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Environmental fallows as a new policy tool to safeguard farmland biodiversity in Finland

Marjaana Toivonen, Irina Herzon *, Juha Helenius

Department of Agricultural Sciences, P.O. Box 27, FI 00014 University of Helsinki, Finland

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ABSTRACT

A novel agri-environment scheme for Environmental Fallows (EFs) was introduced in Finland to replace a former obligatory set-aside under the Common Agricultural Policy. It currently keeps fallow at nearly 7% of the agricultural land area and therefore may make a unique contribution to the enhancement of farmland biodiversity on the national scale. Farmers can chose from four types of EF fields (game, grassland, landscape, and meadow) or their combination as long as their total annual area falls within 5–15% of the field area. We studied the biodiversity value of EF fields in three regions across Finland ($n = 229$) based on survey data of vegetation in four fallow types. We compared EF plant communities to those of other non-cropped biotopes (margins and semi-natural grasslands) ($n = 99$). The meadow type sown with low competitive grasses and meadow species has proven to be the most species-rich EF type, approaching the diversity level of semi-natural meadows. Vegetation of the grassland type varied considerably ranging from swards similar to those of production grasslands to ones typical for semi-natural meadows. The vegetation composition of the game and landscape types of EF differed most from the other non-cropped biotopes, and other EFs. Plant species richness in the perennial fallows correlated positively with the parcel size (through increased within-field diversity) and age, and variation in the sward height. It was negatively related to the sward's height and density, and the reported fertility level before EF establishment. Plant species richness in EFs was not related to the forest cover in the surrounding landscape. The scheme to a greater extent than the former set-aside contributed to both the amount and diversity of non-cropped vegetation on the landscape level. The long-term efficiency of the current scheme is likely to be compromised by its untargeted and unbinding nature.

1. Introduction

Setting aside a portion of field area from production has been demonstrated to deliver environmental benefits such as reduction in nutrient losses, enhancement of farmland biodiversity, and associated ecosystem services (Stoate et al., 2009). Finland is one of the few countries in the European Union (EU) that replaced the former obligatory set-aside under the Common Agricultural Policy (CAP) with an agri-environment scheme of Environmental Fallow (EF) starting in 2009 (Herzon et al., 2010). In Finland, the EF is arguably the single most important subsidy scheme targeted at natural values of ordinary agricultural landscapes and the one currently most preferred by farmers. In 2011, the EFs occupied 6.6% of the utilised agricultural area (Tike, 2012) and claimed up to 8% of the total agri-environmental funding in 2010 (*vf* to 2% spent on managing the semi-natural traditional biotopes). Experiences with a truly large-scale and multi-purpose fallowing in Finland are relevant internationally, especially in light of the Ecological Focus Areas proposed as part of the compulsory greening elements of the reformed CAP (Hart and Baldock, 2011).

The scheme includes two main types of EF: (1) *long-term grassland* established for protecting soil from erosion and nutrient leaching, improving soil structure, reducing use of plant protection agents, and benefiting also biodiversity (hereafter "grassland type"); and (2) *biodiversity field*, including sub-types of meadow, game and landscape fields, designed specifically to provide resources for wildlife as well as landscape amenity. The latter sub-types are sown with the seed mixtures designed to provide resources for pollinators (meadow plants) or game species (seed for birds and root vegetables for mammals), or enhance the landscape's visual appearance (lavish flowering sward). The EF scheme is not targeted regionally or in terms of landscape setting. A participating farmer is required to enrol a minimum of 5% and maximum of 15% of the farm's agricultural area as EF of any type or their combination, and, within this range, the subscribed area can vary

Abbreviations: CAP, Common Agricultural Policy; EF, Environmental Fallow; EU, European Union.

* Corresponding author. Tel.: +358 405330946; fax: +358 919158582.
E-mail address: herzon@mappi.helsinki.fi (I. Herzon).

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Table 1
Major characteristics of the four types of environmental fallows.

	Grassland	Meadow field	Game field	Landscape field
Establishment	Conventional grassland mixture/old grassland without sowing	Low competitive grasses (e.g. *Agrostis capillaris*, *Festuca ovina*) and meadow plants (e.g. *Leucanthemum vulgare*, *Centaurea jacea*)	Game plants, at least two species (e.g. *Brassica rapa* ssp. *oleifera*, *Linum usitatissimum*)	"Landscape" plants, at least two species (e.g. *Helianthus annuus*, *Phacelia tanacetifolia*)
Termination	Autumn of the 2nd year or summer of the 1st (if followed by autumn crop) at the earliest; only mechanical	Autumn of the 2nd year or summer of the 1st (if followed by autumn crop) at the earliest; only mechanical	Spring of the 2nd year; only mechanical	Spring of the 2nd year; only mechanical
Mowing	At least every 3rd year, at any time	Not compulsory, not before 1.8.	Not compulsory, not before 1.8.	Not compulsory, not before 1.8.
Use of biomass	For fodder and grazing	Yes	Only for wildlife	Yes
Fertilisation	Minimal fertilisation at establishment allowed	Minimal fertilisation at establishment allowed	Minimal fertilization at establishment allowed	Minimal fertilisation at establishment allowed
Pesticides	No, at any stage	No, at any stage	No, at any stage	No, at any stage

annually. The type-specific establishment and management requirements are summarised in Table 1. In 2009–2011, about 80% of the EFs were of the grassland type, 10% game fields, 4% meadow fields, and 1% landscape fields (Tike, pers. comm. 31.10.2011).

