IMPROVING THE TARGETING OF AGRI-ENVIRONMENT PAYMENTS

Background

In the current Scottish Rural Development Plan (SRDP) some of the Agri-Environment and Climate Scheme (AECS) options are targeted to specific geographical areas. This targeting was developed by taking distribution data (10 km level) of a set of priority species, an expert panel then assessed which would be positively affected by each AECS option and a map of the number of species per 10 km x 10 km square was then prepared (example in Figure 1a). The targeting area was created by setting a threshold of species density that restricted the option to the areas where spending should have the greatest benefit (Figure 1b). Targeting maps were modified post-hoc to include other areas where the option was considered a priority.

The prioritisation process started with the Scottish Biodiversity List (SBL) and removed species that were very rare (less than six 10 km squares occupied) or were marine species. From this list a new, shorter list was created by keeping species where Scotland has an international conservation obligation, Biodiversity Action Plan species and species that have declined by more than 25 %. This left 83 species, including four not on the SBL added during the process.

(a) (b)

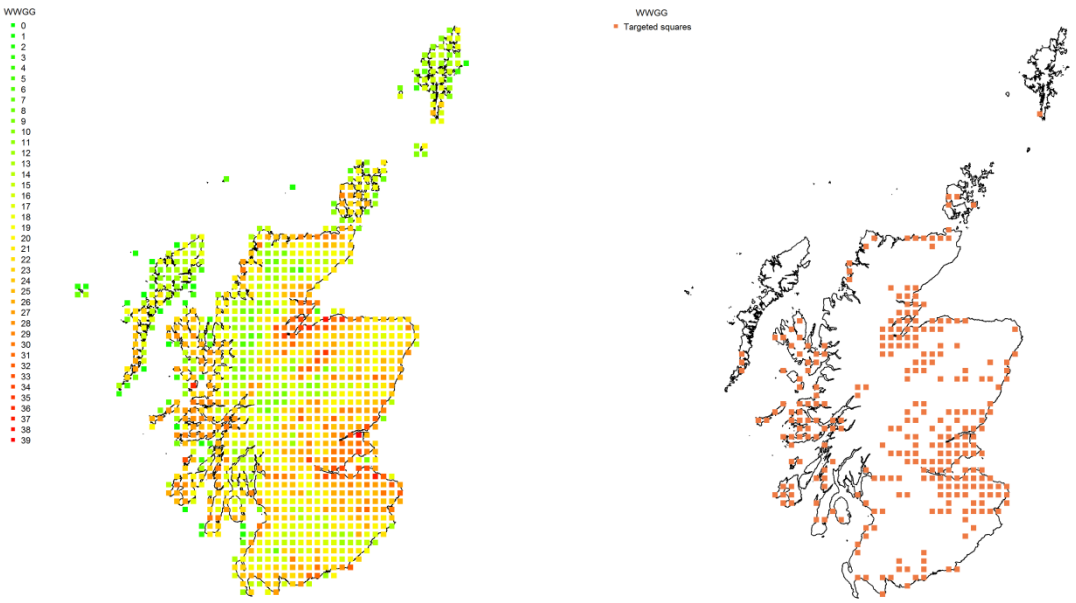

Figure 1. (a) Heat map of species density of species benefiting from Wader Grazed Grassland, and (b) the resulting targeting map highlighting squares with 25 species or more recorded. The targeting map used in AECS had the addition of Lewis, Harris, Orkney and RSPB wader hotspots.

Research carried out

The research focussed on alternative targeting methods to assess if an improvement could be made on the simple setting of threshold approach taken for the 2014-2020 AECS.

The research compared the Simple Targeting method with three other methods: (1) Rarity Weighted Targeting, (2) targeting uniqueness of the 10 km squares[1] (Uniqueness Targeting), and (3)

[1] Legendre, P. & De Cáceres, M. (2013) Beta diversity as the variance of community data: dissimilarity coefficients and partitioning. Ecology Letters, 16, 951–963.

a protected area design software called Marxan[2] which is designed to solve the minimum set reserve design problem: "What is the minimum number of sites, or minimum total area, necessary to represent all species?" (Marxan Targeting). Rarity weighted targeting ensures that rare species have more weight in the analysis, uniqueness targeting means that unusual combinations of species have more weight, whilst the Marxan method attempts to ensure that all species are well represented in the resulting chosen sites.

In order to compare the methods in terms of cost-effectiveness, the "costs" are fixed by setting the number of targeted squares to that of the simple method.

Findings

The Rarity Weighted Targeting and Marxan Targeting (Figure 2a and c) methods produced similar targeting maps to Simple Targeting. Uniqueness Targeting produced maps that had little correspondence to the others.

