Identifying Gaps in the Current Agri-Environment and Climate Scheme (2014-2020)

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5 December 2016

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1. Introduction

The Strategic Research Programme (SRP, specifically Objective 1.1 of RD1.3.4 Biodiversity management of WP1.3 Biodiversity and Ecosystems) was tasked with identifying potential gaps in the suite of options available to land managers in the current Agri-Environment and Climate Scheme (AECS).

The focus of the effort was on gaps in the options for enhancing biodiversity. Research on improving water quality or carbon sequestration is a feature of other parts of the SRP. Similarly, the focus was on AECS and not the Woodland Grant Scheme.

It is envisaged that this report will be used in two ways. Firstly, it can be used by Scottish Government as the basis for dialogue with stakeholders concerning how to adapt the current AECS to provide support for environmentally friendly farming. Secondly, Objective 2 of RD1.3.4 is tasked with assessing novel agri-environment management options. Whilst some options can be adopted in entirety from those of other countries, it may be that other gaps will need research to develop appropriate management options. The intention is to hold an expert workshop with a range of stakeholders to identify potential options that are unsupported by research and prioritise them.

2. Methodology

Three separate methods were adopted.

2.1 Analysis of other Rural Development Plans

The aim of this part of the analysis was to identify agri-environmental management options that have been adopted elsewhere in Europe and have the potential to be added to future schemes within Scotland.

There are 118 Rural Development Plans that have been adopted by the various countries and regions that make up the European Union. The majority of these are only available in languages other than English, but those available in English were analysed in terms of the management options and capital payments for conservation. These came from Croatia, England, Finland (mainland), Ireland, Lithuania, Northern Ireland, Poland (not full document), Romania, Slovenia and Wales (see Appendix 1).

The list of options and payments from each country was checked against the list of options and payments available within SRDP-AECS. Options from other countries were removed from the comparison if (a) they covered specific species or habitats that did not occur in Scotland, and (b) if the option was very general in application, for example the Finnish option of "Biodiversity in arable land environments" as it was not possible to align these against existing Scottish options. In this case it fitted across multiple Scottish options as it, and similar options, are very broad and adaptable to circumstance.

Each option from other countries' AECS was then reviewed to see if it corresponded to an option capable of delivering similar management and biodiversity in Scotland. The results focus on options available elsewhere where there is no corresponding option in Scotland, and hence the potential for adoption of that option in future agri-environment schemes.

2.2 Analysis of Scottish Biodiversity List species and habitats not covered by the current AECS

The aim of this part of the analysis was to review the Scottish Biodiversity List, as an agreed starting point for species of conservation concern in Scotland, to assess which species, species groups and habitats are poorly served by the current options under AECS. It took advantage of the review work undertaken for the targeting of the current AECS options where the ecology of species was assessed to see if they would or would not benefit from specific options.

The Scottish Biodiversity List (SBL) covers 1947 species. Of these 1247 are listed with a "watching brief" (no action at present). Of the remaining 700, 626 of them are listed as needing conservation action and 560 as needing to avoid negative impacts.

During the filtering process for the development of targeting in the current (2014 – 2020) AECS (SRDP species list v2 1.xlsx), 1205 were considered as too rare for actions under AECS to be appropriate. Of the remaining 732, Scotland has an international obligation for 152, had Biodiversity Action Plans for 173 and 111 have seen more than a 25 % decline. As individual species could fall into one or more of these categories a total of 436 species passed the filtering process and were subject to assessment by experts to see if they would benefit from actions within AECS. To these 436 were added four species not on the SBL, but which were considered as important targets for agri-environment management. Of these 440, 110 were considered by the experts to benefit from AECS and 109 were used in developing the targeting maps. The steps in this process are shown in Figure

2.1. This AECS targeting approach was taken as experts on different taxa had checked species habitat requirements and assessed the impacts of management during the process, so that a good baseline against which to judge the completeness of AECS targeting was available.

