the biodiversity target present?.

County Leitrim

Species-rich grasslands

The species-rich grassland measure is designed to support the delivery of a range of species associated with good quality, species-rich grasslands. To evaluate this measure, data were gathered covering a number of taxonomic groups indicative of high quality grassland, namely plants, invertebrates (butterflies, ground beetles) and birds.

Marsh fritillary butterfly wet grassland and mosaic habitat

This measure is designed to support the delivery of both marsh fritillary habitat and a range of species associated with good quality species-rich grasslands. To evaluate this measure, data from surveys of marsh fritillary larval webs along with a number of groups indicative of good quality grasslands were gathered (as above: for plants, invertebrates and birds).

Across County Leitrim, baseline surveys were undertaken on 30 monitoring plots (19 control and 11 RBAPS) for vegetation, birds and invertebrates (butterflies and Carabidae), covering a total of *c.*120ha: surveys were carried out in either 2016 or 2017, using standard methodologies. Stratified sampling design was employed to survey a) the four Irish grassland types – hay meadow, acid, calcareous and wet grassland, b) sample vegetation within marsh fritillary habitat and c) to encompass the range of RBAPS scores. Control sites were selected to be within 10km radius of land in RBAPS, but not contiguous to such land. Due to the very short time period between start and end of scheme surveys (1 year in effect), repeat surveys to analyse impacts of scheme enrolment were carried out for birds (13 plots following the stratified sampling design) and mash fritillary populations (via web count on nine plots). Additional details are summarised in Table 5.

Table 5. Monitoring details in County Leitrim

Measure	Specific biodiversity target	Indicators used for scoring the field	Monitoring & evaluation indicators	Survey methodology	Scoring assessment	Scheme impact
Species-rich grassland in Leitrim	Plants, invertebrates, birds and wider biodiversity associated with species-rich grasslands	- Positive indicator plants (number and cover) - Negative indicator plants - Sward structure for general invertebrates - Plant litter level - Level of encroaching scrub - Cover of bracken - Damaging activities to vegetation, soil or water	**Birds:** abundance & species richness	Two surveys per plots recording all birds	30 plots – 19 control 11 RBAPS Includes both species-rich grassland and marsh fritillary grassland/mosaic plots across the scoring range to assess how the scoring assessment for wider grassland biodiversity correlates with the selected results indicators	13 plots - 7 control 6 RBAPS Birds only, surveyed at start and end of project (2016 versus 2017)
			Vascular plant species presence and cover	Four 2 x 2m^2 quadrats per field		
			Pollinators: butterfly richness and abundance	Two surveys per plot along two field transects recording all butterflies		
			Invertebrates: Carabid beetle richness and abundance	Two sets of three pitfall traps in fields below 10ha in size (three sets in > 10ha)		
Marsh fritillary butterfly habitat (species-rich grassland/mosaic habitat)	Marsh fritillary butterfly populations ***and*** plant, invertebrate, bird and wider biodiversity associated with species-rich grassland	- Positive indicator plants (number and cover) - Negative indicator plants - *Sward structure for marsh fritillary* - Plant litter level - Level of encroaching scrub - Cover of bracken - Damaging activities to vegetation, soil or water	**Marsh Fritillary** larval webs (to provide precise information on breeding areas)	Complete site search for webs on sites <1ha; sample transect on sites >1ha		9 plots - 5 RBAPS 4 control Marsh fritillary larval webs only, surveyed at start and end of project

Shannon Callows

Breeding wader habitat measure

The Shannon Callows breeding wader habitat measure is designed to deliver breeding wader habitat. To evaluate this measure, all plots (management units) were surveyed for incubating birds from a distance before entering the site. Each management unit was then walked to within 100m of all points. All waders present were recorded on a site map, including the number of adults with or without chicks (or behaving as if with chicks), as well as other indicators of breeding behaviour. Where present, the number and location of chicks and their growth stage (according to standardised criteria) were recorded. An estimate was then made of the minimum number of broods present, based on the number and location of adults with chicks (and/or adults behaving as if with chicks). These data provide information on the number of breeding pairs and their success/productivity within RBAPS and control sites. Surveys were carried out on all nine management units entered under RBAPS contracts and on nine control sites.

Species-rich flood meadows

The species-rich flood meadow measure is designed to support the delivery of good quality species-rich plant communities (including Annex I Lowland Hay Meadows [6510], *Molinia* meadows [6410] and Hydrophilous tall herb [6430] plant communities). To evaluate this measure, plant relevé data were analysed to determine correlations with overall plant diversity and Annex I habitats. Annex Result indicators as defined in the Irish Semi-Natural Grassland Survey were used for this analysis. A number of biodiversity indices were also included in the analyses as well as surrogates for environmental measurements (*i.e*. Ellenberg indices).

Monitoring of plant communities on Shannon Callows Species-rich Floodplain Meadow was carried out across 14 monitoring meadow plots in 2016, monitoring was repeated on 11 of these sites in 2017 (three sites were mown before monitoring could be completed) and an additional 5 sites were surveyed in 2017 ahead of proposed green-hay strewing in 2017. At each monitoring site four relevés were recorded in each meadow plot noting the percentage cover of each species within a 2m x 2m quadrat (see Plate 6). Percentage cover of vascular plants, forbs, graminoids, bare soil, open water and litter were also recorded for each relevé. Additional details are summarised inTable 6. Monitoring details in the Shannon Callows..

Relevé data was analysed to explore any possible similarity with Annex I grassland and associated habitats, namely Lowland Hay Meadows [6510], *Molinia* meadows [6410] and Hydrophilous tall herb [6430] plant communities. Annex I assessment criteria used in this analysis follows the Irish Semi-Natural Grassland Survey[4]

[4] https://www.npws.ie/sites/default/files/publications/pdf/IWM-78-Irish-semi-natural-grassland-survey.pdf



Plate 6. Plant monitoring unit (2m x 2m quadrat) in a flood meadow on Shannon Callows

Shannon Callows species-rich flood meadow with ground-nesting birds

The Species-rich flood meadow measure is designed to support the delivery of good quality species-rich plant communities and protection of threatened ground-nesting birds. The same evaluation is carried out as per species-rich flood meadow measure. Since bird surveys were used to determine entry to the measure, the presence of the bird (or breeding territory) is guaranteed.

In 2016, five pairs of whinchat were recorded, three were confirmed breeding (with between 1 and 3 fledglings produced per pair) and two were recorded as probable breeders (no fledglings were observed). In 2017, a total of eight plots, owned by six different farmers were offered the option of delayed mowing for the benefit of whinchat and/or curlew see Table 13). These eight plots qualified by having breeding whinchat and/or curlew, or falling within the breeding territory of whinchat and/or curlew. All eight sites qualified due to the presence of whinchat, although three of these also qualified for curlew.

Table 6. Monitoring details in the Shannon Callows.

Measure	Specific biodiversity target	Indicators used for scoring field	Number of monitoring units (MU)	Monitoring and evaluation indicators	Survey methodology
Breeding wader habitat on Shannon Callows	Curlew, Snipe, Redshank and Lapwing	- Sward height - Tussock coverage - Rush cover - Condition of wet features - Level of scrub encroachment and predator habitat	16 MU 9 RBAPS MU 9 Control MU	Breeding wader bird populations, breeding success and productivity.	Up to 6 surveys per management unit, with each walked to within 100m of all points
Species-rich floodplain meadow on Shannon Callows	Lowland hay meadow, *Molinia* meadow (Qualifying Interests for SAC), and Hydrophilous tall herb	- Positive indicator plants (number and cover) - Negative indicator plants - Level of encroaching scrub and plant litter - Damaging activities to vegetation, soil or water	14 MU 8 RBAPS 6 control	**Plant** community quality including Annex I assessments **Bird populations** (incl. surveys for whinchat, and curlew to determine eligibility for SRFM-GNB)	**Plants:** Four 4m^2 quadrats per plot **Birds:** Up to five surveys per meadow
Species-rich floodplain meadow with threatened GNB on Shannon Callows	Lowland hay meadow, *Molinia* meadow, Hydrophilous tall herb AND presence of rare GNB[5]	- Presence of Whinchat and/or Curlew - Positive indicator plants (number and cover) - Negative indicator plants - Level of encroaching scrub and plant litter - Damaging activities to vegetation, soil or water	6 MU	**Plant** community quality including Annex I assessments **Numbers of Whinchat and/or curlew**	**Plants:** Four 2m x 2m quadrats per plot **Birds:** Up to five surveys per meadow

[5] Ground-nesting bird

Navarra, Spain

In Navarra the biodiversity target is the biodiversity of the mosaic of perennial crops of almond, olive and vines. In order to evaluate this measure, surveys were carried out for a number of flora and fauna groups, examining mammal diversity, bird abundance and insect biomass (both discontinued in 2017 due to lack to correlation with biodiversity output at plot scale), butterfly abundance, grasshopper and dragonfly abundance, reptile species richness, plant species richness and, presence and abundance of endangered flora species (survey details are summarised in Table 7).

The monitoring of the biodiversity target indicators has been done in a sample of 21 management units: 9 RBAPS plots (3 almonds groves, 3 olive groves and 3 vineyards) and 12 non-RBAPS plots (6 almonds groves, of which 3 are abandoned, 3 olive groves and 3 vineyards) that act as control plots.

The management units that were selected for the monitoring fulfilled a number of selection criteria, which were defined in order to avoid, insofar as possible, the influence of environmental, physical, and other external factors on the results. All the selected units were non-abandoned crops (except for the 3 abandoned plots of almond trees), old crops, with a size within the range of the average plus or minus the standard deviation of the total plots included in the project, they were located in sunny orientations (all orientations except for North, North-East and North-West), they were used by different farmers, and they were separated among each other by a distance of at least 100 meters.

In the 21 selected plots, 4 relevés have been recorded in order to carry out both biodiversity estimates and plant community analysis. Three relevés were recorded in each of the 21 plots (63 relevés in total, in June 2016 and in June-July 2017).

The data recorded for each relevé was: identification of vascular and non-vascular species within the frame; cover of species and other elements (bare soil, rock, leaf litter, water surface) using DOMIN scale; estimate of median grass and forb height; slope and aspect; topography, altitude; assessment of any impacts acting on the vegetation; and digital photographs of the relevé.



Plate 7. The RBAPS team in Navarra discussing monitoring indicator selection

Table 7. Summary of monitoring and evaluation indicators for each measure

Measure	Specific biodiversity target	Indicators used for scoring field	Number of monitoring units	Monitoring and evaluation indicators	Survey methodology
Perennial crop mosaic in Navarra	Wider biodiversity of perennial crops and the mosaic landscape	- Quality of herbaceous cover: o species richness of cover o area of plot covered o duration of herbaceous cover - Evidence of livestock grazing - Scrub cover - Damaging activities - Quality of areas of natural vegetation - Condition of natural and built structures	21 MU	- Plants - Invertebrates o butterflies o dragonflies o grasshoppers - Reptiles - Mammals	Three 4m^2 quadrats per plot One butterfly transect per plot One reptile transect per plot One mammal transect per plot

Results

In this report we present results for certain aspects of the evaluation of the measures. We include analysis on the relationship between RBAPS scores and quality of the biodiversity target of that measure, as well as some comparisons of the management units (fields/plots) under RBAPS agreements with the control units and present some finding on comparison of 2016 with 2017 data.

