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# The extent of farmer participation in the rural environment protection scheme – what habitats are actually being protected?

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## *Abstract*

This paper modelled the participation decision of Irish farmers in an agri-environmental scheme. It also uses the sub sample of farmers in the National Farm Survey actively participating in the scheme in 2007 to model the various biodiversity options undertaken as a function of farmer demographic characteristics, farm characteristic and habitat variables. The results of the analysis demonstrate that younger, married farmers with larger farms are more likely to participate in REPS and that the voluntary aspect of REPS can mean that not all habitat types are equally likely to be covered by the scheme. Farmers with internationally important habitats on their farm, like intact peatlands or semi-natural grasslands are more likely to participate in REPS. However, there is evidence to suggest that these farmers are choosing to participate in REPS because they view their land as having low economic value rather than having high ecological value. Farmers with water or wetland and forest are less likely to participate in REPS, which indicates that some important ecosystems may not be included in the scheme. The

biodiversity options undertaken by the farmers are found to facilitate the management of the system of farming on the holing rather than the type of habitats on the land.

## *Introduction*

### The role that the Rural Environment Protection Scheme (REPS) plays in wildlife protection

In 1992, regulation (EEC) 2078 called for the implementation of agri-environmental schemes (AESs) in all EU Member States. The design of these schemes is decided by the Member State in question and is approved by the EU for funding. The Rural Environment Protection Scheme (REPS) has been in existence in Ireland since 1994. Under REPS, farmers enter into a five-year contract with the Department of Agriculture, Fisheries and Food (DAFF) and receive annual payments for farming in an environmentally benevolent manner. A condition of the scheme is that all their land must be managed according to REPS criteria. REPS is available to all farmers in Ireland on a voluntary basis. Farmers must adhere to eleven basic measures and must choose two biodiversity undertaking options (BUs) from a list of 26 to carry out on their farms. (Some farmers with intensive systems may have to take a third BU). According to DAFF, one of the main goals of REPS is to "protect wildlife habitats and endangered species of flora and fauna" (DAFF, 2009). This paper aims to investigate whether this goal is being achieved.

There are a number of opinions in the literature about whether AESs are capable of protecting biodiversity. Some authors argue that the aim of AESs should be to protect specialist species, while others take a generalist viewpoint by looking at changes in overall species abundances in schemes. Specialist species tend to have more intricate habitat requirements than generalist species and are therefore more prone to becoming endangered as they find it increasingly difficult to adapt to habitat changes. Whittingham (2007) and Sutherland (2006) both feel that AESs are failing to protect specialist species because the schemes do not consider the very particular habitat requirements of these species.

The role that REPS plays in protecting specialist species is almost entirely linked with other environmental schemes. The National Parks and Wildlife Service (NPWS), which

is part of the Department of Environment, Heritage and Local Government, is charged with the conservation of a range of habitats and species in Ireland. The EU Birds Directive (79/409/EEC) requires the designation of Special Protection Areas (SPAs) for the conservation of endangered birds, migratory birds and their habitats, such as wetlands. The EU Habitats Directive calls for the creation of Special Areas of Conservation (SACs) to protect habitats and species of European importance. Together, these SPAs, SACs and waterways of importance that have been identified under the Water Framework Directive (2000/60/EC) make up the Natura 2000 network of protected areas in Ireland. In addition, the Irish Wildlife (Amendment) Act of 2000 introduced Natural Heritage Areas (NHAs), which protect areas of national importance in Ireland.

In most areas designated as Natura 2000 sites, current farming practices will not have to change in any significant way and farmers will receive compensation for any loss of income that does result from the fact that their land has been designated (NPWS, 2010). According to conditions 11.5 and 11.9 of the terms and conditions of REPS (DAFF, 2007), if a farmer with a designated site chooses to participate in the scheme, their five-year plan must contain habitat specific requirements for the protected areas on their land. REPS planners have a list of agreed farming conditions that must be met for the following habitat types, once they are included in a designated area:

- The Burren
- Blanket bogs, heaths, upland grasslands
- Sand dunes, machairs
- Shannon Callows corncrake habitat
- Salmonid River SACs

If farmers with designated sites do enter the scheme, they have to enter all their farmland, but they do not have to carry out BUs on their designated land. Farmers with land that has been designated for its riparian zones do not have to enter this land into supplementary measure 4, which exists to protect SACs that are know to contain salmonids, freshwater crayfish or pearl mussels. The only case where mandatory participation for the protection of endangered species exists seems to be for supplementary measure 1. In this case, farmers who participate in REPS that have SPA

designated corncrake habitat must participate in the measure for corncrake habitats, but for all other species of bird, participation is optional.

