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Farmland habitat diversity in Ireland

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ABSTRACT

While appreciation of the fundamental role biodiversity plays in underpinning the long-term sustainability of agricultural systems is growing, international commitments to preserve and protect this natural resource have not yet been achieved. Loss and degradation of farmland habitats are an important contributor to the continued decline of biodiversity. Despite this, little information is available regarding the diversity and ecological condition of farmland habitats in Europe. Indeed, where habitat data are available, this is usually at a very broad landscape scale rather than farm scale. Coupled with this, strategies to increase agricultural output in response to growing global population, will likely place increasing pressure on farmland biodiversity. Knowledge and ongoing monitoring of farmland habitat type and extent is a prerequisite for the future protection of much of Europe's biodiversity. Here we report the findings of a national scale survey of farmland habitat diversity in Ireland.

Detailed surveys of farm habitats and management practices (system, stocking rate agri-environment scheme participation status and organic N and P inputs) were undertaken on 118 farms in three regions of the Republic of Ireland (RoI). Recorded farm habitats were subsequently digitised on orthophotography. The resulting ground truthed data from the total surveyed area of 3688 ha, were then used, together with satellite imagery, to classify the habitat composition of a further approximately 87,000 ha of the surrounding landscape.

Results revealed that at individual farm scale, an average of 73% of the land surveyed comprised agriculturally productive (mainly improved grassland) habitats. Marginally productive habitats (mainly extensively managed grasslands) accounted for an average of 11% of farm area, while other semi-natural habitats (mainly hedgerows) accounted for an average of 13%, with the remaining ca. 3% under build ground. Results from the classification at the wider landscape scale showed a similarly substantial incidence of non-intensively managed habitats. However, at both farm and landscape scales, habitat diversity was found to vary markedly between different regions and farming systems.

This study represents one of a very small number that currently exist, where farm scale habitat and management data have been collected. From the few that are available, semi-natural habitat cover has been found to account for an average farm area of 1–12%. Therefore, our data present a relatively positive picture in terms of the intensity, scale and impact of Irish farming on landscape heterogeneity. However, as in other parts of the world, agricultural expansion and intensification to meet increased global food supply will necessitate careful monitoring of the impact of these changes on the structure of farmed landscapes. This study provides a novel approach for the collection of such monitoring data at farm scale, and illustrates how such data can be reliably up-scaled to landscape level.

1. Introduction

It is now widely recognised that because of its crucial role in facilitating a wide range of ecosystem services, the retention and protection of biodiversity within farmland is fundamental to the productivity and sustainability of agricultural systems (Bommarco et al., 2012; Power, 2010; Tscharntke et al., 2005). In turn, the maintenance of biodiversity is strongly dependent on the retention of habitat heterogeneity in farmed landscapes coupled with the continued existence of diversity in agricultural production systems (Donald and Evans, 2006; Benton et al., 2003).

Expansion and intensification of agricultural practices have been closely linked to depletion of biodiversity. It has been suggested that as much as 23% of species diversity once associated with European farmland has been lost during the period 1970 and 2000 (de Heer et al., 2005). This is illustrated by the decline in a number

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of farmland specialist bird species within the last 40 years in the UK and Ireland (Crowe et al., 2010; Balmer et al., 2013), while Benton et al. (2002) and Aebischer (1991) have reported broadly similar trends for farmland insect and plant populations.

Land under agricultural production systems currently accounts for approximately 39% of global land area. This figure increases to 50% in the EU (FAO, 2014) and 65% in the Republic of Ireland (RoI) (DAFM, 2016). With the global human population set to increase to 9.1 billion by 2050, it is expected that food production will need to increase by 70% relative to 2005–2007 levels (FAO, 2009). It follows that ensuring an increased global food supply will have potentially serious impacts on natural resources, resulting from the combination of further expansion and intensification of agricultural management of the finite land-base (UK GOS, 2011; Royal Society, 2009). Concerns include the parallel depletion and degradation of natural resources. At a global scale, Jackson et al. (2007) predict that this could lead to a further 10^9 ha loss of natural ecosystem. From an Irish perspective, both expansion and intensification of dairy farming are necessary if the national target of increasing milk output by 50% (relative to 2007–2009 baseline average) by 2020 (DAFM, 2010) is to be achieved.

Given the fundamental role of biodiversity in underpinning sustainable agricultural systems, surprisingly little attention has been afforded to mapping and tracking the status of the farmland habitats on which many of its components depend. While the United Kingdom have made significant efforts to classify and quantify the structure of farmland habitats, this has been at landscape scale (see Smith et al., 2007; Howard et al., 2003). Only a very small number of studies deal with the quantification of habitats at individual farm scale. Of these, Manhoudt and de Snoo (2003) estimate that only 2.1% of Dutch farm area is retained as semi-natural habitat, while Vereijken (1995) reports ranges of 2–12%, 1–4% and 3–6% from predominantly arable farms in France, Poland and Baden-Wurttemberg in Germany respectively.