County Leitrim

RBAPS versus Control in 2016 and 2017 in Co. Leitrim

Bird richness and diversity of ground-nesting grassland and field boundary birds were surveyed on 13 monitoring sites (6 enrolled in RBAPS (both measures) and 7 control sites) and the data analysed to ascertain potential impacts from scheme enrolment. RBAPS scores of both control and enrolled sites generally stayed static over the monitoring period and the mean RBAPS score (x = 8.3 ±1.2 S.D.) was not significantly different to the control sites (x = 5.6 ±1.9 S.D.) at the start or end of the project.

At the landscape scale, 33 typical farmland bird species of the region were recorded. The low diversity (5 species or less) and abundance of grassland birds was noteworthy, with only meadow pipit *Anthus pratensis*, an Amber list species, being frequently encountered and abundant. No significant correlations were found between the diversity of grassland ground-nesting bird species and either interior primary or secondary habitat features in the plots. Given the low population size of grassland birds and lack of correlation with field quality, as a group they appear to be unsuitable in County Leitrim as a monitoring proxy for achievement of the general species-rich grassland target. They could however, play a role as part of wider bird species monitoring in assessing landscape scale measure effectiveness. Field boundary bird richness was higher, indicating that the linear boundaries are of prime importance for birds in this HNV landscape. Willow warbler *Phylloscopus trochilus* was the most frequently recorded and most abundant bird along the field boundaries, noted in 10 of the 13 sites.

Table 8. Mann Whitney U test of monitoring sites enrolled in RBAPS versus control monitoring sites (n=13) for observed number of species (Sobs) and abundance of birds at start (2016) and end (2017) of the pilot scheme

	Grassland birds		Hedgerow & grassland birds	
	U	*P*	U	*p*
S_{obs} RBAPS 2016 v Control 2016	18	*0.731*	18.5	*0.731*
S_{obs} RBAPS 2017 v Control 2017	20	*0.945*	19	*0.836*
Abundance RBAPS 2016 v Control 2016	20	*0.945*	20.5	*0.945*
Abundance RBAPS 2017 v Control 2017	18.5	*0.731*	20	*0.945*

No significant differences in the grassland or grassland/field boundary bird species richness (S_{obs}) or abundance were found between the RBAPS and control plots at the start or end of the scheme (Table 8). Therefore, there was no significant impact of enrolment in RBAPS measures on bird

species, although this finding must be viewed with caution in the context of the very short timeframe between surveys.

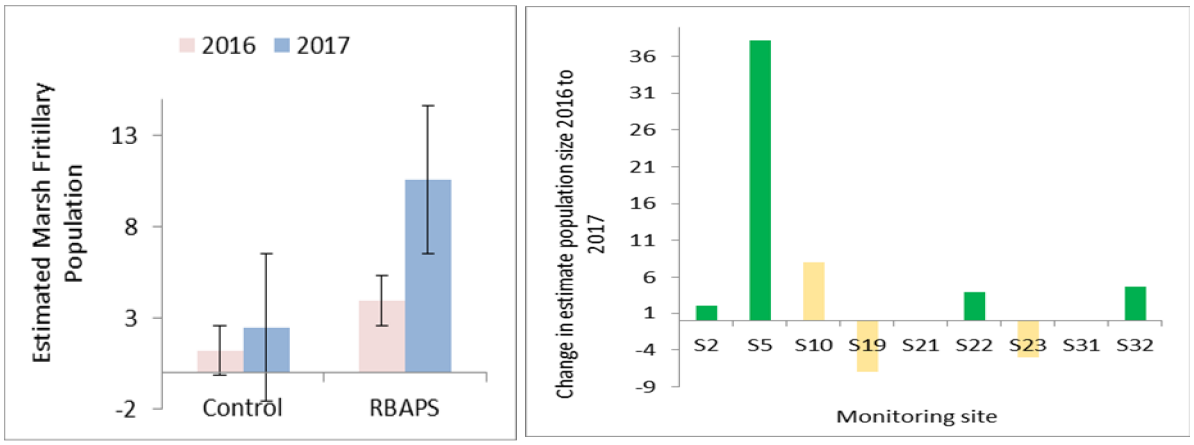


Figure 6. Mean marsh fritillary population estimates (±S.E.) in control sites (n=4) and sites enrolled in RBAPS (n=5) in 2016 and 2017. b) Changes in the marsh fritillary population estimates in the 9 monitoring sites between 2016 and 2017 – RBAPS sites in green

Marsh fritillary larval counts were undertaken in nine monitoring sites, with webs being present in seven of the nine sites over the two monitoring periods. A Mann Whitney U test showed that there was no significant difference between marsh fritillary populations on the RBAPS versus control sites in 2016 (U = 8, p= 0.730) or 2017 (U=4.5, p= 0.190). Therefore, no significant impact of enrolment in the marsh fritillary habitat measure on presence/absence or population size, although again we must reiterate that these findings should be viewed with extreme caution due to the very short timeframe between surveys and small sample size.

As the marsh fritillary sites enrolled in RBAPS were already in suitable condition for the butterfly, the farming practices remained similar in both monitoring years (rotational scrub control was recommended but not undertaken for a number of reasons); similarly no changes in management on the control sites was noted. Therefore, the variation in marsh fritillary population over the monitoring period demonstrates that factors outside of an individual farmer's control are partly influencing this species: and justifies the decision to base the measure, and results indicators, on the provision of high quality, suitable habitat, which is directly linked to farming activity. The annual population fluctuations also point to the need for regular monitoring of species targets such as marsh fritillary over the scheme to ensure robust assessments and interpretations are being made about scheme impacts and population dynamics. This monitoring information could additionally inform potential bonus payments for achievement of population targets.

Scoring assessment suitability

The RBAPS score is weighted so that half of the available points are attainable for the number and cover of positive indicators (together called the ecological integrity), as these are considered to represent grasslands benefiting from sensitive farming and with high potential to support wider

biodiversity. Monitoring of the developed scoring assessment, and particularly the ecological integrity indicators, demonstrates that it is, in general, capable of discerning those grasslands delivering higher levels of biodiversity (Figure 7).

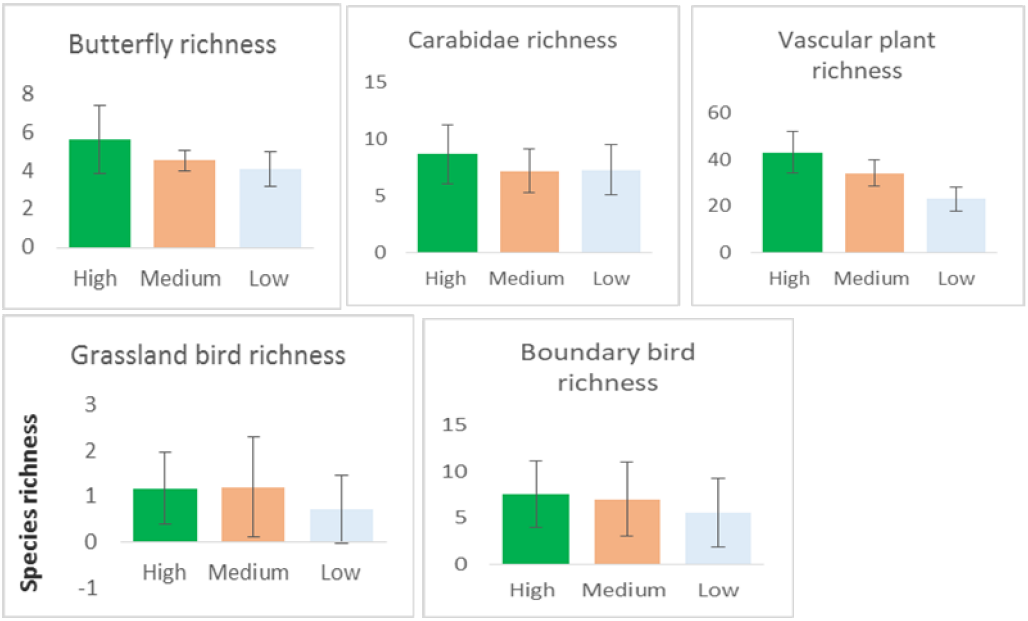


Figure 7. Species richness (± S.D.) of the RBAPS County Leitrim monitoring groups for sites categorized as being of high, medium or low ecological integrity (combination of points for number and cover of positive indicators) on the RBAPS scoring assessment

Due to their ease of use by farmers and assessors and cost effectiveness to assess, vascular plants are often used as indicators of the quality of species-rich grasslands. Whilst this monitoring effort and other studies show that vascular plant richness can function effectively as a surrogate for other taxa such as butterflies, birds and Diptera, they cannot predict the species richness of all grassland taxa. Nonetheless, RBAPS monitoring shows that the results indicators of ecological integrity (number and cover of positive indicators), separately, and more consistently in combination, were significantly correlated with species richness of the four monitoring taxa (Table 9), *i.e.* higher achievement of these indicators is associated with higher levels of grassland species richness. The project findings demonstrate the importance of not establishing a scoring system based solely on presence of indicator plants where wider grassland biodiversity is the target.

Table 9. Matrix of significant pairwise Spearman's non-parametric partial correlation coefficients between species richness of 4 monitoring taxa, notable species and RBAPS results indicators for 30 grassland sites in north-west Ireland. Area of the monitoring site (ha) was entered as a controlling factor.

Results indicator	Vascular plants & ferns	Butterfly	Carabidae	Field boundary & grassland birds	Notable species[+]
RBAPS score	0.639** *0.000*	0.483** *0.008*			0.453** *0.014*
Number of positive indicators	0.788 *0.000*	0.476** *0.009*		0.403* *0.030*	0.440** *0.017*
Cover of positive indicators	0.586** *0.001*	0.570** *0.001*	0.372* *0.047*		
Ecological integrity	0.727** *0.000*	0.582** *0.001*	0.374* *0.046*	0.396* *0.034*	0.600** 0.001
Cover of negative indicators	0.456* *0.013*				0.374* *0.045*
Scrub cover		-0.433* *0.019*			

*p<0.05, **p<0.01 ^Ecological integrity = the combined score for the number and cover of positive indicators [+]Protected and Red list species

As monitoring shows, the results indicators for scrub cover (butterfly richness was correlated with increasing scrub cover) and cover of negative indicators (increasing vascular plant richness was significantly correlated with lower cover of negative indicators) have relationships with grassland biodiversity. It is also to be expected that low to no correlations will exist between some results indicators and the biodiversity target, such as indicators for damaging activities and vegetation structure. These indicators are necessary as part of a comprehensive scoring assessment, acting as early warning signals which can prevent the deterioration of species-rich grasslands. Reversing adverse impacts such as fertilisation, particularly in slow to respond wet grasslands, may not be possible in the short to long term, without costly interventions. If the scoring assessment was based on the ecological integrity indicators alone, early opportunities to positively influence farmer behaviour and to halt declines in grassland condition may be lost. As it is more cost-effective to prevent loss rather than restore, it is sensible to include indicators of future prospects to complement the ecological integrity indicators in grassland assessments.