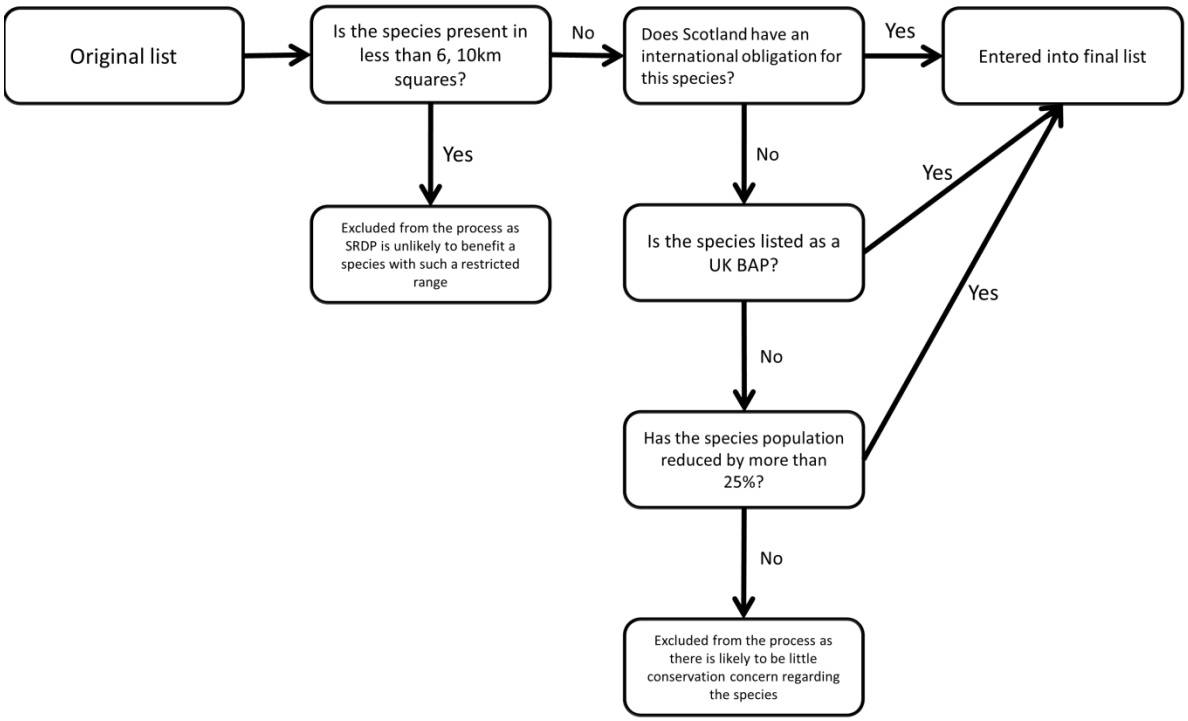

Figure 2.1. Steps used in selecting the species considered for targeting.

The species lists were analysed to identify how each taxon group had fared in the prioritisation and expert assessment process. Further analysis was carried out to assess which main habitats these species were associated with.

The SBL also covers 41 habitats. Of these, four of the Freshwater and Wetland grouping were not considered as they consisted of open water, as were six of the Woodland grouping which are covered under the Woodland Grant Scheme. Of the remaining 31, eight are listed as "Watching brief" only.

The 31 habitats on the habitat list were analysed to see how many options under AECS were applicable to them.

2.3 Stakeholder views on gaps

The stakeholder meeting was held as a workshop session during the Ecosystems and Land Use Stakeholder Engagement Group (ELSEG) meeting on 14 November 2016 at Victoria Quay. The participants were a mixture of government, agency and non-governmental organisation staff.

A brief introduction explaining the rational was presented to the eight workshop participants. The question "What species and habitats are not covered by the current scheme?" was posed. The participants were split into two groups and each spent approximately one hour discussing the question for each of three sub-topics (20 minutes each):

- Annual and perennial crops
- Grass farms
- Uplands and semi-natural habitats

The workshop participants varied in their experience of agri-environment schemes. However, the perspective given from the groups gave an opportunity for consideration of the wider context of AECS rather than an in depth analysis of its gaps.

3. Results

3.1 Analysis of other Rural Development Plans

3.1.1. General impressions of approaches adopted by other countries

Scotland falls roughly in the centre of the approaches in the number of options available for land managers. For instance England and Wales have taken the approach of listing every management action that could be undertaken and also a wide range of habitats for some of these actions. For instance the Scottish option of "Species-rich grassland management" overlaps with Welsh options for "Lowland Unimproved Acid Grassland", "Lowland Unimproved Neutral Grassland", "Calcareous Grassland" and "Lowland Marshy Grassland" with further subdivisions for some into "Pasture" and "Hay Cutting". At the other end of the spectrum, some countries provide very general options with the potential for selecting further actions within them, for example the Polish option of "Valuable habitats outside Natura 2000 areas".

There is obviously a trade-off between the simplicity of a few options, with further sub-options within them, and the presentation of a long-list of very specific options. The former runs the risk of hiding information at first glance whilst the latter runs the risk of burying the potential applicant under too much information.

The Welsh Glastir scheme has an option to select management targets to refine the long list of potential options (e.g. selecting "Arable Plants" gives a list of nine options that can be adopted that should benefit this group of species, http://gov.wales/topics/environmentcountryside/farmingandcountryside/farming/schemes/glastir/glastir-advanced/target-objective-checker-and-how-to-use-guide/?lang=en). The Scottish system achieves a similar objective of reducing the list of choices by limiting the schemes available to a land manager through the targeting of certain options, though the options made available are across the board rather than focussed at a specific species/group of species/habitat.

3.1.2. Options available in other Rural Development Plans

Compiling all options available under AECS from other countries resulted in a list of 634 potential options to assess. After removing those not directly related to biodiversity (e.g. paying for landscape features such as repairing stone barns, managing water quality such as pesticide handling facilities and public access option), that concerned species/habitats/crop systems not found in Scotland and that were very wide in the focus, this left 291 to be assessed against the AECS options from Scotland.

Of these, there was a clear equivalence across 216 of these. The remaining 75 options found in other rural development programs and not the SRDP are tabulated below (Table 3.1), though it should be pointed out this list of 75 contains duplicates contributed by different countries and variations within countries. Also, some options are placed in two rows because they have two potential impacts.