(a) (b) (c)

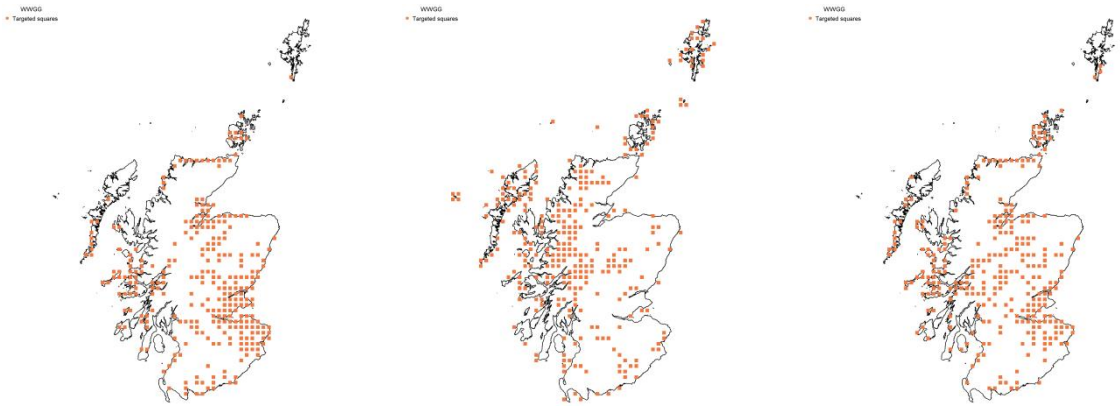

Figure 2. Target maps produced by (a) Rarity Weighted Targeting, (b) Uniqueness Targeting and (c) Marxan Targeting.

The performance of the methods can be assessed by how well the selection of targeted squares ensures that all the priority species are adequately covered. For Wader Grazed Grassland this is illustrated in Figure 3; the proportion of each species' distribution selected in the targeted area plotted against the number of 10 km squares occupied in Scotland. Three of the methods clearly prioritise rarer species (left hand side of each graph) in the selection process (Figures 3a, b and d). Partly this is because the distributions of the rarer species are nested within those of the more common one, and partly because two of the methods are focussed on ensuring that they are covered by the targeting selection (Rarity Weighted and Marxan).

Uniqueness Targeting's focus on community level prioritisation (Figure 3c) does not do a good job of covering any species in the selection process and is, in comparison, poor at targeting the rarer species.

To compare between methods across all the options where targeting is used in the allocation of AECS payments, the mean and minimum coverage of species was compared across all targeted options (Table 1). This clearly shows that Uniqueness Targeting did not perform well using these metrics. The other three are similar, with Rarity Weighted performing best for mean coverage

[2] Possingham, H.P., Ball, I.R., & Andelman, S. (2000) Mathematical methods for identifying representative reserve networks. In: Ferson, S. and Burgman, M. (eds). Quantitative Methods for Conservation Biology. Springer-Verlag, New York, 291-305.

and second best for minimum coverage. Marxan Targeting performed best for minimum coverage but worst for mean coverage, whilst Simple Targeting was second best for mean coverage and worst for minimum. This is reflected in spread of points in Figure 3; some of the rarer species are poorly covered by the Simple and Rarity Weighted methods of targeting (lower left part of each graph).