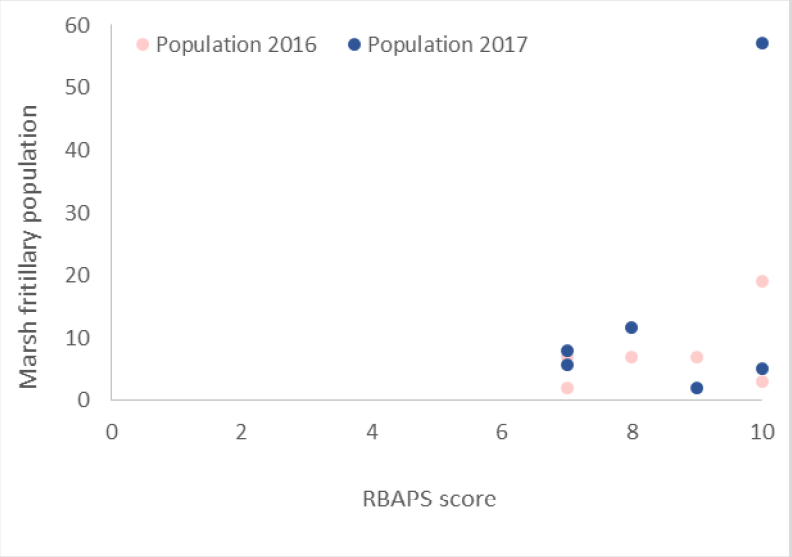


Figure 8. Populations of marsh fritillary butterfly on nine monitoring sites in 2016 and 2017 along the RBAPS scoring range. All sites had high ecological integrity (as measured by the number and cover of positive indicators), but overall scores were affected by sub-optimal scrub cover or vegetation structure.

Habitat suitable for marsh fritillary is expected to deliver wider diversity but primarily stable and increasing fritillary populations. Marsh fritillary butterfly larval webs were found at RBAPS sites with scores ranging from 7 to 10 (Figure 8). Whilst high quality habitat (as robustly measured by the scoring assessment) is necessary for the butterfly, it does not always guarantee the presence of larval webs, with no webs found at some sites scoring 7 and 9 out of 10. As noted above, this may reflect the natural metapopulation dynamics of the species which supports the scheme design of basing payments on habitat quality rather than solely on the presence of the species. Where suitable habitat is set as the biodiversity output for a target species, such as marsh fritillary, monitoring should address both the quality of the habitat and the population trends as a result of scheme enrolment.

In summary, monitoring confirms that the developed RBAPS scoring assessments for species-rich grassland, and the sub-set which is suitable for the rare marsh fritillary butterfly, are scientifically robust, and reflect the quality of the grassland for the biodiversity targets/outputs. The scoring assessments also provide signals of grassland future prospects which are essential to recognise and reward appropriate management.

Shannon Callows

Shannon Callows species-rich floodplain meadows

Scoring system and variation in the biodiversity target [using 2016 relevé data]

Analysing the relationship between the RBAPS score and the measures of the Biodiversity target demonstrates a strong, positive and highly significant relationship between RBAPS score and total plant species-richness, Simpson's diversity index and Shannon's Diversity index (Table 10 and Figure 9). There is also a strong, positive and highly significant relationship between the indicator, A1 Cover of positive indicator plants, and plant species-richness, Simpson's diversity index and Shannon's Diversity index and A2 Cover of positive indicator plants and these indices also (Table 10). These results indicate that the RBAPS score is a robust measure of overall plant diversity.

Table 10. Spearman's correlation coefficients between RBAPS scores and various measures of diversity.

		Plant Sp. Richness	Simpson's Diversity	Shannon's Diversity	Evenness	RBAPS Score
RBAPS Score	Spearman's rho	.741**	.826**	.794**	.658*	1.000
	P- value	*.002*	*.000*	*.001*	*.011*	
A1 No positive	Spearman's rho	.756**	.774**	.774**	.469	.777**
	P- value	*.002*	*.001*	*.001*	*.090*	*.001*
A2 Cover positive	Spearman's rho	.599*	.722**	.688**	.642*	.933**
	P- value	*.024*	*.004*	*.007*	*.013*	*.000*
A3 Cover of dense grasses & meadowsweet	Spearman's rho	.385	.534*	.445	.593*	.755**
	P- value	*.173*	*.049*	*.111*	*.025*	*.002*
A4 Cover negative	Spearman's rho	.241	.103	.103	-.103	.070
	P- value	*.407*	*.726*	*.726*	*.726*	*.812*
B1 Litter and scrub	Spearman's rho	.447	.447	.447	.447	.455
	P- value	*.109*	*.109*	*.109*	*.109*	*.102*
B2 Damaging activities	Spearman's rho	-	-	-	-	-
	P- value	-	-	-	-	-

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

These results indicate that the RBAPS score is a robust and reliable measure of plant species diversity of species-rich flood meadows.

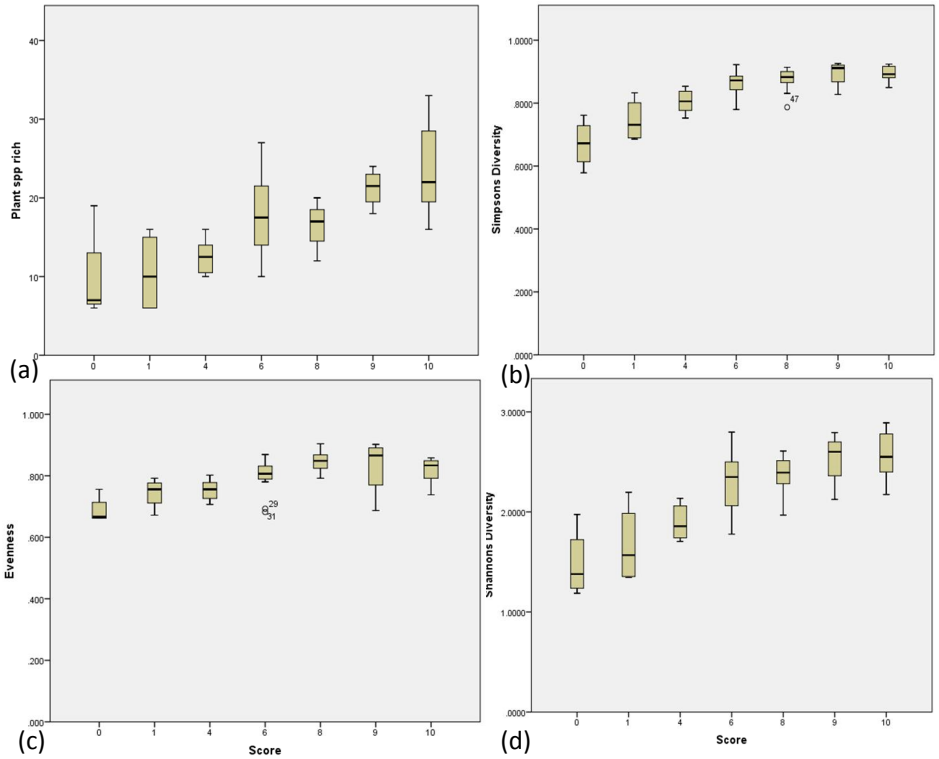


Figure 9. Variation across RBAPS scores for (a) plant species-richness (b) Simpson's diversity (c) Evenness and (d) Shannon's diversity. Each box plot displays the minimum, inter-quartile range, maximum and median (horizontal line in each box)

One of the concerns with using the number of indicators present to determine score and thus payments along a floodplain is that species diversity is determined by flood duration; sites with longer flood duration being associated with lower species-richness. Positive indicators were carefully selected to reward across the hydrological gradient and not negatively affect the score of wetter sites.

An NMS ordination with environmental variables overlaid on the graph is used as a method for visualising the results (Figure 10). A strong hydrological gradient is evident in the ordination diagram. A gradient from dry to wet is evident from left to right across the ordination, along Axis 1, which explains 53.7% of the variation in the ordination. Axis 3, which explains 20.0% of the variance, is strongly correlated with both biotic and abiotic factors, whereas Axis 2, although it explains 13.5% of the variance, illustrates less variation in relation to abiotic variables. Axis 3 illustrates the correlation between the Ellenberg indices for nutrients (Ell N) and pH (Ell R) as well as vegetation height.

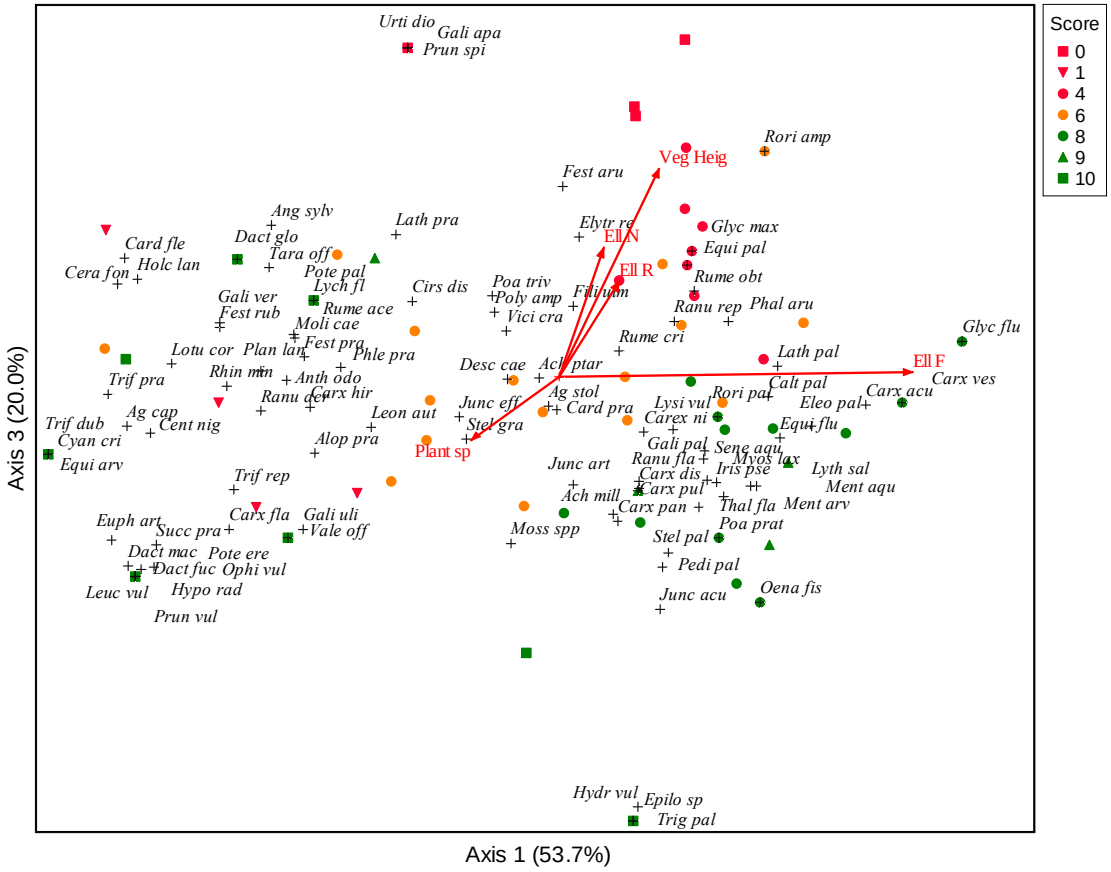


Figure 10. NMS ordination diagram of Axis 1 and Axis 3 for relevés (colour and symbol coded for scores) with vector overlays showing correlation between axis scores & environmental variables[6]

It is evident in the NMS ordination (Figure 10) that some sites associated with the longest flood duration (Ell F) are associated with high scores (scoring 8 and 9 out of 10), and thus sites with longer flood duration are not disadvantaged by the scorecard.