Table 3.1. Agri-environment options adopted in the countries reviewed without a clear equivalent in Scotland

Countries	Target	Options
Arable habitats		
England-mid tier	Pollinators	AB1: Nectar flower mix; AB16: Autumn sown bumblebird mix; AB8: Flower-rich margins and plots; AB15: Two year sown legume fallow
Lithuania	Pollinators	Strips or fields of melliferous [honey-producing] plants on arable land
Northern Ireland	Pollinators	Creation of Pollinator Margins - 10 metre width - Annual Wildflower; Creation of Pollinator Margins - 10 metre width - Pollen and Nectar
Wales	Pollinators	Option 153 – Red Clover Ley
England	Arable plants	AB11: Cultivated areas for arable plants
Croatia	Arable plants	Tilling and sowing on the terrain with slope for arable annual plants;
England-	Farmland birds	AB16: Autumn sown bumblebird mix; AB4: Skylark plots; AB5: Nesting plots for lapwing and stone curlew; AB14: Harvested low input cereal; AB15: Two year sown legume fallow
Northern Ireland	Farmland birds	Lapwing Fallow Plot
Romania	Farmland birds	Arable lands important as feeding areas for Red-breasted Goose (*Branta ruficollis*) (focus areas 4A and 4B)
Wales	Farmland birds	Option 162 – Unsprayed Autumn Sown Cereal Crop for Corn Bunting (Nesting and Feeding); Option 163 – Unsprayed Spring Sown Barley Crop for Corn Bunting (Nesting and Feeding); Option 169 – Unsprayed Spring Sown Cereals, Oilseed Rape, Linseed or Mustard Crop For Lapwing (Nesting); Option 170 – Uncropped Fallow Plot For Lapwing (Nesting)
Coastal habitats		
England	Sand dunes and shingle	CT1: Management of coastal sand dunes and vegetated shingle; CT2: Creation of coastal sand dunes and vegetated shingle on arable land and improved grassland
Northern Ireland	Sand dunes and shingle	Remedial Management Plan - Coastal Sand Dunes - Restricted Grazing
Wales	Sand dunes and shingle	Option 25 – Management of Sand Dunes; Option 25b – Management of Sand Dunes with Mixed Grazing; Option 151 – Coastal Vegetated Shingle and Sand Dunes: Creation
England	Salt marsh	CT3: Management of coastal saltmarsh; CT6: Coastal vegetation management supplement
Northern Ireland	Salt marsh	Remedial Management Plan - Coastal Salt Marsh - Restricted Grazing
Wales	Salt marsh	Option 21 – Management of Grazed Saltmarsh; Option 21b – Management of Grazed Saltmarsh With Mixed Grazing; Option 149 – Saltmarsh:

Countries	Target	Options
		Restoration (No Grazing)
Northern Ireland	Maritime cliffs	Remedial Management Plan - Maritime Cliff and Slope - All Year Grazing; Remedial Management Plan - Maritime Cliff and Slope - Restricted Grazing
Wales	Maritime cliffs	Option 148 – Coastal grassland (Maritime Cliff and Slope)
Northern Ireland	Grazing marsh	Remedial Management Plan - Coastal and Flood Plain Grazing Marsh - Restricted Grazing
<u>Farmland habitats</u>		
England	Enhanced hedgerows	TE1: Planting standard hedgerow tree; TE10: Coppicing bankside trees; TE13: Creation of dead wood habitat on trees
Northern Ireland	Enhanced hedgerows	Creation of Tree Enhanced Boundaries
<u>Grassland habitats</u>		
England	Grassland birds	GS3: Ryegrass seed-set as winter food for birds
Finland	Grassland birds	Crane, goose and swan fields
Ireland	Grassland birds	Conservation of Farmland Birds 4. Geese and Swans; 7. Twite
Wales	Grassland birds	Option 33 – Establish a Wildlife Cover Crop on Improved Land; Option 171 – Grassland Management for Ring Ouzel (Feeding)
England	Haymaking	GS15: Haymaking supplement
Slovenia	Haymaking	Conservation of steep meadow habitats;
Wales-Glastir advanced	General management	Option 401 – Additional Management Payment: Mixed Grazing; Option 405 – Additional Management Payment: Grazing Management For Dung Invertebrates
Croatia	Pollinators	Pilot measure for the protection of butterflies
Northern Ireland	Pollinators	Remedial Management Plan - Marsh Fritillary
Romania	Pollinators	Pastures important for butterflies (*Maculinea* sp.) (focus areas 4A, 4B and 5D)
Slovenia	Pollinators	Grassland habitats of butterflies
<u>Invasive species</u>		
England	Rush control	GS16: Rush infestation control supplement
Northern Ireland	Rush control	Primary Rush Control; Follow Up Rush Control
<u>Orchards and fruit</u>		
Croatia	Orchard management and restoration	Maintaining extensive orchards;
England	Orchard management and restoration	TE3: Planting fruit trees; BE4: Management of traditional orchards; BE5: Creation of traditional orchards; BE7: Supplement for restorative pruning of fruit trees
Ireland	Orchard management and restoration	Traditional Orchards

Countries	Target	Options
Slovenia	Orchard management and restoration	High-trunk meadow orchards;
Wales	Orchard management and restoration	Option 172 – Orchard Management
<u>Upland, peatland and heath</u>		
England-upper tier	Upland birds	UP2: Management of rough grazing for birds
Wales-Glastir advanced	Calaminarian grassland	Option 109 – Calaminarian Grassland
Northern Ireland	Limestone pavements	Remedial Management Plan - Limestone Pavement - All Year Grazing; Remedial Management Plan - Limestone Pavements - Restricted Grazing
Northern Ireland	Montane heath	Remedial Management Plan - Moorlands (Montane Heath)
England-upper tier	Heathland creation	LH2: Restoration of forestry and woodland to lowland heathland; LH3: Creation of heathland from arable or improved grassland
Wales-Glastir advanced	Heathland creation	Option 119 – Lowland Heath Habitat Expansion: Establishment On Grassland
<u>Wetland habitats</u>		
England-upper tier	Ditch management	WT3: Management of ditches of high environmental value; WN3: Ditch, dyke and rhine restoration; WN4: Ditch, dyke and rhine creation

3.2. Analysis of Scottish Biodiversity List species and habitats not covered by the current AECS

3.2.1. Species coverage by AECS targeting

Filtering of the SBL by the criteria used to select species for potential use in targeting options resulted in a preponderance of four groups: birds, fungi and lichens, terrestrial invertebrates and vascular plants (Table 3.2). They represent 88.6 % of the species that passed the filtering, partly reflecting the international importance of species in some of these groups (birds, lichens) and their declines, but also the historical pattern of choice of species to go into the Biodiversity Action Plans. However, some taxon groups were relatively highly represented; the low diversity of reptile and amphibians as well as mammals meant that proportionately high numbers had survived the filtering process.

