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Small woodlands and butterfly conservation on farmland

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Summary

The impacts of small woodlands on farmland biodiversity are less well studied than those of other habitats, such as hedgerows and field margins. Butterfly abundance and species richness were recorded along transects on two farms in southern England, one organic and one conventional, which had small woodlands. Woodland edges were particularly important for two species: comma *Polygonia c-album* and speckled wood *Parare aegeria*. Both were more abundant on woodland edges compared to hedgerows or field margins. A range of declining wider countryside species, including gatekeeper *Pyronia tithonus* and meadow brown *Maniola jurtina*, also frequented woodland edges. The quality of woodland edges was influential. Butterfly abundance was higher on woodland edges with a shrub layer. There was some evidence that bramble presence had a greater effect on butterfly abundance on the conventional compared to the organic farm. Small woodlands can make an important contribution to biodiversity conservation on farmland.

Key words: small woodlands, farmland, biodiversity, butterflies

Introduction

Lowland farmed landscapes in the UK comprise cropped or pasture fields, and a diverse range of uncropped habitats, such as hedgerows, field margins and woodlands. The ecology, function and conservation management of small woodlands within the farmed landscape has been less well studied than other non-cropped habitats such as hedgerows and field margins. Woodlands are likely to be important not only for specialist species, but also the more generalist, wider countryside species, for which they may act as "islands" of habitat, providing sources of food, shelter and breeding sites at certain times of year in often inhospitable farmed landscapes. For example, their presence on farmland can provide early-season floral resources for wild bees (Mallinger et al. 2016), and single trees and small patches of woodland can function as "stepping stones" across farmed landscapes for macro-moths (Merckx et al. 2012, Slade et al. 2013).

In this study, we compared habitat use of woodland edges, hedgerows and field margins by one group of insects, butterflies. Butterflies are a well monitored group and useful indicators of

habitat quality. Many butterfly species are declining in the wider countryside and woodland edges can potentially provide important habitat resources, including larval foodplants, nectar sources, and shelter. Our aim was to investigate the extent to which butterflies use woodland edge habitats compared to field margins and hedgerows, and the factors affecting this, leading to a better understanding of how woodlands can contribute to biodiversity conservation on farmland.

Methods

We studied butterflies on two farms, one organic farm (Harnhill, Gloucestershire) and one conventional farm (near Oxford), in England. Each farm had several small (2-5ha) woodlands, separated by arable or grass fields. At each farm, butterflies were monitored approximately fortnightly between June and September 2017 by walking fixed route transects around the edges of arable fields, using transect methodology adapted from that of Pollard (1977). Transects at each farm incorporated woodland edge, hedgerow and arable field margin sections. Species richness and abundance of butterflies was recorded for each transect section, together with habitat and management details, including field edge habitat (e.g. open field margin, hedgerow, woodland edge), aspect, vegetation (e.g. presence and abundance estimates for woody species, key nectar sources and larval foodplants), and adjoining crop type.

Analysis

Statistical models exploring species abundance were fitted using the base 'glm' option with the R software (R Development Core Team, 2017). Abundance was modelled as a Poisson family response with adjustment for the substantial observed over-dispersion (residual variability was much higher than expected for a Poisson distribution; the 'quasi' option was therefore used with the 'family' specification). The significance for each term was tested (F test) using deviance differences comparing models with and without the term. Each section was treated as a sampling unit. The total number of each individual recorded on each section over the season was used as the response, and the total effort (m walked) expended on each was treated as an offset. Species richness, the total number of species recorded on each section was also recorded. This was treated in a similar way, recognising that, all else being equal, species richness does not increase as a linear function of sampling effort.

Results

A total of 1878 butterflies and 19 species of butterfly were recorded during the study. There were significantly more butterflies recorded on the organic compared to the conventional farm (mean rate per section 64(9.4) vs 25.6, $P<0.05$). There was no evidence that butterfly abundance (N/km) or species richness differed between woodland edges, hedgerows or open field margins ($P>0.05$). Similarly, there was no evidence for an effect of aspect on butterfly abundance or species richness ($P>0.05$).