Assessment against Annex I habitat evaluations using Annex I positive indicator species for [6510], [6410] and [6430]

As the presence of Annex I plant communities in the Shannon Callows and their inclusion as qualifying interests (QIs) under the Special Area of Conservation (SAC 20016) designation informed their selection as a biodiversity target for the area, the quality of the meadows according to the Annex I habitat assessments as described by O'Neill *et al.* (2007) were also analysed. The QIs for the River Shannon SAC include Lowland Hay Meadows [6510] and *Molinia* meadows [6410], with

[6] The NMS ordination produced a 3 dimensional solution which explained 87.1% of the total variance and which had a final stress of 10.5 and final instability of $<10^{-5}$ after 64 iterations.

Hydrophilous tall herb fringe communities [6430] occurring in a mosaic with the other two plant communities. The 56 relevés recorded as part of the monitoring in 2016 were retrospectively put through Annex I assessments. The following section examines the diversity of positive indicator species for Annex I habitats [6510], [6410] and [6430] found along the Shannon Callows.

There is a strong, positive and highly significant relationship between RBAPS score and the measures of diversity for Annex I habitats [6510], [6410] and [6430], specifically species-richness of positive indicators of the three Annex I habitats, and Simpson's diversity and Shannon's Diversity of positive indicators of the three Annex I habitats (Figure 11 and Table 11).

These results indicate that the RBAPS score is a robust and reliable measure of the Annex I quality habitats target under the measure.

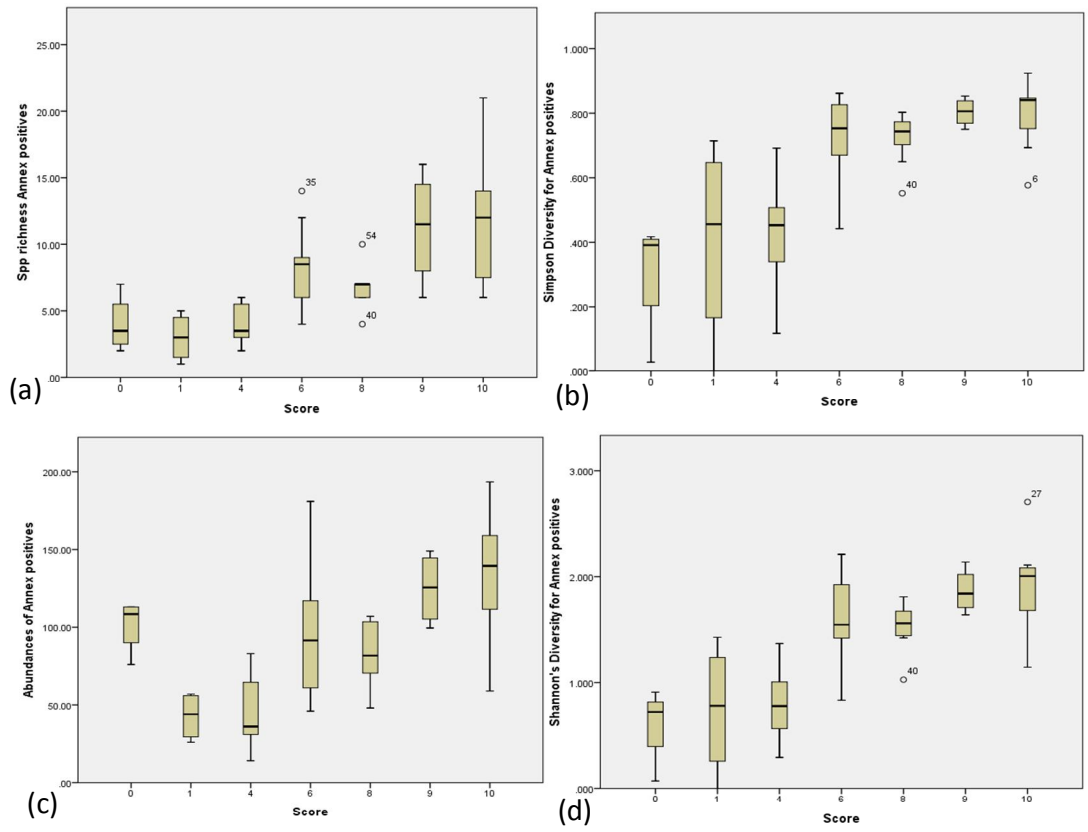


Figure 11. Variation in diversity of Annex I positive indicator species for [6510], [6410] and [6430] (O'Neill et al. 2007) recorded across RBAPS scores, showing (a) species-richness, (b) Simpson's diversity, (c) total cover abundance and (d) Shannon's diversity [n =56 relevés]

In Figure 11(c) we see relatively high abundance of the Annex I positive indicator species at score 0, at this site no management was carried out for a number of years which has resulted in dense cover of Meadowsweet (*Filipendula ulmaria*) and low numbers of positive indicators and some scrub

encroachment. In this instance if appropriate management is put in place it may be possible for the site quality to improve.

Table 11. Correlations between positive Annex I indicator species diversity and RBAPS scores and score result indicators for Species-rich Floodplain Meadows

		Sp Richness Annex I	Simpson's Diversity Annex I	Shannon's Diversity Annex I	Abundance Annex I	Evenness Annex I
RBAPS Score	Spearman's rho	0.772**	0.756**	0.772**	0.615*	0.707**
	P- value	*0.001*	*0.002*	*0.001*	*0.019*	0.005
A1 No positive	Spearman's rho	0.819**	0.708**	0.741**	0.743**	0.567*
	P- value	*0.000*	*0.005*	*0.002*	*0.002*	*0.034*
A2 Cover positive	Spearman's rho	0.660*	0.658*	0.658*	0.617*	0.699**
	P- value	*0.010*	*0.011*	*0.011*	*0.019*	*0.005*
A3 Cover of dense grasses & meadowsweet	Spearman's rho	0.341	0.341	0.341	0.178	0.371
	P- value	*0.233*	*0.233*	*0.233*	*0.543*	*0.192*
A4 Cover negative	Spearman's rho	0.172	0.172	0.172	0.034	0.172
	P- value	*0.557*	*0.557*	*0.557*	*0.907*	*0.557*
B1 Litter and scrub	Spearman's rho	0.310	0.447	0.447	-0.103	0.447
	P- value	0.281	0.109	0.109	0.726	0.109

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

What score and above equates to favourable condition for Annex I habitats

As the criteria vary for each Annex I habitat thus the relevés and sites that passed the Annex I habitat assessments varies. Table 12 outlines the RBAPS scores for which the three Annex I habitats passed retrospective Annex I habitat assessment. Of the three Annex I habitats Lowland hay meadow [6510] is typically the more species rich, with *Molinia* meadow [6410] having marginally lower plant species diversity (Maher *et al.,* 2015[7]), with Hydrophilous tall herb [6430] being characterised by relatively low plant diversity (due to its association with higher soil moisture and inundation).

[7] Maher, C., Sheehy Skeffington, M. and Gormally, M. (2015). Hydroperiod and traditional farming practices drive plant community composition on unregulated Atlantic floodplain meadows. *Wetlands*.

Table 12. Overview of retrospective assessments for each Annex I habitat type across RBAPS scores.

RBAPS Score	6510 pass	6410 pass	6430 pass	Total passes
10 (n = 12)	**8**	**4**	0	**12**
9 (n = 8)	1	**2**	0	**3**
8 (n = 20)	-	-	**13**	**13**
6 (n = 24)	**4**	-	**8**	**12**
5 (n = 16)	-	-	1	1
4 (n = 12)	-	-	-	0
2 (n = 8)	-	-	-	0
1 (n = 4)	-	-	-	0
0 (n = 8)	-	-	1	1
-1 (n = 4)	-	-	-	0
Total *(n= 116)*	**13**	**6**	**23**	**42**

Generally scores of 9 and 10 correspond with Annex I quality Lowland hay meadow [6510] and *Molinia* meadow [6410]. Annex I quality Hydrophilous tall herb [6430] is associated with a broader range of scores between 6 and 9 out of 10. Hydrophilous tall herb habitat is slightly less likely to score 10 out of 10 due to its inherent lower species diversity (and species-richness is awarded 35% of the marks towards the quality score). Two meadows which scored 6 out of 10 had relevés which passed the Lowland hay meadow [6510] assessment, it is likely that one of these meadows may not have been included for Annex I assessment.

Although the RBAPS scorecard (as it is currently designed) does not function as a Annex I assessment, it does indicate where these habitats are likely to be found, and if rolled out at national level could better inform distribution of these habitats.

Shannon Callows species-rich flood meadow with ground-nesting bird(s), 2016 and 2017

Curlew breeding productivity

In 2016, three to four pairs of curlew were recorded, while three pairs were recorded in 2017 (Table 13). Although there were strong indications of breeding from all pairs, it was only possible to confirm breeding of one pair and it is not possible to examine the efficacy of this measure on curlew breeding success and productivity. The single pair confirmed breeding likely nested on Inishee Island, which is opposite Lusmagh Callow (in the Shannon Callows) and does not hold RBAPS participant plots, with at least one fledgling recorded.

Table 13. Summary of the number of whinchat and curlew pairs recorded across the participant Callows

	No. Whinchat pairs on Callow		No. Curlew pairs on Callow	
Co-meadow	**2016**	**2017**	**2016**	**2017**
Long Island	1	1	0	0
Goravinch	2	0	1	0
Clonmacnoise	0	0	1	0
Fahns	4	3	0	0
Lusmagh	2	2	1-2	3
Mather's	NA	1	NA	0
Bloomhill	NA	1	NA	0
TOTAL	**9**	**8**	**3-4**	**3**

Whinchat breeding productivity

Nine pairs of whinchat were recorded in 2016 and eight pairs in 2017. In 2016, five of the nine pairs (60%) bred successfully, *i.e.* produced at least one fledgling, compared with 3 pairs (75%) on control plots (see Table 14). In 2016, the average whinchat breeding productivity, *i.e.* the number of fledglings produced per pair, was 1.4 fledglings per pair on RBAPS plots compared to 1.5 fledglings per pair on control plots (see Table 14). In 2016, the ground-nesting birds measure only required participants to delay mowing until after July 15th, which is too early to protect and stabilise whinchat populations; however, we have insufficient data to determine if this affected productivity on RBAPS plots.