Table 3.2. The breakdown of species on the Scottish Biodiversity List (SBL) by major taxon groups, the numbers that passed the filtering process during targeting (Filtered) and the numbers actually used in developing the targeting maps in the 2014-2020 Agri-Environment and Climate Scheme. Note that the first stage of filtering should be to remove species not likely to be affected by agri-environmental management – i.e. species that are associated with woodland. Many bryophytes and lichens will benefit from appropriate woodland management but only a few would benefit from agri-environment management.

Main taxon group	SBL*	Filtered* (% of SBL)	Targeting* (% of SBL, % of Filtered)
Aquatic invertebrates	83	4 (4.8)	0 (0, 0)
Birds	108	79 (73.1)	36 (33.3, 45.6)
Fish	13	9 (69.2)	0 (0, 0)
Fungi and lichens	713	117 (16.4)	2 (0.3, 1.7)
Mammals	20	19 (95.0)	8 (40, 42.1)
Non vascular plants	457	11 (2.4)	2 (0.4, 18.2)
Reptiles & amphibians	7	7 (100)	5 (71.4, 71.4)
Terrestrial invertebrates	305	97 (31.8)	14 (4.6, 14.4)
Vascular plants	245	97 (39.6)	42 (17.1, 43.3)
Total	1951	440 (22.6)	109 (5.6, 24.8)

* Includes four species not on the SBL, three birds - Snipe (*Gallinago gallinago*), Oystercatcher (*Haematopus ostralegus*), Redshank (*Tringa tetanus*) - and one moth - Small dark yellow underwing (*Noctua cordigera*) .

The expert judgement as to which species would benefit from AECS options particularly reduced the numbers of species of terrestrial invertebrates and fungi and lichens, leaving birds and vascular plants to make up 71.6 % of the species used in targeting. As might have been expected aquatic species were not used in the targeting of terrestrial options, and groups that had high proportional representation in controlling the targeting included reptiles and amphibians, mammals and birds.

Despite the high numbers of fungi and lichens and of terrestrial invertebrates deemed appropriate for inclusion in the targeting, expert judgement identified that only a small proportion of these species would benefit from the AECS options in place. Particular taxon groups that were impacted were lichens (95 after filtering, 2 identified as benefiting) and moths (71 and 3) – Appendix 2.

3.2.2. Habitat coverage by AECS targeting

Six habitats were classed as not being covered by management options in the current AECS (Table 3.3). Of these, two are in the SBL as only being under a watching brief: Open mosaic habitats on previously developed land, Upland flushes, fens and swamps. One further habitat, Limestone Pavements, is of very restricted distribution in Scotland (c. 300 ha).

The remaining three habitats without clear coverage by AECS options are all coastal habitats: Coastal sand dunes, Coastal vegetated shingle, and Maritime cliff and slopes. However, the options for Coastal Saltmarsh only cover restoration not management, for Machair the options cover only arable cropping and for Coastal and floodplain grazing marsh the options only cover floodplain grasslands.

Table 3.3. Coverage (number of options that apply) of SBL habitats by the current Agri-Environment and Climate Scheme. *Watching brief only.

SBL Habitat	Coverage by AECS	Comments
Coastal		
Coastal saltmarsh	1	Restoration not management
Coastal sand dunes	0	
Coastal vegetated shingle	0	
Machair	1	Cropped machair only
Maritime cliff and slopes	0	
*Coastal and floodplain grazing marsh	2	Not coastal
Freshwater and wetland		
Lowland fens	2	
Lowland raised bog	3	
Ponds	1	Creation of steading ponds, not management
*Reedbeds	2	
Lowland		
Arable Field Margins	4	
*Hedgerows	3	
Lowland calcareous grassland	2	
Lowland dry acid grassland	2	
Lowland Heathland	1	
Lowland meadows	2	
*Open mosaic habitats on previously developed land	0	
Purple moor-grass & rush pastures	2	
*Traditional orchards	1	
Upland hay meadows	1	
Woodland		
Wood Pasture and Parkland	1	
Upland		
Blanket bog	3	
Calaminarian grasslands	1	
Inland Rock Outcrop and Scree Habitats	1	Restricted to remnants on cliffs
Limestone Pavements	0	
Mountain heaths and willow scrub	1	
Upland calcareous grassland	1	
*Upland flushes, fens and swamps	0	
Upland heathland	3	
**Juncus squarrosus-Festuca ovina* grassland	1	
**Nardus stricta-Galium saxatile* grassland	1	

The following habitats were not considered as they were either open water or woodland habitats. Freshwater & Wetland habitats: Eutrophic standing waters, Mesotrophic lakes, Oligotrophic and dystrophic lakes and Rivers. Woodland habitats: Lowland mixed deciduous woodland, Native pine woodlands, Upland birchwoods, Upland mixed ashwoods, Upland oakwood and Wet woodland.