Aside from these links with designated sites, the only other mention of specific species of plant or animal in REPS is found in the BU options to create bird or bat boxes. While Birdwatch Ireland provides a list of suggested target species for all regions in Ireland (priority species are barn owl, spotted flycatcher, tree and house sparrow, starling, stock dove, kestrel and swallow), there is no list of areas where participation in this BU is mandatory. When it comes to bat boxes, REPS planners are advised to contact NPWS regarding biodiversity interests for each farm but, again, nothing is mandatory. So, the primary role that REPS plays in protecting specialist, endangered species is actually through the enforcement of other environmental laws and not through any real implementations of its own.

Kleijn *et al*. (2006) showed that, in five European countries, AESs were helping to increase the numbers of generalist species in some way. This would have come about because farmers in the scheme would have made certain habitats available to these species through the AESs. There are 6.8 million hectares of land in Ireland, 4.4 million ha of which are devoted to farming (Emerson and Gillmor, 1999). If less than 2 million hectares of Irish land is designated for protection - and this land is not all farmland (Earthtrends, 2003; EPA, 2006) - then it is important to look at what types of habitat in the remaining millions of hectares are being protected.

An example of a review of how generalist species are getting on throughout Ireland can be seen in the Countryside Bird Survey taken by Birdwatch Ireland and the Royal Society for the Protection of Birds (EPA, 2010). According to this report, the distributions of some common farmland birds are increasing, such as the pheasant, the woodpigeon and the collared dove. The distributions of other farmland species, like the kestrel, the cuckoo and the rook, are decreasing. Unfortunately, this review does not include information about whether REPS is playing any role in these distribution changes.

Any examination of changes in overall species abundance on REPS land faces the problem that there are no ecological baseline data for REPS (Feehan *et al.*, 2002). To overcome the problem, this paper has made use of new habitat data to establish how

different habitat types can influence farmers' decisions to participate in REPS. These new data will show whether farmland habitat types that various Irish species need to survive are being protected throughout the country.

## Farmer participation behaviour in agri-environmental schemes

It is important to investigate the causes of farmer participation in REPS for two connected reasons. Firstly, farmer participation in REPS is voluntary, so there are no environmental criteria for joining the scheme. Secondly, once farmers join REPS, they become primary scheme agents working to improve the agricultural environment. If their motives for initially joining REPS are not influenced by the environment, they are unlikely to take this primary agent role seriously. A number of studies are available that look at the reasons for farmer participation in a variety of AESs worldwide. This section looks at how various demographic, farm characteristic and habitat variables have been found to influence farmer participation in this literature.

Younger farmers have been found to be more likely to participate in agri-environmental schemes than older farmers. The reason for this is most likely that younger farmers are more willing to try new schemes. Also, they may be more environmentally aware (Wilson, 1997).

Farm characteristic variables that have been found to influence farmer participation decisions in AESs include farm size and farm system. The effect of the size of a farm on whether farmers participate in agri-environmental schemes has found to be negative (Hynes *et al.*, 2008), inconclusive (Wossink and vanWenum, 2003) and positive (Wilson, 1997; Lynch and Lovell, 2003). The study by Hynes *et al*. (2008) was carried out on REPS farmers, so their finding for farm size is most pertinent to this study. Reasons why the two other studies disagree with the findings of Hynes *et al*. (2008) seem to include the type of agri-environmental scheme and the intensity of the farms.

Lynch and Lovell (2003) carried out their study on voluntary farmland preservation programmes in the USA. Under these programmes, government entities purchase the development rights of the farm. The fact that larger farms are more likely to participate in this scheme would be influenced by the fact that the cost of purchasing developing rights per hectare is less for larger farms than smaller farms. Wilson (1997) was looking at the

effect of farm size on participation behaviour in a local Environmentally Sensitive Area (ESA) scheme in the Cambrian Mountains, UK. Farms in this area are non-intensively farmed. This means that larger farms will be expected to make pretty much the same management changes as smaller farms, but will receive higher ESA payments for participating. This explains why they would be more likely to join the scheme than smaller farms. Lynch and Lovell (2003) found that crop farmers were most likely to participate in farmland preservation programmes, whereas Hynes *et al*. (2008) found that drystock farmers were most likely to participate in REPS.

The quality of the soil on a farm is closely linked to the productivity of the farm, as well as the habitat types on the farm. Hynes *et al*. (2008) found that farmers with good soil types were less likely to participate in REPS than to participate. This finding indicates that more productive farms are less likely to participate in REPS than less productive farms. Dupraz *et al*. (2003) showed that farmers in the Walloon region of Belgium were less likely to participate in agri-environmental schemes if they had highly productive soil and climate conditions on their farms. The Belgian farmers were also more likely to participate in the scheme if they had low yielding meadows. These papers show that farmers may often choose to participate in AESs to supplement their incomes. This behaviour will have negative implications for ecologically important habitats that grow on productive soils, as it is unlikely that they will be included in AESs.