In 2017, five of the total eight whinchat pairs bred successfully. Four of the five pairs (80%) on RBAPS plots bred successfully in comparison only one of the three pairs (33%) on control sites (see Table 14). Whinchat on RBAPS plots produced 1.4 fledglings per pair, the same rate recorded on RBAPS plots in 2016, while whinchat on control plots produced only 0.7 fledglings per pair. While productivity was the same on RBAPS plots in 2016 and 2017, breeding success was higher in 2017 (at 80%, versus 60% in 2016). In 2017, participants in the whinchat option had to delay mowing until after 26th July versus 15th July in 2016; this may have assisted the higher levels of breeding success recorded.

Looking at breeding success and productivity across the two year period as a whole (

Table **14**), we can see breeding success and productivity was higher on RBAPS plots compared to control plots. Thus, pairs that bred on plots in the RBAPS Ground-nesting Birds measure likely had a greater contribution to the growth of whinchat populations compared to control sites. Unfortunately, the sample sizes in this study are too low determine if there was any statistically significant difference in breeding success and productivity between RBAPS and control sites.

Table 14. Whinchat breeding success and productivity across RBAPS and control plots in 2016 and 2017.

	RBAPS Plots			Non-RBAPS Control Plots		
Year	**No. of pairs**	**Breeding success***	**Breeding productivity†**	**No. of pairs**	**Breeding success**	**Breeding productivity**
2016	5	60%	1.4	4	75%	1.5
2017	5	80%	1.4	3	33%	0.7
2016 + 2017	10	70%	1.4	7	57%	1.1

* Breeding success is the number of pairs that produced at least one hatchling (i.e. chick in the nest) as a percentage of the total number of pairs. †Breeding productivity is the number of fledglings produced per pair (calculated as the total number of fledglings produced by all pairs, divided by the total number of pairs).

Breeding Wader Habitat

Correlations between scores and breeding wader populations

The wader scoring system is split into two sections: breeding season (indicators A1 – C2) and late season (indicator D1). The breeding season score reflects the condition of the habitat during the breeding season. The late season score is designed to encourage positive management at the end of the year in preparation for the following year's breeding season, and can have a substantial impact on habitat suitability the following year. As the breeding season score reflects the habitat conditions at the time of breeding, only this score has been used in this analysis (*i.e*. 85 point out of a total of 100 points, which includes late season scoring i.e. D1). Late season score has not been included in this analysis as we have insufficient data to accurately model it.

Total breeding wader population is significantly positively correlated with breeding season score (negative binomial GLM: $z = 2.348$, $p = 0.019$). Thus, higher scoring plots support higher breeding wader populations and we can conclude that the scoring system used does suitably reflect the quality of the biodiversity target present. Lapwing populations were also significantly, positively correlated with breeding season score (poisson GLM: $z = 2.685$, $p = 0.007$). While not significant, results suggest a strong positive correlation between Redshank population and breeding season plot score (poisson GLM: $z= 1.825$, $p = 0.06$). There are no significant correlations between Snipe populations and score (poisson GLM: $z = 0.165$, $p = 0.869$). All analyses controlled for the effect of year, plot area (ha), priority and participation in a previous breeding wader scheme.

Total productivity and total Redshank productivity did not correlate significantly with breeding season score (poisson GLMs: total: $z = 0.850$, $p= 0.395$; Redshank: $z = 1.111$, $p = 0.267$), however sample size was small. There was insufficient data to investigate this relationship for Curlew, Lapwing and Snipe.

When breeding season scores for each indicator are analysed, total wader populations correlate positively with indicator A1 - Breeding season sward height (negative binomial GLM: $z = 3.309$, $p <0.001$) and indicator B1 Wet features (negative binomial GLM $z = 2.914$, $p = 0.004$). Plots that have

short swards support a significantly higher total breeding wader population than plots that have long swards. There was no significant difference between the populations on plots with short and medium length swards, or between plots of medium and long swards; see Figure 12.

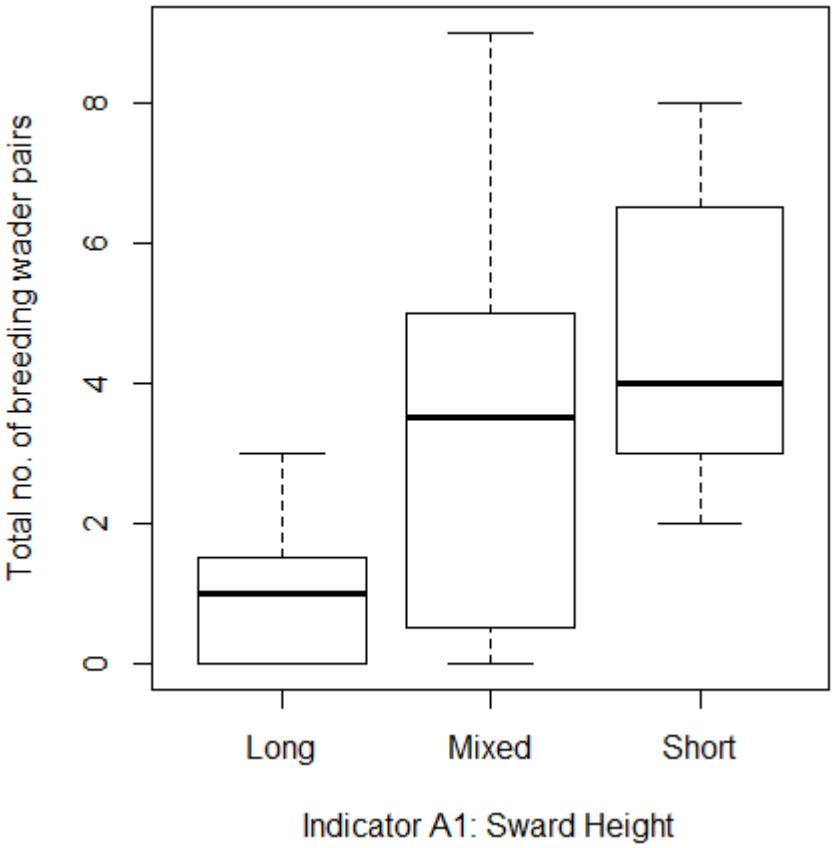


Figure 12. Variation in the total number of breeding wader pairs on a plot according to the sward height of the plot in the breeding season.

While there are many other factors outside the control of the measure (e.g. weather, landscape effects of predation and disturbance), there is a strong correlation between high scoring sites and higher wader populations.

Indicators A1 and B1 seem to be the best predictors of total breeding wader population on a site. Within years, it is likely that these are the most important factors affecting initial site selection by breeding waders. As expected, indicators relating to predator habitat (C1 and C2) were not found to be significantly correlated with population. These indicators are most relevant to breeding success and productivity, as they are designed to help reduce predation rates through the removal of predator habitat. A longer term trial would be required to pick up their effects on population levels, through population growth.

Hatching success and breeding productivity were generally shown to be higher on RBAPS sites compared to control sites, although this difference was not always statistically significant. Lapwing and Snipe recorded considerable inter-annual variation in hatching success and breeding productivity.

All control plots are in the GLAS Breeding Wader Measure. Many of these plots were entered into a breeding wader scheme prior to GLAS, which contained capital works and ongoing advisory services (Finney and Donaghy, 2014) and were found to influence field scores and breeding success. Overall, control plots scored consistently lower than RBAPS plots. It appears from both field score results, and population and productivity results, that active participation in a measure containing these elements, delivers more for population stability and growth, even over a short timeframe.

RBAPS versus Control data

On average, RBAPS plots scored higher than control plots in both 2016 and 2017 (Figure 13). However, after controlling for the effects of plot priority, year, and participation in a previous breeding wader scheme, there was no statistically significant difference between scores on RBAPS and control sites across the two years (generalised linear model (GLM): t= 1.43, p = 0.166).

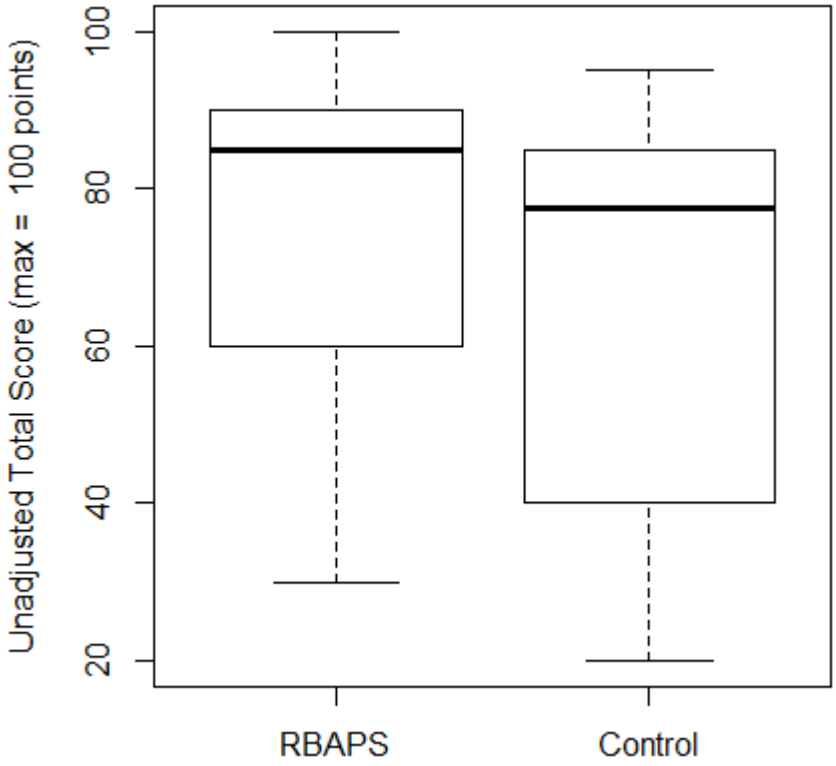


Figure 13. Comparison of scores for RBAPS and control sites for 2016 and 2017. RBAPS, n = 10; Control, n = 11.

Changes in fields scores between 2016 and 2017 for Breeding Wader Measure

Scores were analysed for changes between 2016 and 2017. The analysis only includes plots that participated in the scheme in both years, which comprised four RBAPS and five control plots (see Table 15 below). Although the sample size very low, RBAPS sites scored better than control sites,

across both years (Table 15 and Figure 14). Average RBAPS scores improved by 11.25 points (over one field score/payment band) from 2016 to 2017, while control sites decreased by two points in this period. Sample sizes are too low to draw statistical comparisons between years or groups.

