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Improving conservation planning for semi-natural grasslands: Integrating connectivity into agri-environment schemes

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ABSTRACT

Agricultural intensification is a major driver of biodiversity decline throughout Europe. Agri-environment schemes governed by EU regulation are a significant tool in combating this decline but despite high spending, experiences of their effectiveness have been mixed. Their effectiveness might be improved by targeting them to locations with high biodiversity value, and particularly by spatial coordination to enhance habitat connectivity and the associated ecological processes, such as dispersal. We show, with an example of semi-natural grassland conservation in South-Western Finland, how spatial conservation planning tools, here the Zonation software, could help in assessing the habitat connectivity and allocating management actions. We assign highest priority to sites that have been classified as nationally important and that have been under management, and let connectivity influence the Zonation prioritizations. According to Zonation outputs, 25–30% of highest-ranking grasslands in our study area are without management contracts, indicating weak connectivity of managed sites, whereas Natura 2000 areas are spatially better located. A 50% expansion of the current network would be adequate to bring its value close to that of a network created from scratch, but as the contracts are temporary, reallocation of the contracts from the least valuable, funded sites to more valuable, unfunded ones would be even more effective. Current policy instruments supporting farmland biodiversity are strongly constrained by EU regulation, and appear to be too inflexible to take the spatial differences in conservation values into account. Better communication and incentives to encourage farmer participation to these voluntary programs are needed.

1. Introduction

Agricultural intensification is a major driver of biodiversity decline throughout Europe (Millennium Ecosystem Assessment, 2005; Tscharntke et al., 2005, 2007; Kleijn et al., 2011). In Finland 19.3% of threatened species inhabit agricultural environments, particularly traditionally managed biotopes, such as semi-natural grasslands and wooded pastures (Rassi et al., 2010). A common trend in Europe is that semi-natural grasslands have declined drastically, resulting in a severe habitat loss and fragmentation. For example, in Dorset, UK, 97% of area had been lost and connectivity reduced by up to 98% in 70 years (Hooftman and Bullock, 2012). In Calestienne, Belgium, less than 5% of calcareous grasslands remain and their connectivity has decreased to 7% of the original (Polus et al., 2006). Similar decreases have been estimated for Finland as well with ca. 99% of semi-natural grasslands lost after 1880s (Luoto et al., 2003). In many European countries, one of the key measures to mitigate the loss of farmland biodiversity is the maintenance of traditional agricultural environments through active habitat management and restoration (Krauss et al., 2010).

Traditional semi-natural habitats are largely dependent on management. Thus, the sole establishing of protected areas is not sufficient for their conservation. Major policy instruments are the agri-environment schemes (AESs), which provide crucial funding for the management of semi-natural habitats in many European countries, e.g. Finland, Sweden and the UK (Donald and Evans, 2006; Ottvall and Smith, 2006; Butler et al., 2010). However, these instruments pay only limited attention to the significance of landscape-moderated effects on the success of conservation. It is especially true for habitat connectivity – which is often critical for species survival in patchy habitats – that it is ignored (Donald and Evans, 2006). Such aspects are difficult, if not impossible, to account for in the regulatory environment where decisions are made.

There is a wealth of empirical evidence showing that the increasing habitat fragmentation and associated decreasing

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connectivity really matters for the persistence of the local populations in the occupied habitat patches (Hanski and Pöyry, 2007; Tscharntke et al., 2007; Pöyry et al., 2009; Brückmann et al., 2010). For example, the long-term habitat fragmentation and grassland butterfly monitoring study of Polus et al. (2006) shows that decreasing habitat connectivity is intimately linked with several extinctions and dramatic rarefaction of butterfly species, resulting in the loss of habitat specialist species and generalists becoming more dominant. The impacts of fragmentation are amplified in landscapes with high levels of habitat loss (Hanski and Ovaskainen, 2000; Rybicki and Hanski, in press), which applies to the semi-natural grasslands in many European countries. However, despite such clear reasons to support connectivity in AES, various subsidies appear to be allocated at the farm level independently of any landscape context or subsidies given to other farms in the region. This suggests that the use of subsidies could be much more effective if coordinated across the landscape to enhance ecological processes, such as dispersal.

This study focuses on open semi-natural grasslands in Finland, which are typically small and scattered treeless habitat patches created and maintained by mowing and grazing (Pykälä, 2000). In the Finnish AES conservation management of semi-natural grasslands is supported by two voluntary special measures: "Management of traditional biotopes" and "Enhancement of biodiversity management". We used the Zonation software (Moilanen et al., 2005) to investigate the spatial conservation prioritization of semi-natural grasslands with respect to the current implementation of AES, giving special attention to habitat connectivity. The analyses were based on the locations of all known grasslands in comparison to the sites with AES-based management contracts. We also conducted a second set of analyses using a dataset that additionally contained sites with wooded semi-natural habitats, based on the premise that such sites are suitable targets for restoration measures when well connected to the open grasslands.