3.3 Stakeholder views on gaps

There were a number of themes that emerged across the three landscape types (Annual and perennial crops, Grass farms, Uplands and semi-natural habitats):

- We could focus on ecosystem services as well as biodiversity;
- There ought to be a long-term approach and consistent funding, as the objectives of the scheme may only be achieved through long-term efforts;
- We need to redesign schemes that consider winter requirements, not just summer feeding and breeding. This applies specifically to waders;
- There ought to be better links between WGS (Woodland Grant Scheme) and AECS;
- There is the opportunity to integrate goose management and raptor schemes with AECS.

3.3.1. Annual and perennial crops

There was a good degree of consistency between the two stakeholder groups. Gaps identified included:

- More efforts to support pollinators, especially in areas of soft fruit production;
- The potential to achieve productivity gains through supporting options that support Integrated Pest Management (IPM);
- Support for silvo-arable systems (agroforestry);
- Support improvements of biofuels production systems to benefit biodiversity;
- Geographically targeted support for the genetic conservation of crop varieties.

As mentioned above there was agreement that support ought to be given to improving ecosystem services, then a number of other options to do this could be considered:

- Soil management aimed at improving quality, increasing soil organic matter (e.g. green manures) reducing erosion and compaction, and supporting nutrient management planning;
- Use of legumes to improve soil quality and support pollinators.

3.3.2. Grass farms

Similarly, there was good agreement across the two stakeholder groups:

- Better support for agro-forestry;
- Support for managing habitat mosaics, including scrub and areas around buildings;
- Support for appropriate management of coastal grasslands, especially with the view of preventing erosion
- There are a number of possibilities that could benefit pollinators, such as widening the range of flowering species by diversification of swards, management for nectar production, and incorporation of legumes into grassland;
- Options that allow for conservation headlands to be used in grazed areas could be developed;
- Break crops are essential in areas where grasslands are often reseeded – the choice of crops could be influenced to benefit other parts of the system, e.g. pollinators;
- There could be more options for wetland creation;

As for cropped systems, support could be used to build up ecosystem services;

- Grasslands could be managed to build up soil function, improve soil structure and resilience;
- Liming could be supported to increase invertebrate population sizes to benefit waders;

Whilst the focus of the workshop was not on improving current options, the following relevant points were made;

- There ought to be a re-examination of the wader options to see where they need extra management included;
- Greater emphasis should be given to the creation and management of lowland species-rich grassland.

3.3.3. Uplands and semi-natural habitats

There was more diversity in opinion between the two groups for this landscape type, potentially as the possibilities for species and habitats options were greater:

- The focus of upland options is currently on moorlands, more could be done to improve the management of montane habitats and upland scrub. This could also include specific options for Juniper management;
- Support for rewilding could be developed under AECS;
- Payments should be made to prevent both under-and over-grazing;
- The options available under AECS are too restricted for peatland habitats. Possible to revert to the wider set of options funded under SNH's Peatland Plan;
- Habitat management to benefit raptors could be supported so that management can move beyond diversionary feeding;
- Options could be developed that provide for species that use the uplands only at certain times – e.g. waders;
- Positive management options for mountain hares could be included.

Managing to improve ecosystem services could be focussed on

- Support for upland wetland conservation to benefit water quality;
- Prevention or repair of erosion;
- Developing options that boost carbon storage outside of peatlands.

4. Discussion

4.1. Cropped and farmland habitats

From the analysis of other countries' AECS it was clear that there were gaps relating to pollinators, arable plants (weeds) and further options could be developed for farmland birds. This gap regarding pollinators was backed up by the stakeholders who also envisioned that management could be developed to support Integrated Pest Management (IPM).

Gap analysis also identified that hedgerow management could be supplemented by the increased planting of standard trees to increase heterogeneity. The stakeholders went further than this and suggested that there could be support for agro-forestry within an arable context.

The gap analysis also indicated that other countries supported orchard management, particularly traditional orchards. Given the dependence of fruit trees on pollinators, there is the possibility of managing for fruit growing (including soft fruits) and pollinators through mimicking options such as the Slovenian option on meadow orchards.

Stakeholders also suggested that biofuel production systems could be examined to identify how their management could be enhanced for biodiversity gains, and also suggested that genetic conservation of crop varieties could be funded via this route.

4.2 Grassland habitats

Gap analysis identified a number of options that could be adopted. These included further options for grasslands birds, including Twite and Ring ouzel, supplements to encourage haymaking and management of grasslands to benefit pollinators, especially grassland butterflies. There were also specific options related to rush control in England and Northern Ireland.

The stakeholders also suggested that benefits for pollinators should be a focus of future options; with suggestions to diversify swards by include more legumes and other nectar rich species. This could be partly achieved by using conservation headlands and by using break crops with multiple benefits. They also felt that greater emphasis should be given to the creation and management of lowland species-rich grassland.

The stakeholders also suggested better support for agro-forestry, for managing habitat mosaics in farmland and for wetland creation. They also suggested merging the goose schemes with AECS so that payments were available to support farms providing geese and swans feeding areas.

