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Pastoral farmland habitat diversity in south-east Ireland

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ABSTRACT

In this study, habitat surveys were undertaken on 50 grass-based farms in SE Ireland and data digitised onto aerial photography. Additional data i.e. stocking rates, and participation (or otherwise) in the Irish Rural Environment Protection Scheme (REPS) were collected and analysed as possible explanatory variables for farm habitat composition.

Results indicated that approximately 14.3% of the land area of sampled farms comprised of semi-natural habitat types, a proportion substantially greater than has been reported for many other European countries. The most frequently recorded semi-natural habitats included, field boundaries, scrub, and deciduous and riparian woodlands.

Multivariate analysis of farm habitat configuration showed a strong dichotomy between dairy and non-dairy farming systems. Habitats such as intensively managed grassland and built ground were closely associated with dairy-based enterprises. In contrast, the incidence of other habitat types was associated with non-dairy and/or REPS participating enterprises. The ecological quality of field boundaries as assessed by the Field Boundary Evaluation and Grading System (FBEGS) Index was significantly greater on dairy, compared with dry-stock farms.

This dichotomy in farm habitat composition is not reflected within current Agri-Environment (AE) policy. Integration of locally important drivers of habitat diversity into the design and implementation of AE policy, is integral to the successful performance of AE schemes.

1. Introduction

Despite the ambitions of the 1992 Convention on Biological Diversity (CBD), the continued homogenisation and simplification of European agricultural landscapes and intensification of farming systems are associated with an ongoing decline in biodiversity (e.g. Green et al., 2005; Donald and Evans, 2006). At the global scale, this trend is likely to continue as an 18% increase in the total land area devoted to agricultural production is projected by 2050, with a consequent loss of 10^9 ha of natural ecosystem (Jackson et al., 2007).

Agricultural land currently accounts for approximately 50% of the land area of the EU (Donald et al., 2002). Approximately 50% of the biotopes listed in the EU Habitats Directive (Council Directive 92/43/EEC) occur on low intensity farmland (Bignal and McCracken, 1996). This fact alone highlights the potential importance of land management by farmers in achieving the objectives of the CBD. Across the EU approximately 10.5% and 13.3% of the terrestrial land area is afforded statutory protection through designation as Special Protection Areas, and Special Areas of Conservation, respectively (EUROPA, 2009). Within Ireland a total of ~15% of land area used for agricultural production is protected in this way (DAFF, 2007). However, it is now widely accepted that the continued existence of many species, including those which are still relatively common, is heavily dependent on the maintenance of diverse agricultural practices, and the retention of a matrix of semi-natural habitat, within the farmed landscape (Donald and Evans, 2006; McMahon et al., 2008; Sheridan et al., 2008).

Changes in Irish land use identified through CORINE land cover assessments made in 1990 and 2000, include a 35% increase in arable land (this category includes land used for silage production), a 31% increase in artificial surfaces and a 23% increase in afforested land. These changes have principally been at the expense of areas under permanent pasture, mixed farmland and wetland habitats (EPA, 2007). Similar reductions in semi-natural habitat area have been documented throughout much of Europe. In Sweden, an estimated 80% reduction in the area of semi-natural grassland occurred in the period 1870–1990 (Berg and Gustafson, 2007). Data for

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Northern Ireland over the period 1987–1998, show a 33% increase in improved grassland and a 12% increase in coniferous plantations, at a cost of 19% loss of fen, marsh and swamp habitats, and 8% and 7% reductions in bog and calcareous grassland habitats, respectively (Cooper et al., 2003).

Surprisingly little attention has been afforded to quantitative and qualitative assessment of habitats at farm scale and in particular to the farm management factors which influence the quantity of 'non-cropped' and other semi-natural habitat types which have been retained on farmland. This study seeks to address this deficiency through the classification and quantification of habitats on 50 farms located in S.E. Ireland. We hypothesise that farm habitat composition and ecological condition, is influenced by the type of farming system in operation and its level of intensity, as measured by stocking rate. We also aim to investigate whether farms participating in the Irish Agri-Environment Scheme, Rural Environment Protection Scheme (REPS), differ from non-participating farms in terms of their habitat configuration.

2. Materials and methods

Habitat surveys were undertaken on 50 farms located in SE Ireland over a 12-month period from September 2005. Farms were primarily pastoral, which account for over 90% of the total agricultural area of Ireland (DAFF, 2009).