Morris and Potter (1994) separated farmers who participated in agri-environmental schemes into passive and active scheme participants. Economic variables like income support is negatively linked to the likelihood of farmers being active adopters of agri environmental schemes and demographic variables, like levels of environmental awareness, are positively linked to farmers being active adopters of a scheme. For REPS to be deemed successful as an agri-environmental scheme, it needs to be attracting a high number of active participants because they are most likely to take their role as primary scheme agents seriously.

The objectives of this paper are twofold. Firstly, the role that demographic, farm characteristic and habitat variables play in farmers' decisions to participate in REPS will be examined as well as any indication of active participation behaviour. Secondly, the implications of these findings for the Irish environment will be discussed.

## *Data*

Table 1

Description of variables being used to investigate farmer participation behaviour in REPS

| National Farm Survey Data | Description |
|---|---|
| REPS | Farmer participation dummy |
| Farm size | Size of the farm in hectares |
| Farmers' age | Age of farmer in years |
| Married | Marriage dummy for farmer |
| Sheep | Specialist sheep farm enterprise dummy |
| Cattle other | Cattle rearing and fattening farm enterprise combined with other mixed livestock dummy |
| Tillage | Specialist crop production farm enterprises dummy |
| Dairy other | Dairy farm enterprise combined with field crops or mixed livestock production dummy |
| Cattle rearing | Specialist cattle rearing enterprise dummy |
| Dairy | Specialist milk production dummy |
| BUS | Dummy variables for all 26 BU options |
| Habitat Data | Description |
| Damaged bog | Cutover, eroding or bare fen, blanket or raised bog dummy |
| Water or wetland | Water or wetland dummy |
| Semi natural grassland | Wet grassland, heath , coastal complex or bare karst rock dummy |
| Created grassland | Reclaimed fen, blanket or raised bog and bare peat and soil dummy |
| Intact peatland | Intact fen, heath, blanket or raised bog dummy |
| Forest | Semi-natural or plantation mature or understorey forest dummy |

Table 1 shows a description of all the variables that have been used to examine farmer participation behaviour in REPS for this study. All the dummy variables in Table 1 have a value of one if the farmer has the feature in question and a value of zero if he has not. The source of these data, the National Farm Survey (NFS) and new georeferenced habitat data are discussed in the next two sections.

## The National Farm Survey (NFS)

All data relating to farm and farmer characteristics for this chapter come from the NFS. The NFS was set up in 1972 and has been published annually ever since. It consists of a random sample of approximately 1,200 farms, which represents about 115,000 farms nationally. The objectives of the NFS according to Connolly *et al*. (Connolly *et al.*, 2008) are to:

- Determine the financial situation on Irish farms by measuring the level of gross output, costs, income, investment and indebtedness across the spectrum of farming systems and sizes,
- Provide data on Irish farm output, costs and incomes to the EU Commission in Brussels (FADN),
- Measure the current levels of, and variation in, farm performance for use as standards for farm management purposes and
- Provide a database for economic and rural development research and policy analysis.

The NFS data from 2007 are used in this study. The variables farm size, farmers' age, marriage and the six farm system variables in Table 1 all come from this data set. Pig and poultry farms, stud farms, institutional and industrial-type farms and market gardening are excluded from the sample.

Data showing the BUs that farmers chose in 2007 also come from the NFS. 26 BUs is too many to use in this study. In a description of the terms and conditions of REPS, DAFF categorised the 26 BUs according to their objectives, which resulted in five BU groupings (DAFF, 2007). These five groupings, which have been used in this study, are "maintaining farm and field boundaries", "grassland management", "protecting water courses", "retaining wildlife habitats" and "visual appearance of farm and farmyard".

"Maintaining farm and field boundaries" is concerned with hedgerow coppicing and laying as well as additional stonewall maintenance. The BUs in "grassland management" require farmers to encourage traditional hay meadows, species rich grasslands and methods that reduce invasive species and the overuse of fertilisers. Farmers who chose a BU in the grouping "protecting water courses" must exclude animals' access to, create buffer zones for, or increase margins around, water courses. "Retaining wildlife habitats"

involves the creation of new habitats, nature corridors or woodlands as well as planting broadleaved trees. Farmers choosing BUs in the grouping "visual appearance of farm and farmyard" must plant orchards, install bird or bat boxes or provide landscaping around the farm. Finally, "other" is a grouping that includes BUs that require extra care for archaeological sites on the farm or BUs that produce tillage crops respecting environmental principals. Each farmer must choose two BUs (or three if they have intensive farms), so for each REPS farmer in this study, there are at least two BU observations.