In RoI Sheridan et al. (2011) and Sullivan et al. (2011) reported an average of 14.3 and 15.2% semi-natural habitat cover on Irish pastoral farms based in the south-east and the west of the country. However, both of these Irish studies were relatively localised in scope, and so do not necessarily provide a nationally representative picture of farmland habitat composition. This study seeks to address that deficiency through the provision of a much larger nationally relevant baseline dataset of farmland habitat diversity at both farm and landscape scales. We also identify aspects of farm management that significantly influence this diversity. Through doing this we hope to better understand the impact of farm management on habitat diversity. This study also provides a resource against which changes in farmland habitat diversity, can be recognised, monitored and evaluated in the future.

2. Materials and methods

2.1. Site selection

Habitat surveys were undertaken on 118 predominately pastoral farms during 2007 and 2008. Selected farms were stratified across three different regions i.e. Sligo-Leitrim (n = 39), Offaly-Laois (n = 40) and Cork (n = 39). These regions constitute a north-south gradient across the country with increased farm management intensity (reflected by higher incidence of dairy farming) and a converse decrease in Agri-Environment Scheme (AES) participation from south to north (see Lafferty et al., 1999). This approach was taken to ensure that as much variability in Irish farmland composition and management practices could be captured, resulting in a nationally relevant dataset.

For the purpose of sample selection, ten individual 10 km squares were randomly chosen within each region on the relevant Ordnance Survey Ireland (OSI) maps. Squares where peatland, upland and freshwater habitats accounted for greater than 20% of the land area were excluded. Four individual farms located as close as possible to the center of the four central 1 km squares within each 10 km square were chosen, and all but two of the farmers involved agreed to allow access to their farm.

Farms were primarily pastoral, which accounts for approximately 81% of the total agricultural area of Ireland (DAFM, 2016). The sample only included farms located at <100 m elevation above sea-level, and managed by a single farmer/family. Department of Agriculture, Food and the Marine (DAFM) personnel and the farmers involved also provided farm management details including:

1) Farm system, defined by livestock type i.e. dairy (n = 36), beef (n = 32), suckler (n = 44) and other (n = 7) i.e. a miscellany of essentially extensive management types which included: a) farms without an active herd number (n = 3), b) sheep farms (n = 1), c) retired farmer (n = 2), d) farm partially sold during the survey period (n = 1).
2) Farm Agri-Environment Scheme (AES) participation status. At the time of surveying the scheme in question was the Rural Environment Protection Scheme (REPS).
3) Farm stocking rate (LU ha^{-1}) derived from details of number, type, sex and age of livestock and the Utilisable Agricultural Area (UAA) of the farm (this is defined by the DAFM as the 'Area under crops and pasture plus the area (unadjusted) of rough grazing. It is the total area owned, plus area rented, minus area let, minus area under remainder of farm'.)
4) Organic N and P inputs (kg ha^{-1}). These were calculated based on standardised annual output estimates for different stock types (kg per animal). As these data were highly co-linear with stocking rate, they were standardised and transformed to capture any additional explanatory information they might offer.

2.2. Farm habitat surveys

Habitat survey procedure followed the Heritage Council (2005). All habitats greater than approximately 2 × 2 m in size, encountered on the participating farms were recorded. A full list of recorded habitats is presented in Table 2. Classification principally followed the Irish national standard of Fossitt (2000). However, given that agricultural grasslands are afforded little attention within this classification, 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 approximately 3 m of the field boundary were excluded from this classification process. Fields were subsequently assigned to one of the following grassland categories (modified after Sheridan et al., 2011).

1) Intensive grassland—*Lolium perenne* or *L. multiflorum* Lam., account for at least 70% of the vegetation cover; with the exception of *Trifolium repens* L. and *Rumex obtusifolis* L., very few other species occur in these swards. Typically these grasslands are grazed on an intensive 21–28 day rotation.
2) Improved grassland—Often dominated by *L. perenne*, but this occurs at <70% cover. On average 5–10 species frequently occur within these swards. This includes at least three other grass species e.g. *Agrostis stolonifera* L., *A. capillaris* L. *Holcus lanatus* L., *Alopecurus pratensis* L., *Phleum pratense* L., *Dactylis glomerata* L., *Anthoxanthum odoratum* L., *Cynosurus cristatus* L., etc. while herb species might include *T. repens* and *T. pratense* L., *R. obtusifolis*, *R.*