The main questions addressed were: How different is the current network of management contract areas from prioritized solutions outlined by the Zonation conservation planning software? If spatial re-allocation of contracts was possible, how and how much could the current network be improved? We examined how the current agri-environment contract sites and the existing Natura 2000 sites perform with respect to the Zonation prioritization. Finally, we assessed the main obstacles for taking connectivity and other ecological management principles into account in the implementation of AES, and discuss how to improve the policy instruments.

2. Materials and methods

2.1. Data

Our study area was a ca. 20,000 km^2 sized heterogeneous mosaic of forests, farmland and built up areas in South-Western Finland (Fig. 1). Both agriculture and semi-natural grasslands concentrate along the small rivers crossing the area.

We used four GIS datasets in our analyses (Fig. 2). Our first dataset (I) consisted of grasslands of conservation concern included in the Finnish national survey of traditional rural biotopes. These sites were classified into nationally, regionally and locally important ones primarily based on the occurrence of vegetation types and vascular plant species associated with traditional animal husbandry (Vainio et al., 2001). They include several habitat types that are listed in Appendix I of the EU's Habitat Directive (Salminen and Kekäläinen, 2000). The classification also corresponds with the general aims and principles for the priority habitats outlined in the EU's Common Agricultural Policy (CAP). CAP acknowledges that many valuable habitats in Europe are maintained by extensive farming, and numerous wild species rely on this for their survival, and that the preservation of traditional agricultural landscapes is necessary to tackle biodiversity loss (Commission of the European Communities, 2001).

The second dataset (II) consisted of all types of open grasslands from the SLICES land cover database (National Land Survey of Finland, NLS). The third dataset (III) contained pasture areas from the register of the Ministry of Agriculture and Forestry (Fig. 2). To generate a grassland dataset of 'common' grasslands with lower conservation potential, we used ArcGIS (ESRI® ArcMAP™ 10.0) to include areas belonging to either one or both of the 'Pastures and meadows' and 'Grasslands' and excluded all areas overlapping with the higher quality National survey of traditional rural biotopes

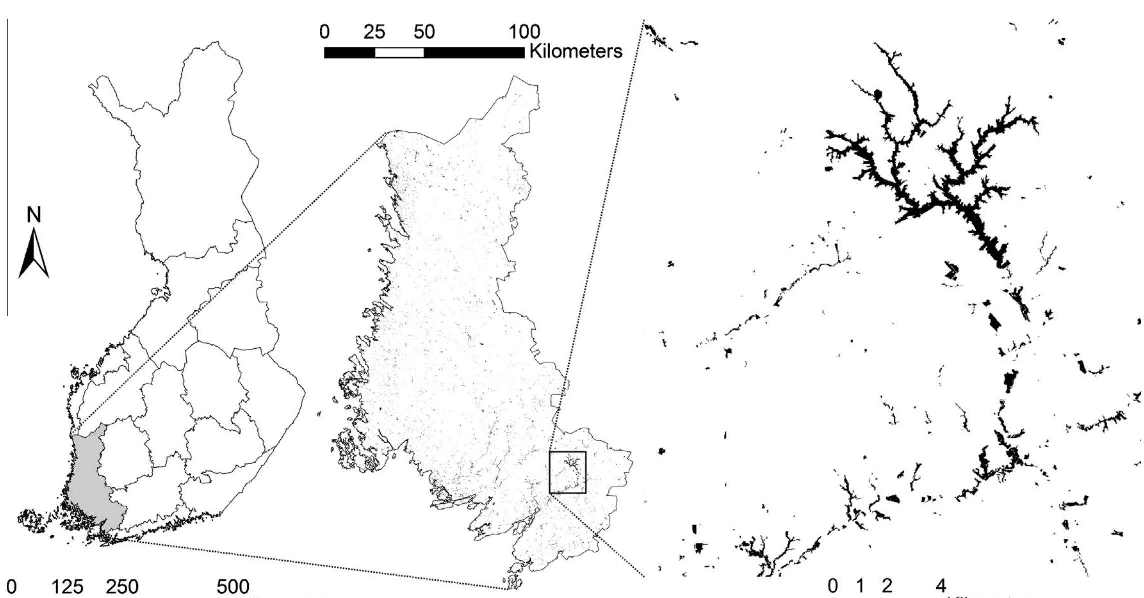

Fig. 1. Our study region in SW Finland in gray, magnified in the middle map. Our habitat layer data (open grasslands and wooded traditional biotopes) are illustrated in black in the magnified map, but show poorly because of the small size of these habitat fragments. The rightmost map is the example area where we focus on in our output maps, the Rekijoki river valley, which contains sites of varying importance and shows well the effects of connectivity in the prioritization.