## Habitat Data

The habitat data used in this paper came from a habitat indicator map, which was derived from a spatial model implemented in a geographical information system (GIS) using remote sensing sources. These maps are a product of an expert rule based spatial model that exploits the know associations between land cover, subsoils, elevation and location in Ireland. The minimum mapping unit is 1 ha and the total number of habitat types is 29. The geographical locations of each farmer in the NFS were used to link the habitat types of their farm with all the other farm and farmer characteristic information in the scheme.

Table 2 provides an outline of how much of each habitat type is found in Ireland. This is given as a percentage of overall land cover in the country. The commonest habitat type is dry grassland, while sand and salt marsh both only cover 0.01% of the Irish landscape.

Table 2

Percentage coverage of habitat types in Ireland

| Habitat | Coverage (%) | Habitat | Coverage (%) |
|---|---|---|---|
| Sand | 0.01 | Cutover raised bog/fen | 1.12 |
| Salt marsh | 0.01 | Built land | 1.21 |
| Fen | 0.03 | Raised bog/fen | 1.71 |
| Coastal complex | 0.11 | Water | 1.94 |
| Bare rock | 0.14 | Forest U and scrub | 3.04 |

| | | | |
|---|---|---|---|
| Reclaimed fen | 0.16 | Rocky complex | 3.19 |
| Karst bare rock | 0.18 | LBB | 3.22 |
| Bare peat and soil | 0.20 | UBB | 3.37 |
| Cutover/eroding LBB | 0.47 | Mature forest | 3.65 |
| Wetland | 0.54 | Heath | 4.13 |
| Cutover/eroding UBB | 0.57 | Reclaimed raised bog/fen | 4.76 |
| Reclaimed UBB | 0.69 | Wet grassland | 5.74 |
| Reclaimed LBB | 1.03 | Dry grassland | 58.76 |

It was felt that providing a full list of habitat types for each farmer in the NFS would make them identifiable, which violates confidentiality issues. So, habitat data were made available in two ways for this study. Firstly, the data were provided as normalised habitat data: for each habitat, the farm with the largest amount of the habitat was given a value of 1. All other farms are scored according to this value. For example, if a farmer has half the amount of this habitat, he is given a value of 0.5. Secondly, they were provided as dummy variables, whereby any farmer with the habitat type on their farm was given a value of one and those without it were given a value of zero.

These dummy habitat variables have been re-classified to create seven grouped habitat categories. These groupings are shown in Table 1 and have been created according to how the different habitats are viewed by farmers, because the choice to participate in REPS is ultimately theirs. In Ireland, about 50% of agricultural land is used for pasture, 30% is grass converted to silage or hay, 11% is rough grazing and 9% is arable crops, so it is not surprising to see that so many of these habitat groupings are based on grazing (Emerson and Gillmor, 1999).

Habitats that are not generally involved in agriculture, such as built land and bare rock, have been removed from these groupings. Sand and salt marsh were also disregarded as there were not enough observations for either habitat type in the NFS sample. Also, all farms in the 2007 NFS data set had some amount of dry grassland on their farm, so this habitat also had to be excluded from the groupings.

The water or wetland habitat group either has permanent water bodies on it, such as a lake or pond, or it contains swamps or flushes. Generally, these habitats are not very useful for agriculture. Damaged bog has fen and raised or blanket bogs that have been cutover or eroded. The removal of peat from these damaged bogs would have been carried out by hand or machine and the erosion is usually caused by animal grazing (IPCC, 2010). Intact peatland includes intact fen, raised bog and upland and lowland blanket bogs. As agricultural land, both damaged and intact peatlands are only useful for grazing.

Created grassland contains reclaimed peatland and bare peat or soil. In this study, reclaimed peatland means those that have been restored to grassland, but that still have a subsoil of peat. While agriculture is often a good use for reclaimed peatland, there can be problems with it. These problems include peat subsidence, nutrient deficiencies and flooded grassland (Renou and Farrell, 2004). Semi-natural grassland includes wet grasslands, heath, coastal complexes and bare karst rock. Farmers would view these habitats as being suitable for grazing animals when intact or as habitats that could be improved for agriculture using lime, fertiliser or drainage (IPCC, 2010).