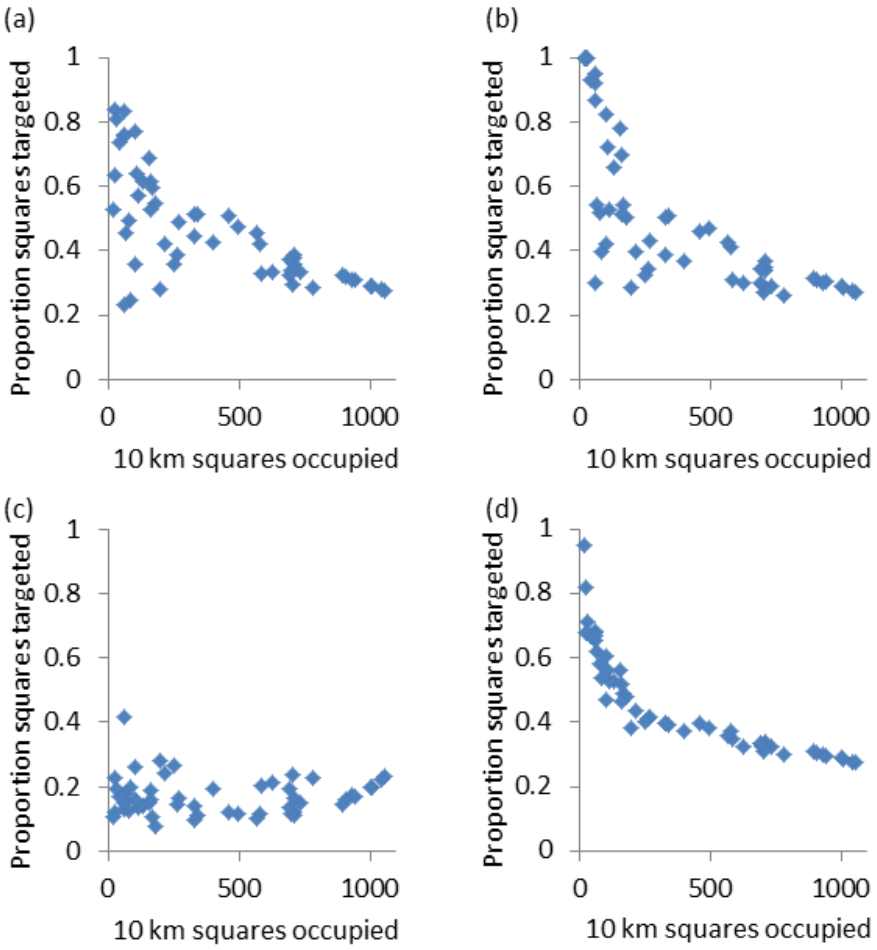

Figure 3. Proportion of the extent of each priority species which ends up in the targeted squares for Wader Grazed Grassland; (a) Simple, (b) Rarity Weighted, (c) Uniqueness and (d) Marxan targeting.

Table 1. Mean values across the mean and minimum proportion of species present in the targeted 10 km squares for the four targeting methods across the eleven options* with targeting.

	Simple	Rarity Weighted	Uniqueness	Marxan
Mean mean proportion	0.545	0.569	0.297	0.529
Mean minimum proportion	0.259	0.348	0.181	0.374

*Beetlebanks, Creation of Hedgerows, Forage Brassica Crops for Farmland Birds, Grass Strips in Arable Fields, Management or Restoration of Hedgerows, Retention of Winter Stubbles for Wildlife and Water Quality, Stubbles Followed by Green Manure in an Arable Rotation, Unharvested Conservation Headlands for Wildlife, Wader and Wildlife Mown Grassland, Wader Grazed Grassland and Wild Bird Seed for Farmland Birds.

The effect of altering the threshold

In setting up the current AECS targeting map decisions were taken by comparing the areas targeted at different thresholds and decisions reached about the appropriateness of the targeting. However, no analysis was done concerning how varying the threshold would act on the how the distribution of each targeted species would be covered at the different thresholds. As can be seen from Figure 4, over most of the realistic thresholds the response of the different methods is largely linear – so that tuning the area targeted has a direct relationship with both the mean of the coverage of each species and the minimum coverage.

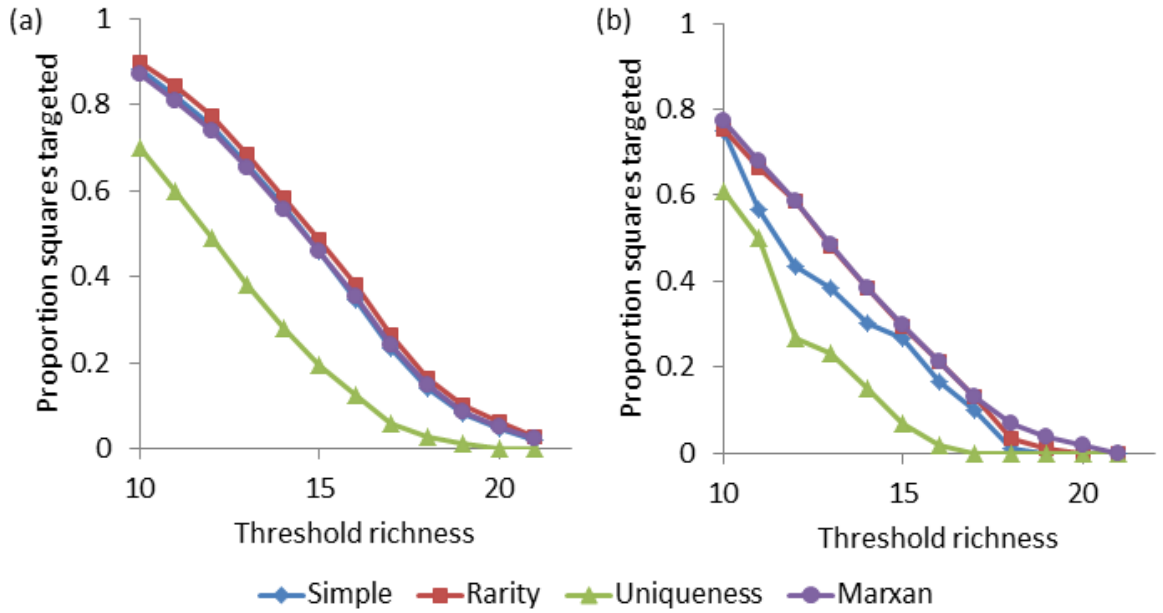

Figure 4. Mean values for (a) the mean and (b) the minimum proportion of species present in the targeted 10 km squares for the four targeting methods for Wader Grazed Grassland when the threshold value for species richness is varied from the current value of 16.