Table 15. Field scores on plots that participated in both years of the scheme

Status	2016 average score (field score)	2017 average score (field score)	Change 2016 to 2017
RBAPS (n=4 plots)	77.5 (8)	88.75 (9)	+11.25
Control (n=5 plots)	58 (6)	56 (6)	-2

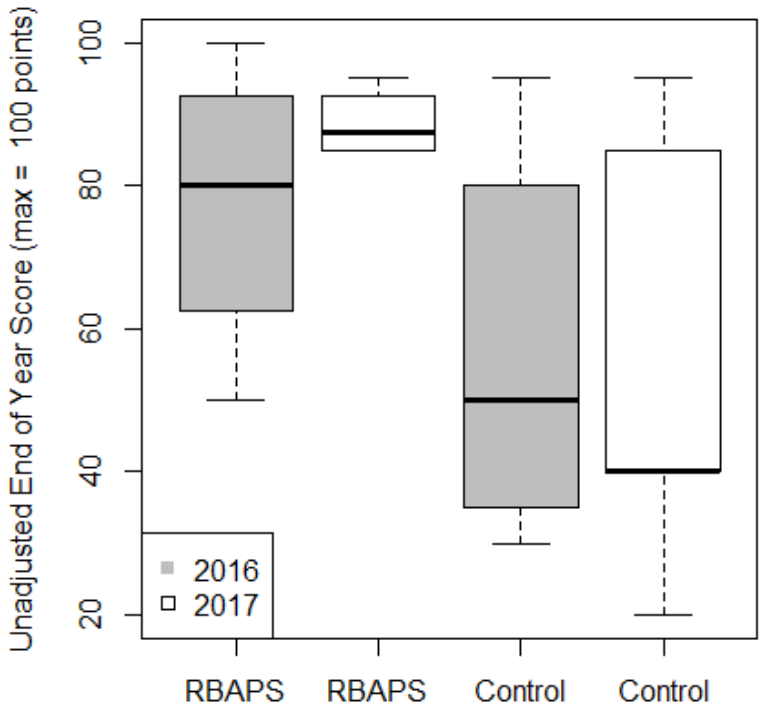


Figure 14. Changes in unadjusted[8] end-of-year score from 2016 to 2017. RBAPS (n = 4) and control (n = 5) sites that participated in the measure in both 2016 and 2017.

On average, RBAPS plots scored higher than control plots in both 2016 and 2017 (Figure 14). However, after controlling for the effects of plot priority, year, and participation in a previous breeding wader scheme, there was no statistically significant difference between scores on RBAPS and control sites across the two years (generalised linear model (GLM): t= 1.43, p = 0.166).

[8] The unadjusted scores do not take into account non-productive investments, if indeed they were carried out.

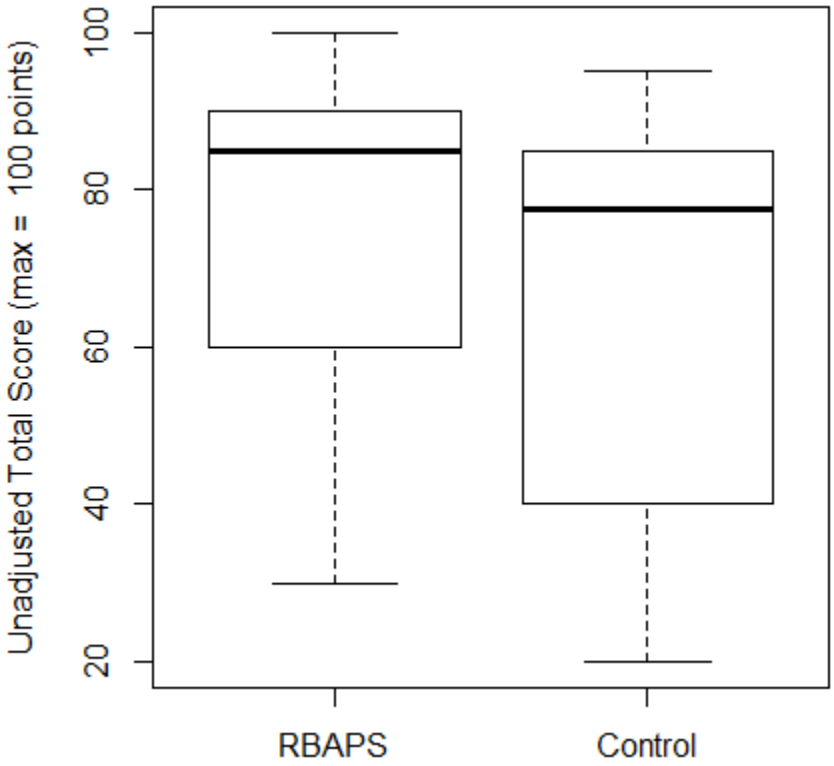


Figure 15. Comparison of scores for RBAPS and control sites for 2016 and 2017. RBAPS, n = 10; Control, n = 11.

Navarra, Spain

Comparing 2016 and 2017 data & RBAPS versus Control data

Flora species richness (S) and diversity indices (H and D) were always higher in RBAPS than in control monitoring sites (Table 16. Likelihood ratio test (LR) of group (control, RBAPS), year (2016, 2017), crop (Almond trees, Olive groves, Vineyards) and the interactions group x year and group x crop for flora species richness and diversity indices. Abbreviations of diversity indices: S, species richness; H, Shannon diversity index; D, Simpson diversity index, J, Pielou's evenness. Bold values represent significant differences ($P < 0.05$). Significance levels: $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$, except for Pielou's evenness (J), which was lower in the RBAPS monitoring sites. These results indicate that the management of crops done by farmers participating in RBAPS results in a higher flora species richness and diversity than other farmers of the area.

However, the interaction between group and year was significant on the flora species richness and Shannon's diversity index. This means that the effect of group (RBAPS versus control data) on those variables depended on the monitoring year. In 2016 both indexes showed significant higher values in RBAPS than in control monitoring sites, and in 2017 no significant differences were found between the groups observed (Figure 16). This could probably be explained due to differences in sampling time between both years: in 2016 mainly the months of May and June (17th of May- 5th July), and in 2017 in June and July (21st of June - 20th July).

When dividing the data into different crops, all the indices (except for Pielou's evenness index) were significantly lower in monitoring sites covered by vineyards, which traditionally have been cultivated more than others crops. Comparing RBAPS versus control sites (Figure 17), no differences occurred in almond trees and olive groves; however in vineyards the Simpson's diversity index was higher in RBAPS than in control sites. Analysis including abandoned almond groves monitoring sites showed that values in the abandoned plots were not significantly different from those either in control or in RBAPS monitoring sites, and further analysis interacting group and year led to similar conclusions as in the analysis without the abandoned sites. This could be expected, since almond groves in the area generally have a herbaceous cover despite not participating in the RBAPS project.

Table 16. Likelihood ratio test (LR) of group (control, RBAPS), year (2016, 2017), crop (Almond trees, Olive groves, Vineyards) and the interactions group x year and group x crop for flora species richness and diversity indices. Abbreviations of diversity indices: S, species richness; H, Shannon diversity index; D, Simpson diversity index, J, Pielou's evenness. Bold values represent significant differences ($P < 0.05$). Significance levels: $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$

	S	H	D	J
Group	**7.86****	**6.56***	**7.03****	**4.12***
Year	0.39	1.88	0.33	0.30
Crop	**22.45*****	**28.14*****	**23.62*****	0.25
Group: Year	**12.58*****	**6.09***	0.43	1.4
Group: Crop	0.85	4.81	**6.13***	0.37

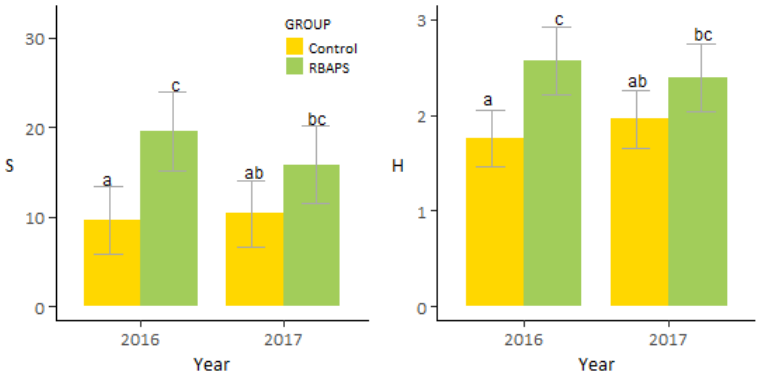


Figure 16. Predicted flora species richness (S) and Shannon's (H) diversity index (least squares means) for the interaction between group and year. Post hoc statistical significant differences (P < 0.05) are indicated with different letters.

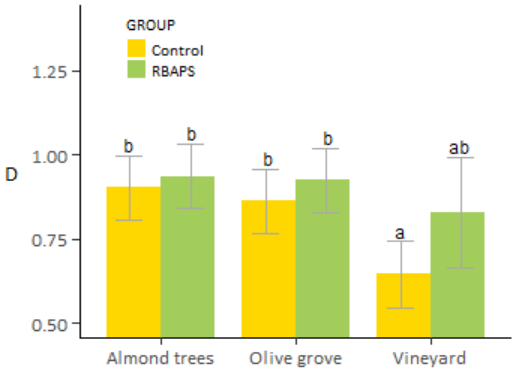


Figure 17. Predicted flora Simpson's (D) diversity index (least squares means) for the interaction between group and crop. Post hoc statistical significant differences (P < 0.05) are indicated with different letters.

In relation to fauna, some animal groups, such as mammals and reptiles, have not given as much information as expected, and only monitoring data related to grasshoppers, dragonflies and butterflies was analysed. The presence of grasshoppers and dragonflies was occasional and no significant patterns among type of crops or group of monitoring sites were observed.

Data of butterfly abundance followed an annual cycle inside, in the edge and outside the monitoring sites (Figure 18), which was significantly influenced by group inside the monitoring sites, as higher values were observed in RBAPS and abandoned monitoring sites than in control ones.

Moreover, butterfly abundance in both inside and in the edge of monitoring sites was significantly influenced by the type of crop and year (Figure 19). Almond trees showed higher values than vineyards in both sample types. Values in olive groves compared to almond trees and vineyards were significantly different inside the monitoring sites, but not in the edge. Additionally, butterfly abundance was higher in 2016 than in 2017 both inside and in the edge of the monitoring sites,

while no differences between years were observed on butterfly data outside the monitoring sites.

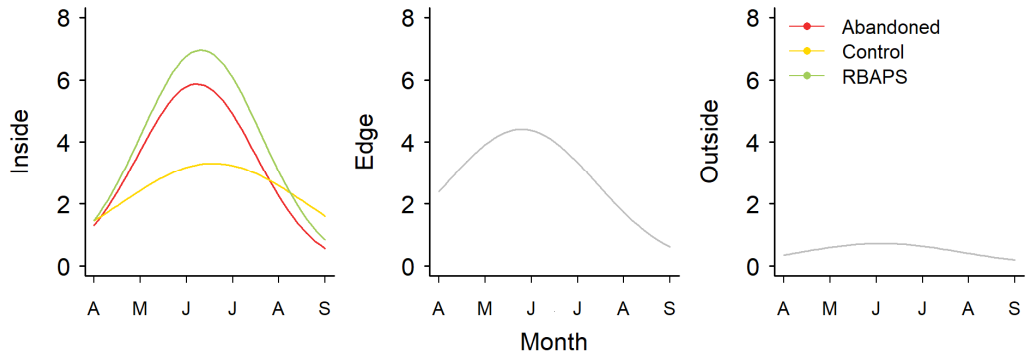


Figure 18. Predicted butterfly abundance inside the monitoring sites (significant differences between control and RBAPS group), and in the edge and outside the monitoring sites.

