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Editorial

Landscape ecology and biodiversity in agricultural landscapes

Agriculture is mainly seen as a threat for biodiversity of agro-ecosystems. Intensification of agriculture and its expansion into marginal lands has substantially modified the physiognomy of rural landscapes through fragmentation and homogenisation, promoting the loss of both natural habitats and biodiversity (Benton et al., 2003). Nevertheless, agricultural landscapes harbour an important range of biodiversity, both within crops and in non-crop habitat (Storkey et al., 2012).

The landscape level controls part of biodiversity structure and dynamics. In agricultural landscapes, emphasis has been put on the role of semi-natural elements for the fate of biodiversity (Tscharntke et al., 2005, Billeter et al., 2008). But it has been shown for many taxa that agricultural matrix matters (Kuroe et al., 2011, Anderson et al., 2007, Watling et al., 2010). In this special issue we address the role of semi natural areas at the landscape level, and consider the landscape effects on biodiversity for agriculture, e.g. weeds, pests and auxiliary organisms. Moreover, this issue comprises a wide variety of agricultural environments, which range from the millennial farming systems of China and Europe to the much more recent ones in the New World, as well as the contrasting levels of agricultural intensification, such as in Western and Eastern Europe.

1. The role of semi-natural habitats for retaining biodiversity in farmland mosaics

Many ecological functions associated with the provision of ecosystem services to agriculture are closely related to the biodiversity in associated semi-natural patches. Species occurring in semi-natural habitats may be benign, beneficial in terms of pollination or pest biocontrol, or may be crop pests or weeds. In this issue, Le Féon et al. (2013) investigate the influence of the landscape structure on solitary bee abundance and species richness, especially focusing on the role of semi-natural habitats, oilseed rape and other crop types in the rotations. Poggio et al. (2013) in this issue, shows that distance from fencerows is the main factor to explain the arable field flora.

Two forms of semi-natural habitat commonly occur, (a) remnant patches of grassland and forest vegetation and (b) corridor networks. Both contribute to sustain biodiversity in agricultural mosaics. In this issue, Báldi et al. (2013) demonstrate that semi-natural grasslands in Hungary, compared with regions in Western Europe, harbour a comparatively high farmland biodiversity of plants, birds and arthropods. Corridors in farmland mosaics, such as field margins, fences and road verges, are key landscape features that often retain the biodiversity associated with larger semi-natural habitat patches in agro-ecosystems. The role of introduced grassy strips in biodiversity is further explored in this issue (Delattre et al., 2013; Ernoult et al., 2013).

Biodiversity conservation in agricultural environments should consider the restoration of semi-natural areas in agricultural landscapes (Donald and Evans, 2006; Hilty et al., 2006; Vandermeer and Perfecto, 2007). Mitigation of adverse agricultural impacts on ecosystem service provision from a UK perspective is discussed in this issue by Firbank et al. (2013). In addition, two standpoints about biodiversity conservation are also presented in this issue for the contrasting land use histories of China (Liu et al., 2013) and Australia (Smith et al., 2013).

2. How does landscape structure affect semi-natural vegetation and the services it provides?

The combination of plant dispersal modes (e.g. wind, animals, vegetative) and landscape structure (connectivity of semi-natural habitat, presence of dense hedgerows or woodlands or landscape openness) determines how far plant species can move through the landscape to reach suitable patches. However, intensity or type of land use may hinder establishment of species arriving from surrounding areas in cropped fields and therefore often no correlations are found between landscape characteristics and in-field weed vegetation (Armengot et al., 2011, Clough et al., 2007, Marshall, 2009). A growing number of studies include landscape composition and structure variables for the identification of factors influencing field weed and semi-natural vegetation composition and diversity.

3. How does landscape structure affect pests?

Several studies have related landscape structure and arthropod pest abundance, generally focusing on landscape composition rather than configuration. Insect pests respond to the spatial distribution of their host plant resources, these being found either mainly in crops (e.g. codling moth, Ricci et al., 2009) or both in crop and semi-natural habitats (e.g. mirid bugs, Takada, 2012; pollen-eating beetles, Rusch et al., 2013), leading to equivocal relationships between landscape scale area of crops and or seminatural habitat and pest abundance in fields (Veres et al., 2013). Further, in case of annual crops, variation of crop areas between years may lead to concentration–dilution effects that affect the abundance of pests in fields (pollen beetles, Zaller et al., 2008). Finally, pests that affect different crops can either use resources from different crops at a given time or move from one crop to the other to complete their life cycle (e.g. aphids, Vialatte et al., 2006), their abundance in one crop

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thus being dependent upon the area covered by the other crop(s). Weeds diversity and species traits depend on landscape dynamics and structure (Carlesi et al., 2013).

4. How does landscape structure affect auxiliary organisms and the services they provide?

Most of the studies looking at the positive, negative or neutral effects of landscape on the abundance of auxiliary insects deals with landscape composition (Thies and Tscharntke, 1999) (see (Bianchi et al., 2006) for a review). Landscape complexity is often reduced to the presence or not of semi-natural habitats (mainly woods) at different scales (buffer of various diameter in which the proportional area of non-crop land and crops are calculated). In this issue Monteiro et al. (2013) address the question of the effects of agricultural practices at the landscape level on natural enemies in orchards. On a more general view, in this issue Vasseur et al. (2013) underline the importance of the hidden heterogeneity of farming systems and agricultural practices on ecosystem services.

One of the essential qualities of auxiliary species for controlling pests in agricultural systems is the ability to stay in the landscape even when the targeted pest is absent or in low abundance. There is a growing literature on landscape management to promote specific auxiliary species. The goal of this landscape management is to create a suitable ecological infrastructure within the agricultural landscape to provide resources such as food (mainly nectar for the adults stage), alternative prey or hosts and shelter from adverse conditions (Landis et al., 2000), all these resources should be available in a short range distance specific to the targeted auxiliary species.

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