4.3 Uplands, peatlands and heath

The gap analysis highlighted that management of specific upland habitats was a feature of other countries' AECS. This included specific management for Calaminarian grassland (covered under Heath management at present), Limestone pavements and Montane heath. The latter habitat was identified by the stakeholders as well; they also identified the need for more support for managing upland scrub and Juniper habitats. Stakeholders also identified that some upland habitats are undergrazed and that payments ought to be structured to both avoid overgrazing and prevent undergrazing. Options for heathland creation/restoration were also a feature of other countries' AECS.

Stakeholders also suggested that the current options for peatland management are too restrictive and that support for rewilding could be considered.

Stakeholders also identified that habitat management to benefit raptors has to move beyond diversionary feeding and there could be positive management for mountain hares. They also identified that management for wading birds has to be integrated between lowland and upland areas. The English-upper tier has an option for "Management of rough grazing for birds". This could go hand-in-hand with re-examining the wader options to make them coherent across habitats and seasons, including the use of lime to build up invertebrate numbers.

4.4. Coastal habitats

Clearly identified in both the analysis of other countries' AECS and in the coverage of the SBL, coastal habitats receive little in the way of support from AECS. Sand dunes and shingle are covered by all the other UK countries, as are Salt marsh and Maritime cliffs by both Northern Ireland and Wales. Coastal grazing mash is also covered in Northern Island. The stakeholder discussions did support appropriate management of coastal grasslands, especially with the view of preventing erosion.

All of these habitats have had their condition assessed as either "Inadequate-improving" (machair), "Bad-improving" (Shingle), "Bad-stable" (Salt marsh) or "Bad-declining" (Sand dunes) during the last round of UK level Habitats Directive reporting (http://jncc.defra.gov.uk/page-6565). East coast sand dunes have seen considerable changes in relation to eutrophication (Pakeman et al. 2016) and a lack of grazing (Pakeman et al. in press).

4.5. Individual species

The current AECS has options that target only a few individual species: corncrake, corn bunting, chough, eagle and hen harrier. This approach is largely followed across the countries investigated, so that few options are followed elsewhere that could be adopted into Scotland's AECS. The exceptions to this are specific management options to benefit Ring ouzel and Twite.

However, what is apparent from the analysis of the SBL species list is that only a small proportion of the list (5.6 %) are considered by the expert panel to benefit from the options available under AECS. Even expressing this as a proportion of species that need either conservation action or avoidance of negative impacts means that only 15.6 % (109/700) of species in these categories are considered as likely to benefit from AECS.

This, in part, reflects the lack of knowledge about the ecology of many species. This is less true for birds and vascular plants as their percentages are high in the final column of Table 3.2. However, we are lacking information regarding the ecology of fungi and lichens, non-vascular plants (mosses and liverworts) and many groups of terrestrial invertebrates, and hence are unsure of what options may currently benefit them or what other options could be developed to provide these benefits.

4.6 Ecosystem Services

The stakeholder workshop identified that AECS could be extended to support benefits wider than the conservation and enhancement of biodiversity. These options could include imposing management to build up soil quality, including soil carbon, and prevent erosion whilst benefiting other services such as pollination.

5. Conclusions

As might be expected in reviewing the gaps in a large and complex policy such as the AECS part of the Scottish Rural Development Plan, a number of areas were identified where there was potential for new options. These covered land holdings where the main form of management were cropping and grazing, as well as areas where managing for environmental benefit was the priority.

The purpose of this gap analysis is not to make recommendation as to future actions, but to highlight areas for consideration and potential future research. The analysis of other countries' AECS, the gaps in coverage of SBL species and habitats and the views of the workshop participants suggest that there are areas where there is already good evidence for successful intervention and where other countries have brought in options. This is particularly true for pollinators in arable areas and for coastal habitats.

There was less certainty over what could be adopted in upland areas in terms of habitat management, though there was support from the workshop for management that focussed on specific species, including raptors. Also, the workshop identified the need to revisit options designed for waders to integrate across habitats and seasons.

What was also clear from the analysis was that our understanding of the ecology of vertebrates and vascular plants is far ahead of that for other groups. Consequently, the benefits of AECS for groups such as moths and lichens will be serendipitous at best. There is no short term fix for this deficiency in knowledge, but without broadening the focus of the benefits of AECS to under-represented groups, there is a risk that their conservation may be hampered by the lack of appropriate wide-scale management.

The end of the current AECS in 2020 offers an opportunity to adapt agri-environment support. This could be through the adoption of new options or by reshaping the support to cover other benefits (services) beyond biodiversity. However, there is always a trade-off present within agri-environment schemes between simplicity of application/operation and the need to provide options which will bring benefits in very specific circumstances. Where this trade-off is made could be affected by how schemes are operated – for instance payment by results could be simpler to apply for and allow targeting of specific species and habitats, but it may be difficult to monitor. Hopefully, this report will contribute to that debate by highlighting areas where options could be adopted or new options developed.

Appendices

Appendix 1. Data sources for the Agri-Environment and Climate schemes of other countries and regions in the European Union.