Forest habitats in Ireland include both planted and semi-natural mature and understorey forests. Planted forests are mostly coniferous and semi-natural woodlands are the nearest forests that we have to natural in the country. The main economic use farmers get from these habitats is through forestry. Otherwise, these habitats are mainly found at the edge of fields or as hedgerows on farms (Fossitt, 2000).

## *Theoretical Framework and Estimation Methods*

For any farmer, the utility derived from participating in REPS can be expressed as:

$$U_{REPS}(P + N, \bar{E}; Z) \qquad (1)$$

where P is the REPS payment, N is family farm income, Z is a vector of farm and farmer characteristics that affect utility and $\bar{E}$ is the additional effort that is necessary on the part of the farmer to meet the requirement of REPS.

Alternatively, the utility for not participating in REPS can be expressed as:

$$U_A (N, 0; Z) \quad (2)$$

where the 0 shows that if the farmer decides not to participate in the scheme, there is no additional effort expected of him. The decision function can therefore be given as:

$$Y_i^* = U_A (N, 0; Z) - U_{REPS} (P + N, \overline{E} ; Z) \quad (3)$$

The value of $Y_i^*$ is not actually witnessed; instead a discrete participation indicator is observed, where Y = 0 if $Y_i^* > 0$ and otherwise Y = 1 (i.e. a value of 1 indicates the farmer is participating in REPS and a value of 0 indicates he is not). The decision function that the farmer evaluates when contemplating joining the scheme can be rewritten as:

$$Y_i^* = U_A(N, 0; Z) - U_{REPS}(P = N, \overline{E} ; Z) = X\beta + \varepsilon \quad (4)$$

where X is a vector containing proxy variables for P, N, $\overline{E}$ and Z; β is a parameter vector and ε is an error term. This decision can be fitted to the NFS data using a maximum likelihood logit model where the model fitted is:

$$Pr (Y_i^* \neq 0|X_j) = [\exp (X_j\beta)]/[1 + \exp(X_j \beta)] \quad (5)$$

and the likelihood function is given by:

$$\ln L = \sum_{i \in S} . \ln F(X_j\beta) + \sum_{i \neq S} . \ln \{1 - F(X_j\beta)\} \quad (6)$$

where S is the set of all farmers, such that $Y_i^* \neq 0$, $F(X_j\beta) = [\exp (X_j\beta)]/[1 + \exp(X_j \beta)]$.

The second component in the modelling undertaking in this paper relates just to those farmers in our sample who are actively participating in REPS. Once the farmer has decided to enter REPS then he must make a decision in relation to which two BUs, out of a choice of 26, he will choose. To capture this decision making process (which it should

be noted is advised on by a REPS planner) we use a reduced form multinomial logit model that specifies the effect of characteristics of different types of farmers on the uptake of the alternative BUs within the scheme. In terms of utility the choice options presented to the REPS farmer involves making trade offs between what will be needed in management changes under each BU but there is no variation in the monetary compensation between these options.

## *Results and discussion*

Table 3 shows a comparison of different habitat types on REPS and non-REPS farms. Normalised habitat data were used to create this table. Column t shows the results of equal variance t tests for each habitat type – the null hypotheses for these t tests are that the average amount of habitat type on REPS farms are equal to the average amount of the same habitat type on non-REPS farms. A negative sign on the t-value means that REPS farms have more of the habitat type in question than non-REPS farms. The average amount of raised bog or fen, heath, forest understorey or shrub, lowland blanket bog or wet grassland is significantly higher on REPS farms than on non-REPS farms. The average amount of bare peat and soil, wetland and dry grassland is significantly higher on non-REPS farms than REPS farms.

Dry grassland habitat makes up 58.76% of the landcover in Ireland (Table 1). The fact that the average amount of dry grassland on a REPS farm is significantly lower than the average amount on a non-REPS farm is problematic. The reason that farmers choose not to enter farms with this habitat class into REPS may be because it is very productive grassland. However, this habitat type also contains ecosystems of high biodiversity value, such as lowland hay meadows or calcareous grasslands, which can have high numbers of orchids (Fossitt, 2000).