It is well established that in agricultural landscapes non-cropped areas, such as perennial margins and semi-natural meadows and pastures, are vital for agricultural biodiversity (Marshall and Moonen, 2002; Öckinger and Smith, 2007). Vegetation of fallow fields may resemble that of existing semi-natural elements in a landscape, in which case they supplement the resource base of the patches too small for population persistence (*sensu* Dunning et al., 1992). Alternatively, it may represent a distinct type of vegetation with a complementary resource value on the landscape level. The issue of distinctness of fallow vegetation has been seldom explored in studies on set-aside vegetation (but see Parish and Sotherton, 2004) or functioning (Thies and Tscharntke, 1999).

The character and composition of fallow vegetation largely depend on establishment and management of the sward (Boatman et al., 2011; Tscharntke et al., 2011). Seed mixture in particular affects the resulting vegetation composition and associated animal taxa in sown fallows during first years of establishment (Kuussaari et al., 2011). Fertility of soil, as well as high and dense swards, negatively affects the diversity of vegetation in semi-natural grasslands and margins (Hansson and Fogelfors, 1998; Tarmi et al., 2009). Finally, local biodiversity is influenced by composition and configuration of agricultural landscapes (Bengtsson, 2009).

This study examined a novel agri-environment fallowing scheme in Finland with respect to one of the major objectives assigned to it – support and enhancement of biodiversity in the agrolandscapes. As a measure of biodiversity value of EFs, we used species richness and composition of vascular plants. Species composition and vegetation structure are known to influence the utility of fallow swards for animals through availability and accessibility of foraging resources, nesting sites, and moving space (Hyvönen and Huusela-Veistola, 2011; Kuussaari et al., 2011; Henderson et al., 2000). The main objectives were (i) to describe the community composition and diversity of vascular plants in four fallow types in three agricultural regions in Finland; (ii) to compare the vegetation of fallows to that of the other non-cropped biotope types, and (iii) to explore characteristics of fallows and their landscape setting that potentially contribute to the community diversity.

2. Data and methods

2.1. Sample selection and field survey

The data were collected from three regions in Finland different in their geographical position and character of agricultural production: Uusimaa, Pohjois-Pohjanmaa, and Pirkanmaa (Fig. 1). Uusimaa is the southern-most region in the country (the regional centre Helsinki 60°10′N, 24°56′E) and production is specialised in cereal growing on clay soils. Of the utilised agricultural area, production grassland occupies 16% and EF 9% (Tike, 2012). The landscape is relatively open and fields are large. The diversity of non-productive species is nationally high due to the southern location (Kivinen et al., 2006). Pirkaanmaa is located in south-western Finland (centre in Tampere 61°29′N, 23°45′E), and agriculture is characterised by animal husbandry and crop growing on silt soils. Production grassland occupies 27% and EF 8% (Tike, 2012). Farms and fields are smaller than in the other study regions, and the landscape is fragmented by forests. Pohjois-Pohjanmaa is the northern-most of the study regions (centre in Oulu 65°01′N, 25°28′E). The main production on intensively cultivated coastal lowlands is dairy (Tike, 2011) and fields are mainly cultivated for fodder. Production grassland covers 43% and EF 5% (Tike, 2012).

Within each region, farms were selected randomly from a list of those situated within a 100-km circle from the regional centre. Only two farm owners refused to participate. The survey fields were selected according to the ratio of 3:1:1:3 representing the four prescribed types (grassland, game, landscape, and meadow fields). The ratio was based on the assumption that vegetation of the grassland and meadow types would be most variable (confirmed in the pilot survey in 2009; unpublished data). A total of 229 parcels were surveyed. Additionally, five production grasslands (all silage and hay fields) chosen randomly were sampled in 2011 in Uusimaa.

Vegetation surveys were conducted in Uusimaa and Pohjois-Pohjanmaa in summer 2010 and in Pirkanmaa in summer 2011 between end of June and mid-August. One to four transects of 1.0×12.5 metres were placed within each field depending on its size: only one diagonal transect in fields below 0.1 ha, two transects for fields of 0.1–0.5 ha, three transects in fields of 0.5–1.0 ha, and four transects in fields over 1 ha. The placement of transects was systematic by the criteria agreed in advance, with one to two transects running across the field and one to two along the edge but not in a permanent margin. At each transect, vegetation height and density, area of bare soil, coverages of vascular plant species, signs of mowing, mowing and cut removal, and grazing were measured. Vegetation height and density were measured in five systematically spaced spots along each transect. A banded measuring stick was set vertically into the vegetation, and height was recorded with 10-cm accuracy by reading the measurement from the highest point where the vegetation touched the stick. Density was recorded with the same accuracy by reading the lowest point of the stick that could be seen from a 1-m height. A 9-grade logarithmic scale for estimating coverage of individual species was used: $1 \leqslant 0.125\%$, $2 \leqslant 0.5\%$, $3 \leqslant 2\%$, $4 \leqslant 4\%$, $5 \leqslant 8\%$, $6 \leqslant 16\%$, $7 \leqslant 32\%$, $8 \leqslant 64\%$, $9 > 64\%$. Not all species were fully (binomially) identified but placed within a genus