Croatia
http://www.mps.hr/ipard/UserDocsImages/Postpristupno%20razdoblje%20%20EAFRD/PRR%202014-2020%20finalna%20ina%C4%8Dica%20EN/Adopted_RDP2014-2020_ENG_26May2015.pdf

England
https://www.gov.uk/government/collections/countryside-stewardship-get-paid-for-environmental-land-management

Finland
https://www.maaseutu.fi/en/rural-development-programme/objectives-of-the-program/Pages/default.aspx

Ireland
https://www.agriculture.gov.ie/media/migration/farmingschemesandpayments/glastranche1/GLASTranche1Spec161015.pdf

Lithuania
https://www.nma.lt/index.php/support/rural-development-programme-2014-2020/6721

Northern Ireland
https://www.daera-ni.gov.uk/publications/2014-2020-rural-development-programme-version-2

Poland
http://www.eeb.org/?LinkServID=38E51E44-5056-B741-DB8EB930DA215325&showMeta=0&aa

Romania
http://www.madr.ro/docs/dezvoltare-rurala/programare-2014-2020/PNDR_2014_EN_-_2020_01.07.2014.pdf

Slovenia
http://www.program-podezelja.si/en/rural-development-programme-2014-2020

Wales
http://gov.wales/docs/drah/publications/150206-glastir-advanced-rules-booklet-management-options-2016-en.pdf

Appendix 2

The breakdown of species on the Scottish Biodiversity List (SBL) by major taxon groups, the numbers passing the filtering process during targeting (Filtered) and the numbers actually used in developing the targeting maps in the 2014-2020 Agri-Environment and Climate Scheme.

Main taxon group	SBL*	Filtered*	Filtering as % of SBL	Targeting*	Targeting as % of SBL	Targeting as % of Filtered
Aquatic invertebrates						
Annelid	1	1	100	0	0	0
Crustacean	2	0	0	0	0	-
Insect - beetle (Coleoptera)	74	1	1.4	0	0	-
Insect - dragonfly (Odonata)	1	0	0	0	0	-
Insect - ephemeroptera	1	1	100	0	0	-
Mollusc	4	1	25	0	0	-
Birds						
Bird	105	79	75.2	36	34.3	45.6
Fish						
Bony fish	10	6	60	0	0	-
Jawless fish	3	3	100	0	0	-
Fungi and lichens						
Fungus	161	13	8.1	0	0	-
Lichen	486	95	19.5	2	0.4	2.1
Lichenicolous fungus	28	3	10.7	0	0	-
Non-lichenised fungus	18	6	33.3	0	0	-
Slime mould	20		0	0	0	-
Mammals						
Land mammal	20	19	95	8	40	42.1
Non-vascular plants						
Alga	240	0	0	0	0	-
Liverwort	47	2	4.3	0	0	-
Moss	163	7	4.3	2	1.2	28.6
Stonewort	7	2	28.6	0	0	-
Reptiles and amphibians						
Amphibian	3	3	100	2	66.7	66.7
Reptile	4	4	100	3	75	75
Terrestrial invertebrates						
Insect - beetle (Coleoptera)	14	1	1	1	7.1	100
Insect - butterfly	12	10	83.3	7	58.3	70
Insect - earwig (Dermaptera)	1	0	0	0	0	-
Insect - flea (Siphonaptera)	1	0	0	0	0	-
Insect - hymenopteran	62	5	8.1	3	4.8	60
Insect - lacewing (Neuroptera)	2	0	0	0	0	-
Insect - moth	100	71	71	3	3	4.2
Insect - orthopteran	2	0	0	0	0	-
Insect - spider (Araneae)	18	4	22.2	0	0	-
Insect - stonefly (Plecoptera)	1	0	0	0	0	-
Insect - trichopteran	1	0	0	0	0	-
Insect - true bug (Hemiptera)	4	0	0	0	0	-
Insect - true fly (Diptera)	70	5	7.1	0	0	-
Mollusc	17	2	11.8		0	-
Vascular plants						
Fern	12	4	33.3	1	8.3	25
Flowering plant	233	93	39.9	41	17.6	44.1
Grand Total	1951	440	22.6	109	5.6	24.8

* Includes four species not on the SBL (Snipe *Gallinago gallinago*, Oystercatcher *Haematopus ostralegus*, Small dark yellow underwing *Noctua cordigera*, Redshank Tringa tetanus)

Appendix 3. Options available under AECS in the 2014 to 2020 SRDP

*Not considered in the analysis as their application is too general for comparison or has no direct link to species or habitat conservation.

Arable options
- Unharvested Conservation Headlands for Wildlife
- Wild Bird Seed for Farmland Birds
- Forage Brassica Crops for Farmland Birds
- Stubbles Followed by Green Manure in an Arable Rotation
- Retention of Winter Stubbles for Wildlife and Water Quality
- Beetlebanks
- Grass Strips in Arable Fields
- Water Margins in Arable Fields
- Cropped Machair

Grassland options
- Species-rich Grassland Management
- Water Margins in Grassland Fields
- Wader and Wildlife Mown Grassland
- Wader Grazed Grassland
- Corn Buntings Mown Grassland
- Corncrake Mown Grassland
- Corncrake Grazing Management
- Management of Cover for Corncrake
- Chough Mown Grassland
- Chough Grazing Management
- Hen Harrier Grassland Management

Upland, peatland, moorland and heath options
- Moorland Management
- Stock Disposal
- Away Wintering Sheep
- Summer Hill Grazing of Cattle
- Heath Management (Coastal, Serpentine, Lowland and Special Interest)
- Predator Control
- Wildcat Friendly Predator Control

Wetland and bog options
- Wetland Management
- Lowland Bog Management
- Management of Buffer Areas for Fens and Lowland Bogs

Farmland habitat and feature options
- Management or Restoration of Hedgerows
- Creation of Hedgerows
- Habitat Mosaic Management
- Managing Scrub of Conservation Value
- Tall-herb Vegetation Management
- Ancient Wood Pasture