Table 3

Results of equal variance t-tests on normalised habitat data comparing the average amount of habitat on REPS farms to the average amount of habitat on non-REPS farms.

| Habitat | t | Habitat | t |
|---|---|---|---|
| Sand | … | Cutover raised bog/fen | -1.6 |

| | | | |
|---|---|---|---|
| Salt marsh | … | Built land | 1.8* |
| Fen | -0.8 | Raised bog/fen | -3.6*** |
| Coastal complex | 1.6 | Water | 0.5 |
| Bare rock | -1.3 | Forest U and scrub | -2.1** |
| Reclaimed fen | 0.8 | Rocky complex | -1.0 |
| Karst bare rock | 0.8 | Lowland blanket bog | -1.8* |
| Bare peat and soil | -2.7*** | Upland blanket bog | 1.0 |
| Cutover/eroding LBB | -1.3 | Mature forest | -0.3 |
| Wetland | 1.9* | Heath | -1.7* |
| Cutover/eroding UBB | -0.5 | Reclaimed raised bog/fen | -1.2 |
| Reclaimed UBB | 0.2 | Wet grassland | -2.8*** |
| Reclaimed LBB | -0.1 | Dry grassland | 2.8*** |

Degrees of freedom: 966

Table 4 shows a breakdown of the results obtained from a binary logit of the REPS participation decision made by farmers. The NFS weighting factor has been incorporated into this analysis because some sectors of the sample only have a small number of representative individuals. The results for the binary logit are provided as odds ratios. Odds ratios are given as:

$$\frac{\text{The odds of a farmer participating in REPS}}{\text{The odds of a farmer not participating in REPS}}$$

So, a value less than one indicates that a farmer is *ceteris paribus* less likely to participate in the scheme for the given variable and a value above one indicates that the farmer is more likely to participate.

Table 4

Results of a binary logit on the REPS participation decision made by Irish farmers

| REPS | Odds Ratio |
|---|---|
| Farm size | 1.001(3.98)*** |
| Farmers' age | 0.9802(-32.42)*** |
| Married | 2.266(46.22)*** |

| | |
|---|---|
| Sheep | 3.542(45.40)*** |
| Cattle other | 2.042(31.49)*** |
| Tillage | 2.510(27.30)*** |
| Dairy other | 1.618(14.72)*** |
| Cattle rearing | 1.729(21.55)*** |
| Damaged bog | 1.355(12.56)*** |
| Water and wetland | 0.700(-23.04)*** |
| Semi natural grassland | 1.566(21.09)*** |
| Created grassland | 0.948(-3.00)*** |
| Intact peatland | 1.523(20.92)*** |
| Forest | 0.860(-9.96)*** |

Z value in parentheses, n = 923 (85,281 with weights). - 412 REPS farmers, 511 non-REPS farmers, log likelihood = -54911.879.

Younger, married farmers with larger farms are more likely to participate in REPS than not participate. Younger farmers are generally considered to be more environmentally aware and open to the idea of new management than older farmers, which might explain why they are more likely to participate in REPS than older farmers. Married farmers may be more likely to participate in REPS than unmarried farmers because they have extra help with the running of the farm and with the implementation of the increase in workload that REPS brings. The finding for farm size does not agree with those of Hynes *et al*. (2008), who found that in 2005, farmers with smaller farms were more likely to participate in REPS. This may be showing that REPS4 has been more attractive to farmers with more land than previous REP schemes.

The base case of farm system in this logit is dairy. This means that all the farm system results in this table are in comparison with dairy farms. The farm systems that are most and least likely to be found in REPS, respectively, are sheep and dairy farms. Irish farms can be defined as extensive (those that produce less than 170Kg of nitrogen per hectare) or intensive (those that produce more than 170Kg of nitrogen per hectare). Sheep farming is generally extensive and dairy farming is generally intensive. An extensive level of production was an entry requirement for earlier REPS schemes. It created an adverse selection problem whereby farmers who generated the least amount of pollution in the

first place were the most likely to participate in the scheme. Fortunately REPS4 has introduced nitrates derogations for farms with intensive production levels. The odds ratio for the tillage dummy, which is also an intensive farm system, is 2.510 in comparison with dairy. This finding may be showing that some of the earlier problems of adverse selection are being reversed.

Farmers with the habitat groupings damaged bog, semi-natural grassland and intact peatlands on their farm are all significantly more likely to join REPS than not. According to the EU Habitats Directive (92/43/EEC), raised bogs are a priority habitat because they are very scarce throughout Europe. Similarly, there are many ecologically important habitats within the semi-natural grassland grouping such as acid grasslands, machair and limestone pavements. Heath is also an important ecosystem because it provides shelter for species like stonechat, skylark, meadow pipit, hen harrier and merlin (IPCC, 2010).

That farmers with damaged bog are significantly more likely to participate in REPS than not participate in REPS may be because peatlands make poor agricultural land or because they would like to fix the ecological problems on their land. Farmers with intact peatlands and semi-natural grassland may be more likely to participate in REPS for similar reasons: that their land has low agricultural value or that they want to protect their landscapes further. This link between poor agricultural productivity and certain habitat types makes the identification of active REPS participants difficult to distil.