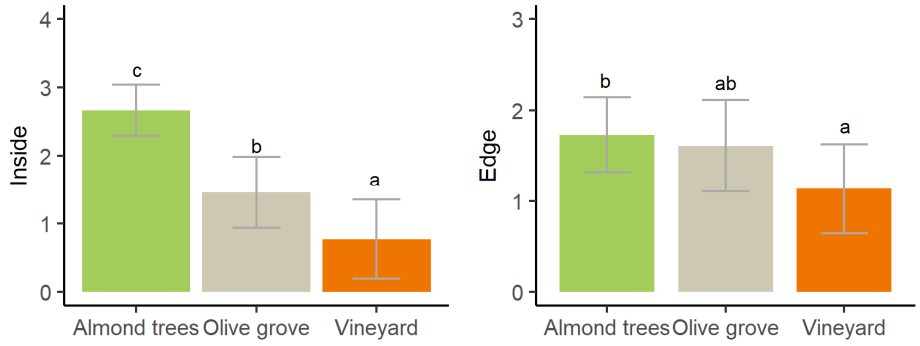


Figure 19. Predicted butterfly abundance inside and in the edge of the monitoring sites for crop. *Post hoc* statistical significant differences ($P < 0.05$) are indicated with different letters.

Butterflies appeared to be a very good indicator group for monitoring. They are very visible, move on a small scale, respond well to the herbaceous cover and, apart from common species, in that group, there are also threatened species and are included in the Habitat Directive. In addition, no training is required to obtain basic abundance data that can be related to RBAPS practices and thus monitoring could potentially be done later by farmers themselves.

Correlation between biodiversity and scores

Analysis of the data indicates some positive relationships between the RBAPS score and biodiversity targets. Flora species richness (S) and diversity indices (H and D), except Pielou's evenness (J), were positively correlated with the RBAPS scores of "diversity of the herbaceous cover" (A) (Table 17).

However, no significant relationships were found between flora indices and RBAPS scores of "structure of shelter for biodiversity" (B1 and B2).

Also, the maximum relative annual abundance of butterflies inside monitoring sites was positively correlated with the RBAPS scores of "diversity of the herbaceous cover" (A) (

Table 18), but no significant relationships were found with scores of "structure of shelter for biodiversity" (B1 and B2).

Table 17. Spearman's Rho correlation coefficients among flora and RBAPS scores. Abbreviations of diversity indices: S, species richness; H, Shannon diversity index; D, Simpson diversity index, J, Pielou's evenness. Abbreviations of RBAPS scores: A, diversity of the herbaceous; B1, diversity of natural vegetation; B2, natural and built structures. Bold values represent significant differences ($P < 0.05$). Significance levels: *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$; + $P < 0.1$.

	Flora species richness and diversity indices			
RBAPS score	S	H	D	J
A	**0.83*****	**0.83*****	**0.83*****	0.15
B1	-0.16	-0.13	-0.14	0.06
B2	0.19	0.22	0.22	0.3

Table 18. Spearman's Rho correlation coefficients among maximum relative annual abundance data of butterflies, grasshoppers and dragonflies (individuals minute^{-1}) in the edge, inside and outside monitoring sites, and RBAPS scores. Abbreviations of RBAPS scores: A, diversity of the herbaceous; B1, diversity of natural vegetation; B2, natural and built structures. Bold values represent significant differences ($P < 0.05$). Significance levels: *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$; + $P < 0.1$.

	Butterflies			Grasshoppers		Dragonflies	
	Edge	Inside	Outside	Edge	Inside	Edge	Inside
A	0.260	**0.66****	-0.160	-0.040	0.330	0.110	0.350
B1	0.040	-0.030	-0.030	-0.120	0.240	-0.280	-0.20
B2	0.120	0.050	-0.370	-0.360	0.20	0.050	-0.020

Relationships among fauna (annual maximum relative abundance of butterflies, grasshoppers and dragonflies) and flora (species richness and diversity indices) monitoring data were investigated using linear mixed effects models (LMMs). Abundance of butterflies inside monitoring sites was significantly (positively) influenced by all variables of flora species richness and diversity except for Pielou's evenness. This seems to indicate that farmers' who leave a high quality herbaceous cover in the plots create favourable conditions for the presence of butterflies.

The analysis shows that plots with higher scores in result indicators of "diversity of the herbaceous cover" have higher values of some biodiversity indices. However, this relation has not been found for the result indicators of "structure of shelter for biodiversity". It is thought that the lack of significant

correlations could be related to the monitoring process rather than the design of the scorecard of the RBAPS project in Navarra. If doing the monitoring and data collection again, it would be useful to carry out more previous field work, so that monitoring indicators that provided little information were discarded in an early stage and new ones were defined. Previous monitoring experience is very important in order to select the most appropriate indices of flora and fauna as monitoring indicators. It is also necessary to predict the scale of work, since very small plots require specific indicators.

Databases

A series of databases was set up and maintained to manage the wide variety of data and additional information generated by the project. This includes data on participation in RBAPS, interest in the project from farmers and wider public, evaluation of the project and monitoring of the specific measures. In Ireland the databases are maintained in Microsoft Excel, Word and GIS format. The Navarra team used a Microsoft Access database from which Farm Plans and payment systems were prepared. Full amalgamation of data took place in 2018.

Dissemination

The project has been presented at conferences and workshops in Ireland, Spain, Belgium, Poland, Denmark, Italy, Romania, the UK and Cyprus by RBAPS team members and partners. The project website (www.rbaps.eu) was continually updated during the project and a project newsletter was produced in spring of 2016 and 2017. Regular meetings were held with local groups and project stakeholder advisory meetings were held annually in each pilot area.

RBAPS Seminar in Brussels March 2017

Several members of the RBAPS team presented and contributed to discussion at the RBAPS seminar hosted by the European Commission, in Brussels. Several presentations at the seminar drew information from this project.

International workshop on High Nature Value Farmlands (HNFS), Cyprus, March 2017

Within the development of LIFE 13 BIO / CY / 001114 AgroLIFE, we participated in the workshop on "High Nature Value Farmlands (HNVf): Science, Policy and Agro-tourism", which was held from March 1 to 3, 2017, in Limassol (Cyprus).

Partners' meeting June 2017

In June 2017, the RBAPS Co. Leitrim team organised and facilitated a RBAPS meeting between the RBAPS partners in Ireland and Spain, along with our sister RBAPS projects in the UK and Romania, together with representatives from the European Commission; Department of Agriculture, Food and the Marine; Teagasc; the Burren Programme; AranLIFE Project and the newly commenced Hen Harrier Project.

End of project seminar, Ireland, June 2018

There was an overwhelming turnout at the end of project seminar on 22nd June, with in excess of 130 attendees filling the room with excitement about the future of results-based and locally adapted schemes and payments. All of the presentations from the final seminar are available on the project website: https://rbaps.eu/events/rbaps-end-of-project-seminar/.

Newsletter 2016, 2017:

Project newsletters available at www.rbaps.eu/newsletters.

Journal publications:

A number of Journal publications will be produced as outputs to this project. A number of conference publications have already been produced and three core papers are being developed for submission to peer reviewed journals later in 2018. Target scientific journals include Journal of Rural Studies; Land Use Policy; Ecological Indicators; Environmental Management; and Journal of Applied Ecology.

Project publications include:

Maher *et al*. (2015) Developing Result Based Agri-environmental Payment Schemes for the conservation of species and habitats in Ireland and Spain. *Teagasc Biodiversity Conference proceedings 2015.*

Cullen, P., Dupraz, P., Moran, J., Murphy, P., O'Flaherty, R., O'Donoghue, C., O'Shea, R. and Ryan, M. 'Agri-Environment Scheme Design: Past Lessons and Future Suggestions', *EuroChoices,* 0(0). https://doi.org/10.1111/1746-692X.12187

Byrne, D., C. Maher, V. Alzaga, C. Astrain, G. Beaufoy, A. Berastegi, A. Bleasdale, V. Clavería, A. Donaghy, K. Finney, S.B.A. Kelly, G. Jones, J. Moran, B. O'Donoghue & J. Torres. (2017) Developing Results Based Agri-environmental Payment Schemes (RBAPS) for biodiversity conservation in Ireland and Spain. Grassland Science in Europe 22: 299-301 download at http://www.europeangrassland.org/fileadmin/media/EGF2017.pdf

Project website www.rbaps.eu

The project website has been updated throughout the project and receives a lot of attention across the EU and further afield (see Appendix II. Overview of www.rbaps.eu website visits per country). All outputs from the project will be made available on the project website.

TV and popular media

In addition, RBAPS team members and participating farmers were interviewed in January 2017 for a national network broadcast, *Ear to the Ground*, and aired in February 2017; further details are available on the rbaps.eu website.

Two RBAPS team members were interviewed by *Shannonside Radio* in Ireland in December 2017.

In Navarra, a detailed article on the RBAPS project was presented in the regional newsletter '*Conocer Navarra*' (Plate 8). In addition, a specific poster has been prepared to use in meetings and dissemination activities.



Plate 8. Sample pages from the June 2017 edition of *Conocer Navarra* featuring the RBAPS project.

Key project output documents

The objectives of the RBAPS project have been achieved, in addition to the standard reporting requirement, through the development of scoring guidance (SG), best-practice guidance documents (BP), measure handbooks (MH), overall general guidance to development of results-based schemes (GH) and policy documents (PD). Figure 20 illustrates the breadth of project outputs in a systematic order to demonstrate their relationship to one another.