Small unit options
• Conservation Management of Small Units*
• Cattle Management on Small Units*

Control of invasive non-native species options
• Control of Invasive Non-native Plant Species – Primary Treatment
• Control of Invasive Non-native Plant Species – Follow-up Monitoring and Treatment
• Rhododendron Control – Manual Eradication – Light, Medium or Difficult
• Rhododendron Control – Mechanised Eradication – Light, Medium or Difficult
• Rhododendron Control – Stem Injection Eradication – Medium or Difficult
• Rhododendron Control – Foliar Spray / Treatment
• Rhododendron Control – Follow-up Treatment

Managing water quality and flood risk options
• Converting Arable at Risk of Erosion or Flooding to Low-input Grassland
• Management of Floodplains
• Alternative Watering*
• Coastal Embankment Breaching, Lowering or Removal
• Hard Standings for Troughs and Gateways*
• Livestock Crossing*
• Livestock Tracks*
• Managing Steading Drainage and Rural Sustainable Drainage Systems*
• Pesticide Handling Facilities*
• Restoring (Protecting) River Banks*
• River Embankment Breaching, Lowering or Removal
• Rural Sustainable Drainage Systems – Retention Pond
• Rural Sustainable Drainage Systems – Sediment Traps and Bunds*
• Rural Sustainable Drainage Systems – Swales
• Rural Sustainable Drainage Systems – Wetland
• Water-use Efficiency – Irrigation Lagoon*

Organic options
• Organic Farming: Conversion
• Organic Farming: Maintenance

Public access options
•Improving Public Access*

Targeted capital items
Associated with a management option listed above*

Non-targeted capital items which can stand alone
• Alternative Watering*
• Conversion of Deer Fence to Stock Fence*
• Creation of Wader Scrapes
• Cutting of Rush Pasture
• Deer Census – Helicopter Counts
• Enhancing or Modifying a Deer Fence*
• Enhancing or Modifying a Stock Fence*
• Heather Restoration

- Heather Restoration – Follow-up Molinia Control
- Muirburn and Heather Cutting
- Planting of Dune Grasses
- Pond Creation for Wildlife
- Sand-blow Fencing
- Small-scale Tree and Shrub Planting (on a site not exceeding 0.25 hectares)
- Supplementary Feeding for Golden Eagles
- Upland Habitat Impact Assessment for Deer Management
- Wetland Creation – Field Drain Breaking
- Wetland Creation – Pipe Sluices
- Boardwalk*
- Gabion Basket Retaining Wall *
- Gate – Self-closing, One-way Opening Gate*
- Gate – Self-closing, Two-way Opening Gate*
- New Path – Semi-bound Surface*
- New Path – Unbound Surface*
- Picnic Table*
- Path Drainage Ditches / Pipe Culverts*
- Seats*
- Signage*
- Stock Fence and Stock Gate for Improving Public Access*
- Timber Board and Aggregate Steps*
- Tree Safety for Paths*
- Upgrade to an Existing Path*

Non-targeted capital items which can stand alone without approval from SNH or HES
- Control of Scrub – Follow-up treatment
- Control of Scrub or Woody Vegetation – Primary treatment – Intermediate and Heavy Vegetation
- Control of Scrub or Woody Vegetation – Primary treatment – Light Vegetation
- Control of Scrub or Woody Vegetation – Removal from Site of the Cut Vegetation
- Ditch Blocking – Peat Dams
- Ditch Blocking – Plastic Piling Dams
- Matting to Prevent Damage to Bogs
- Moving or Realigning Ditches
- Stock Bridges for Bog, Fen or Wetland Management*

Non-targeted capital items which must be tied to a management option
- Coppicing of Hedges
- Creation of Wild Bird Seed for Farmland Birds
- Creation of Beetlebanks
- Creation of Buffer Areas for Fens and Bogs
- Creation of Chough Nest Shelter*
- Creation of Cover for Corncrakes
- Creation of Green Manure
- Creation of Grass Strips and Water Margins in Arable Fields
- Creation of Low-input Grassland to Convert Arable Land at Risk of Erosion or Flooding
- Creation of Species-rich Grassland
- Cutting Stock Access Tracks for Bog or Wetland Management*
- Deer Fence*
- Diversionary Feeding for Hen Harriers
- Fence Removal*

- Follow-up Treatment of Bracken – Mechanised or Chemical
- Gate*
- Laying of Hedges*
- Open-range Deer Management
- Planting or Replanting of Hedges
- Post and Rail Tree Guards*
- Primary Treatment of Bracken – Manual*
- Primary Treatment of Bracken – Mechanised or Chemical
- Rabbit-proofing an Existing or New Stock or Deer Fence*
- Replacement or Planting of Individual Trees within Ancient Wood Pasture or Hedgerows
- Restoration of Species-rich Grassland
- Restoring Drystone or Flagstone Dykes*
- Scare and Temporary Electric Fencing*
- Stock Fence*
- Use of Seaweed as a Fertiliser on Cropped Machair
- Vole, Rabbit or Hare Guards*

Datasets

These are available from the author:

SRDP species list v2 1.xlsx [a file created during the targeting process for the current AECS, original held by SG and SNH]

Comparison with other countries.xlsx, sheet Comparison

Gap-analysis.xlsx, sheets AllData! And HabitatsSBL

References

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Pakeman, R.J., Hewison, R.L. & Lewis, R.J. (in press) Drivers of species richness and compositional change in Scottish coastal vegetation. *Applied Vegetation Science.*