Farmers with the habitat groupings water and wetland, forest and created grassland on their farms are significantly less likely to participate in REPS. It is not clear why farmers with forest or water and wetland habitats on their land are less likely to participate in REPS than participate. Considering how important wetlands are for birds in particular, and that semi-natural woodlands support diverse insect fauna and provide essential food sources for many other animal species, this is not a good finding for the protection of Irish biodiversity. It may be showing up that the voluntary nature of REPS does not allow for all habitat types to be represented in the scheme (Grime *et al.*, 1996; EPA, 2006).

Table 5

Results of a multinomial logit on REPS farmer participation in different Biodiversity undertaking options.

| Variable | Grassland management | Protecting watercourses | Retaining wildlife habitats | Visual appearance of farm and farmyard | Other |
|---|---|---|---|---|---|
| Farm size | 1.006(10.27)*** | 1.004(9.65)*** | 1.006(17.58)*** | 1.005(7.91)*** | 1.017(16.22)*** |
| Farmers' age | 0.992(-5.28)*** | 1.020(21.44)*** | 0.995(-5.17)*** | 0.999(-0.03) | 1.026(12.03)*** |
| Married | 0.909(-2.15)** | 0.721(-12.62)*** | 0.801(-8.64)*** | 0.748(-7.07)*** | 0.733(-5.10)*** |
| Sheep | 1.101(1.48) | 0.546(-15.59)*** | 0.963(-1.12) | 0.952(-0.84) | 5.056e-15(0.00) |
| Cattle other | 1.961(12.44)*** | 0.922(-2.53)** | 0.688(-11.71)*** | 1.565(8.98)*** | 0.117(-24.51)*** |
| Tillage | 0.298(-9.55)*** | 0.978(-0.47) | 0.828(-4.12)*** | 0.851(-1.95)* | 2.337(13.25)*** |
| Dairy other | 1.717(6.84)*** | 0.883(-2.43)** | 2.068(17.34)*** | 0.740(-3.36)*** | 0.200(-11.55)*** |
| Cattle rearing | 1.696(8.32)*** | 0.916(-2.44)** | 1.097(2.74)*** | 0.805(-3.45)*** | 0.714(-5.05)*** |
| Damaged bog | 1.684(8.92)*** | 0.926(-2.43)** | 0.727(-9.95)*** | 0.414(-14.50)*** | 0.073(-15.20)*** |

| | | | | | |
|---|---|---|---|---|---|
| Water or wetland | 0.800(-5.67)*** | 1.078(3.45)*** | 1.177(7.69)*** | 0.982(-0.52) | 1.317(5.29)*** |
| Semi natural grassland | 0.928(-1.67)* | 1.623(14.49)*** | 0.680(-13.99)*** | 2.222(14.03)*** | 0.793(-3.77)*** |
| Created grassland | 0.629(-11.20)*** | 1.363(12.37)*** | 0.831(-7.48)*** | 0.533(-15.92)*** | 0.987(-0.23) |
| Intact peatland | 0.550(-11.15)*** | 0.833(-6.75)*** | 1.349(11.26)*** | 1.929(15.21)*** | 1.271(3.5)*** |
| Forest | 0.621(-13.87)*** | 0.777(-12.03)*** | 1.628(22.64)*** | 0.610(-15.00)*** | 1.279(-24.20)*** |

Z values in parentheses. Note: n = 831 (70,782 with weights), log likelihood = - 95033.62

Table 5 shows the results of a multinomial logit of REPS farmer participation behaviour in the five BU groupings described above, using dependent variables listed in Table 1. As with the binary logit, NFS frequency weights have been used for this analysis. The change in population size from 923 in Table 4 to 831 in Table 5 is explained by the fact that the data used in Table 5 do not include the entire 2007 NFS sample as non-REPS farmers do not choose BUs. Also, each farmer in REPS makes at least two BU choices, so there are at least two observations for each farmer in this sample. The base category for the BU groupings in this multinomial logit is "maintaining farm and field boundaries", which means that all the results in Table 5 are given in comparison with this grouping. The results for the multinomial logit are also provided as odds ratios. In this case the odds ratios are given as:

$$\frac{\text{The odds of a farmer participating in the given BU grouping}}{\text{The odds of a farmer participating in the base BU grouping}}$$

None of the findings for farm size or system in Table 5 are particularly surprising. "Other" contains a lot of options designed for tillage farmers, which would explain why tillage farmers are most likely to choose this BU. It also helps to explain why the largest significant effect on increasing farm size can be seen for farmers who chose this option. In comparison with the base system dairy, sheep, cattle other and cattle rearing farmers are most likely to choose the BU grouping "grassland management". This may be because these systems generally require extensive levels of grazing and the farmers will not have to alter their management strategies too much. In comparison with dairy, dairy other farmers are most likely to choose "retaining wildlife habitats", perhaps because, as farmers with more intensive grazing plans, they prefer the idea of sectioning off part of their land for wildlife to altering their production methodologies.