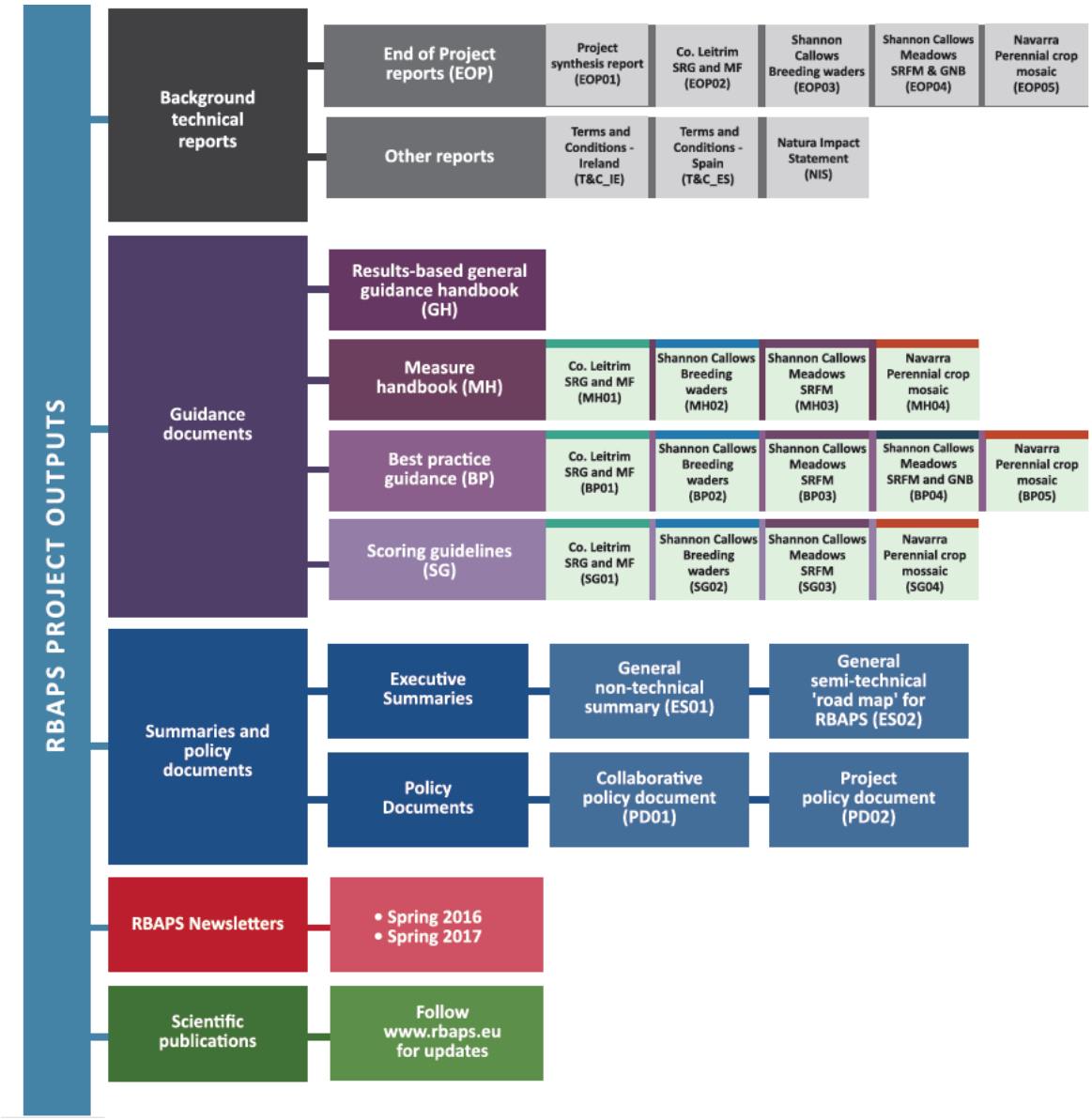


Figure 20. RBAPS output document map illustrating the key project outputs and their relationship to one another.

Financial report

The financial report will be provided on completion of full project auditing (August 2018).

Conclusions

The RBAPS Ireland and Spain pilot has built on the evidence and success of existing and previous results-based schemes, particularly the Burren Programme. Robust scoring assessments have been developed for a wide range of species and habitats associated with grasslands and croplands. Monitoring results indicate that these assessments are capable of distinguishing between grasslands and cropland of varying quality, providing a basis for the assessment and payment for those of higher ecological value.

The scoring assessment and indicators developed for the six RBAPS pilot measures can be a useful 'starting point' from which a wide range of measures for high quality targets could be delivered through scaled-up implementation of such schemes. Whilst these measures have been developed to assess individual plots or units, the next step is to develop scoring assessments in a whole farm context. Moving to a farm-level assessment will encourage greater understanding by farmers and authorities of the ability of farm holdings to produce high quality ecosystem service goods as opposed to focusing payments for production on a small proportion of the farm holding. To complement the whole farm approach, a comprehensive set of scoring assessments should be available that encompass the whole farm setting and diversity of habitats and features supported which are suitable for results-based measures.

Tiered payment structures which link the quality to the payment rate can incentivise change in farmer attitudes and management and bring about benefits for biodiversity targets. Payment rates must reflect the value of the biodiversity being produced, the effort required to produce it and also the prevailing market concerns. For example, the current €450 per hectare ceiling for permanent grassland payments under agri-environment is approximately €200 lower than income forgone for the opportunity to afforest in Ireland; this upper limit needs to be re-examined to facilitate greater scheme flexibility in attracting and maintaining farmers in result-based schemes.

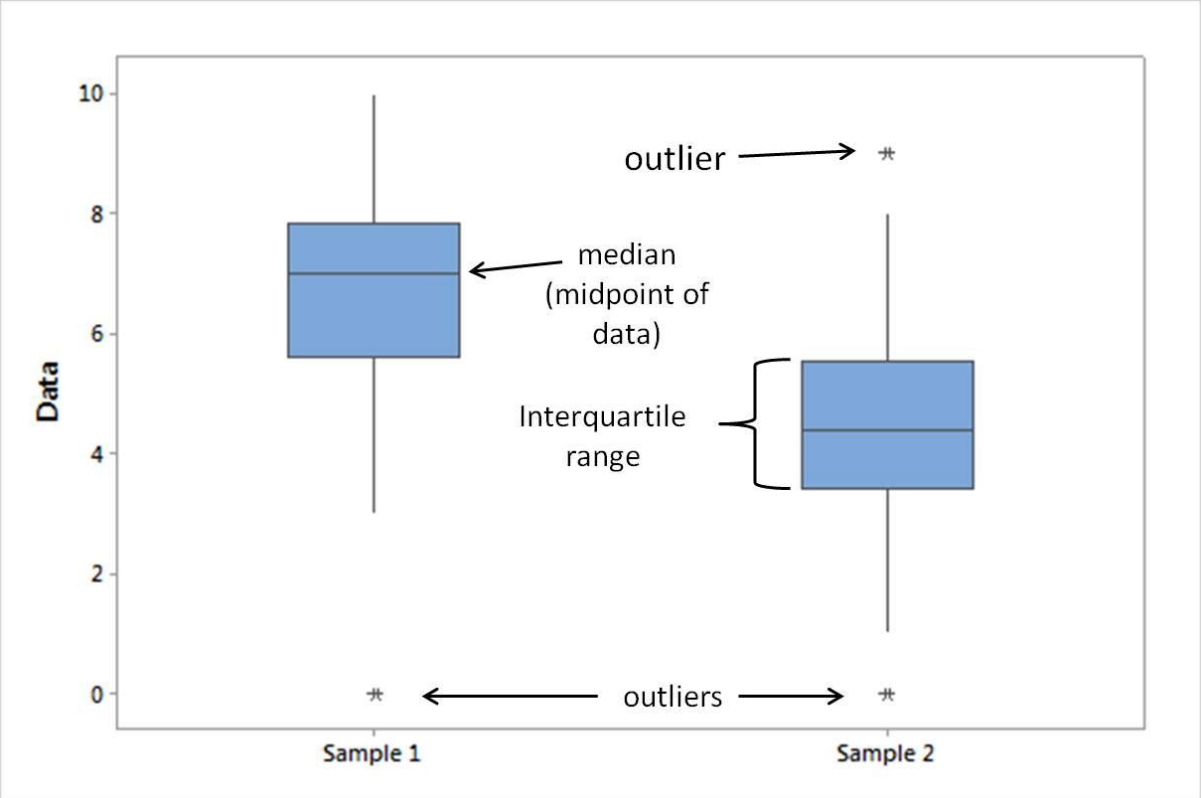
It is clear from farmer response to the pilot that they want agri-environment schemes which fit their land, their type of management and their ability to deliver high quality environment, something many feel the conventional prescription schemes fail to take into account. This pilot has found that farmers, on the whole, view the results based approach as a fair mechanism for delivering agri-environment monies. They are however, aware that there are pitfalls and that the policy, administration, expertise and resources need to be in place in order to make any type of scheme, prescription or result-based, work for them and for the environment in which they farm.

RBAPS is more challenging to roll-out in regions with no comprehensive agri-environment advisory service available to farmers, which would be the case for any agri-environment scheme with higher level biodiversity targets. Similarly, for any scheme type, up-skilling of advisors or farm information authorities and participants will be a key aspect in supporting and delivering scheme objectives and ensuring success of the scheme. It is also vital that sufficient resources are placed into the appropriate design, monitoring and evaluation of agri-environment schemes, both prescription and results-based.

To facilitate more widespread Member State uptake of the results-based approach to agri-environment, we recommend a dedicated Article within the rural development regulations in CAP post 2020. Having this in place will provide administering organisations, farm organisations and farmers with confidence that the schemes and approaches will be integrated with obligations under Pillar I with other schemes under Pillar II.

Appendix I. Boxplots

A boxplots, also called box and whisker plots, are a visual representation of the distribution of a series of data. Boxplots are more informative than bar charts because boxplots display the minimum, inter-quartile range, maximum and median (shown as a horizontal line in each box). The 'box' represents the inter-quartile range, which is 50% of the data points (one quarter below the median and one quarter above the median). The 'whiskers' outlier is a value that is at the extreme of a data series, i.e. a value which is either very small or very large and thus can affect the overall observation made from the data series. Boxplots display outliers as asterix outside the box of the boxplot.



Appendix II. Overview of www.rbaps.eu website visits per country

	Country	No. of views
1	Ireland	4051
2	Spain	1904
3	United Kingdom	1101
4	Belgium	437
5	United States	376
6	Germany	296
7	Italy	159
8	France	126
9	Sweden	116
10	Canada	89
11	Cyprus	78
12	Finland	77
13	Portugal	62
14	Denmark	61
15	Netherlands	51
16	Austria	50
17	Estonia	46
18	Switzerland	36
19	Romania	34
20	Russia	28
21	China	27
22	Hungary	27
23	South Korea	25
24	Greece	24
25	Luxembourg	23
26	Australia	22
27	Poland	21
28	India	20
29	Bulgaria	20
30	Serbia	18
31	Slovenia	17
32	Brazil	17
33	Czech Republic	17
34	Japan	12
35	Norway	12
36	Croatia	11
37	Slovakia	10
38	Lithuania	9

	Country	No. of views
39	Mexico	7
40	Ukraine	6
41	Nigeria	6
42	Turkey	5
43	Iceland	5
44	Latvia	4
45	Argentina	4
46	Philippines	4
47	European Union	4
48	China	3
49	Bangladesh	3
50	Azerbaijan	2
51	Chile	2
52	Algeria	2
53	Pakistan	2
54	South Africa	2
55	Belarus	2
56	Albania	2
57	Ghana	1
58	Gambia	1
59	Kyrgyzstan	1
60	Taiwan	1
61	New Zealand	1
62	Ethiopia	1
63	Macedonia	1
64	Tunisia	1
65	Sri Lanka	1
66	Costa Rica	1
67	Angola	1
68	Israel	1
69	Iraq	1
70	Vietnam	1
71	Singapore	1
72	Thailand	1
73	Malaysia	1
74	Faroe Islands	1
75	Honduras	1
76	Fiji	1