This linear decline parallels the decrease in area covered by targeting as the threshold is increased over the range 12 -18 (Figure 5). At higher threshold values the decline is shallower as there are a few squares with exceptional richness of targeted species.

Of the different methods, a similar pattern is seen as that shown in Table 1. Rarity Weighted is the best method on average (Figure 4a), with Marxan and Simple close behind. However, Simple is much poorer in ensuring minimum coverage than either Rarity Weighted or Marxan, with the latter marginally better. As for the other simulations, Uniqueness does not perform well as a targeting method.

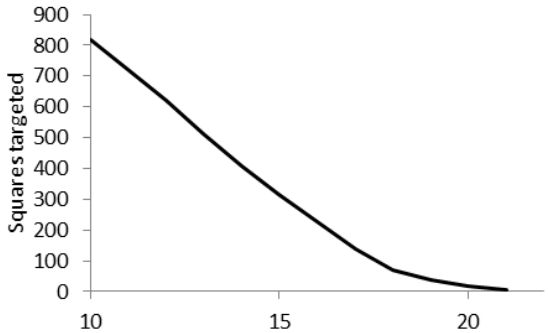

Figure 5. 10 km x 10 km squares identified as targeted for Wader Grazed Grassland when the threshold value for species richness is varied.

Coverage of rare species

Part of the identification process for the species used in targeting was that they could not be "rare", i.e. with less than six occupied 10 km x 10 km squares in Scotland as it was thought that their ecological requirements would be unlikely to be met under AECS. However, stakeholders questioned how good the current targeting would be at covering the range of these rare species.

The Scottish Biodiversity List was taken, the rare species extracted and these reduced to those associated with grassland and arable – i.e. likely to be associated with areas targeted under the 11 AECS options with geographic targeting. This amounted to 32 species[3]. The areas targeted for each scheme with the current thresholds was compared to the distributions of the 32 rare species and mean and minimum proportions compared across the four methods (Table 2). Contrary to the other tests, the Simple targeting method performed best for coverage of the rare species, though the Rarity Weighted method was better at ensuring a minimum representation in the targeted area. It should be noted that all methods would be improved by including the rare species in the allocation of targeted squares.

Table 2. Mean values across the mean and minimum proportion of rare species present in the targeted 10 km squares for the four targeting methods across the eleven options.

	Simple	Rarity Weighted	Uniqueness	Marxan
Mean mean proportion	0.614	0.592	0.243	0.513
Mean minimum proportion	0.208	0.228	0.015	0.152

Policy recommendations

The current simple method of targeting can be improved upon. However, there is a choice to be made about what is most important aspect of a method. If a focus on the less common species is important then using Marxan would ensure that they were adequately covered in the identification of the area to be targeted. However, if this was less important than maximising the coverage across all species, then the Rarity Weighted Targeting should be chosen.

If the current approach to targeting is carried on beyond the 2021 endpoint of the current SRDP, then adopting either the Rarity Weighted or Marxan approaches would improve the targeting of resources to ensure better coverage of the targeted species. Each has their own strengths.

Next steps

In the longer-term it is envisaged that this species targeting work is integrated with datasets on ecosystem services from the Natural Asset Register. This would allow choices to be analysed

[3] Adscita statices, Carex divulsa, Colletes fodiens, Dactylorhiza ebudensis, Entoloma indutoides, Entosthodon fascicularis, Erodium moschatum, Evagetes crassicornis, Filipendula vulgaris, Geoglossum elongatum, Hygrocybe calciphila, Juncus compressus, Lathyrus sylvestris, Limosa limosa, Lindenius albilabris, Linum perenne, Lotus tenuis, Melanoleuca schumacheri, Microbryum curvicolle, Orchis morio, Parentucellia viscosa, Picris hieracioides, Polygonum rurivagum, Priocnemis schioedtei, Rhodocybe gemina, Torilis nodosa, Usnea esperantiana, Valerianella carinata, Vicia bithynica, Viscum album, Weissia longifolia var. longifolia, Zygaena lonicerae subsp. jocelynae

concerning how well targeting for biodiversity met the need for multi-functionality from land management decision making.

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