Farmers with damaged bog are most likely to choose the BU "grassland management", which does not suit the habitat requirement of bogs. Farmers with intact peatlands and semi-natural grassland are most likely to choose the BU "visual aspects of farm and farmyard". If farmers end up planting orchards under this BU, they could greatly damage the intact peatlands or semi-natural grassland. If they put up bird or bat boxes it should not damage the habitats, but this BU choice will not protect them either. In fact, the least

likely option that farmers with semi-natural grassland chose was "retaining wildlife habitats".

Farmers with intact peatlands and semi-natural grasslands habitats on their farms are more likely to participate in REPS than not (Table 4), but the BU options that they are most likely to choose do not reflect the importance of these habitat types. Intact peatlands and semi-natural grasslands make up 18.46% of the land cover of Ireland (Table 2). Perhaps farmers view these habitats as common wastelands and choose to participate in REPS to maximise profits from their unproductive land rather than because they are active participants in the scheme.

Gwyn *et al*. (2003) feel that the problem of overlooking different important habitats in REPS plans comes from the "black and white habitat-or-not choice" that the scheme forces planners to make. This means that, unless land has been designated as a Natura 2000 or NHA site, advisors have to single-handedly decide the ecological value of farmland, which is a big ask.

If habitats are not being recognised for their ecological importance, then REPS farmers certainly are not being advised about how to maintain said habitats appropriately. Peatlands and semi-natural grasslands will be succeeded by scrubland and then forest if grazing pressure is relaxed. However, many of these habitats are also sensitive to overgrazing. For example, it is estimated that around 20% of the upland areas of blanket bogs in Ireland may be affected by soil erosion due to overgrazing at some level (Foss *et al.*, 2001). Farmers should be given AES plans that recognise and encourage their role in maintaining semi-natural landscapes and that discourages them from doing anything that could damage specific habitats on their farms (Gwyn *et al.*, 2003).

Farms with forest habitat are most likely to choose the BU "retaining wildlife habitats". As these farmlands would have been allowed to develop into forest anyway, fencing them off for wildlife habitats would not be a big management change for farmers. "Maintaining farm and field boundaries" is only the third most likely BU these farmers chose, despite the fact that it includes hedgerow coppicing and laying. That farmers with the habitat type water or wetlands are most likely to choose the BU "other" is unexpected and not appropriate for this habitat type at all.

## *Conclusion*

This paper firstly modelled the participation decision of Irish farmers in an agri-environmental scheme REPS. It also used the sub sample of farmers activily participating in the scheme in 2008 and modelled the various biodiversity options undertaken as a function of farmer demographic characteristics, farm characteristic and habitat variables. The results of the analysis demonstrate that younger, married farmers with larger farms are more likely to participate in REPS and that the voluntary aspect of REPS can mean that not all habitat types are equally likely to be covered by the scheme. Farmers with internationally important habitats on their farm, like intact peatlands or semi-natural grasslands are more likely to participate in REPS. However, there is evidence to suggest that these farmers are choosing to participate in REPS because they view their land as having low economic value rather than having high ecological value. Farmers with water or wetland and forest are less likely to participate in REPS, which indicates that some important ecosystems may not be included in the scheme.

The BU options that farmers choose seem to overwhelmingly suit the system of farming on the land rather than the type of habitats on the land. They are chosen on the basis of ease of emplimentationwithin the current management system rather than being choosen to meet the conservation requirements of the actual habitats on the ground. This shows a lack of understanding of the importance of certain habitat types on Irish farmlands and what the primary function of an agr-environmental scheme should be. The results of this study indicate that many of the REPS plans being created for farmers may not have been designed in a way that encourages the continued maintenance of what are predominantly semi-natural habitats that require some level of human management.

At the time of writing, REPS4 is being wound down to be replaced by a new, smaller scale Irish AES. Some of the findings in this paper could be used to improve the design of this new scheme. Future Irish AESs should be focussed on identifying important habitats on farms and ensuring that farmers are obliged to choose options that are tailored to the protection of those habitats – something that it would appear is not always the case in the current design of REPS.

The BU groupings used in this paper come from an outline of REPS provided by DAFF. An avenue for future research would be an investigation into BU groupings

according to the amount of effort they require, their aesthetic values and the extent of management changes required of them. This could provide further useful information about how farmer participation decisions are helping to protect Irish farmland habitats.

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