The sample only included farms located at <100 m.a.s.l and managed on a full-time basis by a single farmer/family. They were selected from the Teagasc National Farm Survey database (NFS) (Connolly et al., 2004). Farms were stratified according to NFS livestock category type and then randomly selected within each of the counties (i.e. Cork, Waterford, Kilkenny, Carlow, Wexford, Wicklow and Meath). NFS livestock categories refer to the dominant farm enterprise (Table 1) and are based on the EU farm typology specified in Commission Decision 78/463 and its subsequent amendments (Connolly et al., 2004). In addition, the NFS also provided data relating to livestock type and number and participation status within the Irish Agri-Environment Scheme i.e. Rural Environment Protection Scheme (REPS) for each farm. Farm stocking rate was calculated on the basis of livestock units per hectare of Utilised Agricultural Area (UAA) (Connolly et al., 2004).

2.1. Habitat surveys

A survey of farm habitats was undertaken on the principal farm holding following the Draft Habitat Survey Guidelines (Heritage Council, 2005) and classifying habitats according to Fossitt (2000). Fields were walked along their longest diagonal and a comprehensive, though not exhaustive visual assessment of the component species and their abundance was recorded according to the DAFOR scale (Kent and Cooker, 1992). Field margins i.e. areas within 1.5 m of the field boundary, were excluded from this assessment. Fields were subsequently assigned to one of the grassland types presented in Table 2.

The classification of all other semi-natural, agricultural and built ground habitats on the surveyed farms followed Fossitt (2000). Watercourses were classified as seasonal or permanent, the latter following the REPS definition as one which carries water for nine months/year. All habitats were grouped on the basis of their perceived agricultural productivity i.e. 'cropped – agriculturally productive', 'cropped – agriculturally marginal', 'non-cropped – semi-natural' and 'other' (Table 3).

The majority of permanent field boundaries were hedgerows. These were classified as either stock-proof or non-stock proof. Other types of permanent field boundaries that were recorded, included tree-lines, grassy banks and stonewalls. A more detailed ecological evaluation of a single field boundary on each farm was undertaken between April and July 2006, using the Field Boundary Evaluation and Grading System (FBEGS) (Collier and Feehan, 2003). For this purpose a field boundary was defined as 'a permanent hedgerow or stonewall with homogenous management and orientation'. To ensure independence of sampling, all field boundaries were assigned a number and one randomly selected per site (McMahon et al., 2010).

Selected field boundaries were walked to assess the various aspects of the boundary: (a) Boundary Structure i.e. mean height and width; (b) Associated Features i.e. earthbanks, drainage ditches, field margins; (c) Boundary Connectivity i.e. gaps and connectivity to other boundaries and habitats; (d) Botanical Diversity i.e. native and non-native shrub species richness; and (e) Boundary Type i.e. orientation and slope. Each of these components was assigned a score between one and five, with one being the worst and five being the best. For example, a hedgerow with an average height and width at its base of $\geq$4 m, received a score of five, while one which had an average height and width at its base of $\leq$0.5 m, received a score of one. Component scores were then summed to provide an overall FBEGS score for each field boundary.

2.2. Data analysis

All recorded farm habitats were digitised onto Ordnance Survey Ireland (OSI) orthophotographs (2004) using ArcView 3.2a. This allowed calculation of total habitat area (m^2/ha) and/or length (m/km). Maps produced by Ordnance Survey Ireland at a scale of 1:25,000 and produced between the years 1887 and 1913 were available for 36 of the surveyed farms. For this sub-sample, it was possible to calculate the extent of field boundary loss over the intervening period.

An initial Detrended Correspondence Analysis (DCA) was undertaken to investigate the longest gradient length in the data. This was found to be 2.79 Standard Deviation Units, which indicated that all subsequent ordination analyses should follow linear methods. A Principal Components Analysis (PCA) was undertaken to summarise the variation in the response variable i.e. habitat composition of individual farms, and to investigate the relationship between farm habitat composition with farm management. Variables overlaid on this unconstrained ordination were: (1) farming system (including all of the systems defined in Table 1); (2) participation status in the REPS; (3) farm stocking rate i.e. LU ha^{-1}.

A second PCA was then undertaken to investigate the influence of the more general distinction between farm systems, on farm habitat composition. Within this analysis, all farms involved in dairy production were included within the 'dairy' category while all other farms i.e. drystock farms, were regarded as 'non-dairy'. Ordination analyses were undertaken using CANOCO 4.5 (ter Braak and Smilauer, 2002).

Linear regression models were used to investigate the relationship between farm habitats i.e. response variables, and farm management i.e. explanatory variables. Farm habitats corresponded to the proportion of surveyed farm area: (1) under each individual habitat type (see Table 3), (2) within the habitat categories based on their agricultural productivity (see Table 3), and (3) UAA. Farm management variables included within the analysis were those listed above. Data transformations were made where necessary to fulfil the assumptions of normality i.e. UAA data were log transformed while both intensive and improved grassland data were square root transformed.

Generalised linear models with Poisson error and log link were used to quantify the relationship between the total FBEGS