Woodland edges were particularly important for two species of butterfly: the comma *Polygonia c-album* (Fig. 1a), a species which nationally declined in abundance by 28% between 2005 and 2014, and the speckled wood *Parare aegeria* (Fig. 1b). Both species were significantly more abundant on woodland edges compared to hedgerows or field margins. A range of declining wider countryside species, including gatekeeper *Pyronia tithonus* and meadow brown *Maniola jurtina* also frequented woodland edge habitats.

The quality of woodland edges was influential. Butterfly abundance was higher on woodland edges with a shrub layer compared to woodland edges which abutted directly on to the crop and had no shrub layer (Fig. 2). A frequently recorded woody species, whose flowers and fruits were visited by foraging butterflies, was bramble *Rubus* spp. There was some evidence that bramble

presence had a greater effect of increasing butterfly abundance on the conventional compared to the organic farm (Fig. 3).

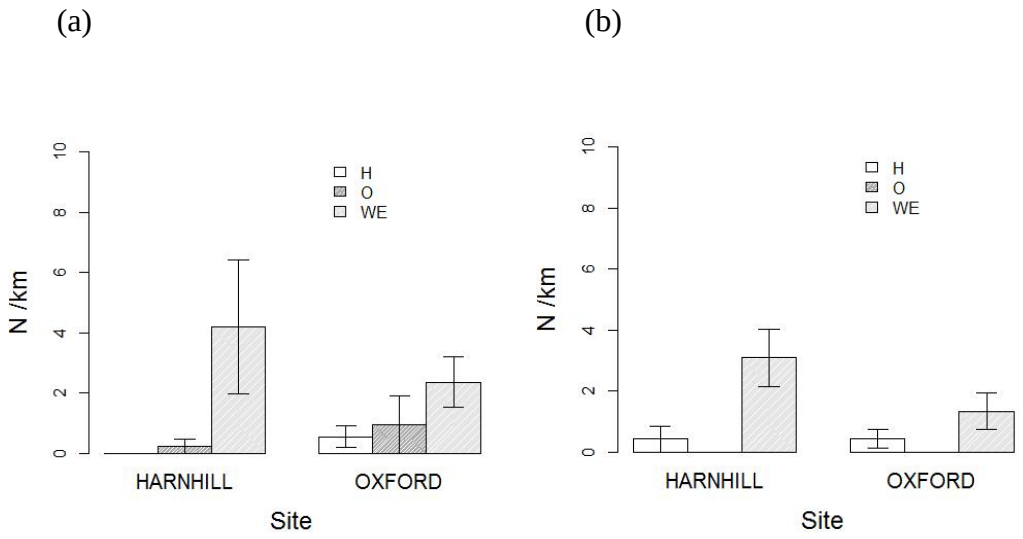

Fig.1. Abundance (N/km) of (a) comma *P. c-album* and (b) speckled wood *P. aegeria* butterflies on hedgerows (H), open field margins (O) and woodland edges (WE) at two farm sites (Harnhill and Oxford).

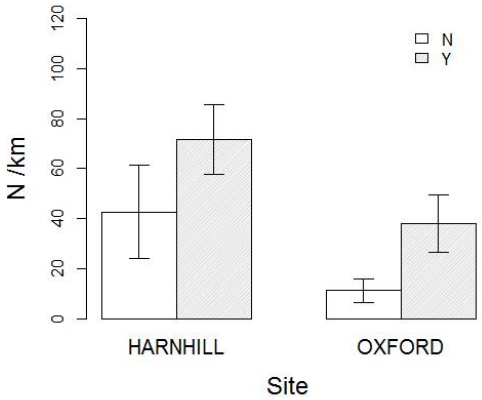

Fig. 2. Butterfly abundance (N/km) on woodland edges with (Y) or without (N) a woody shrub layer between the woodland edge and the crop, at Harnhill and Oxford.

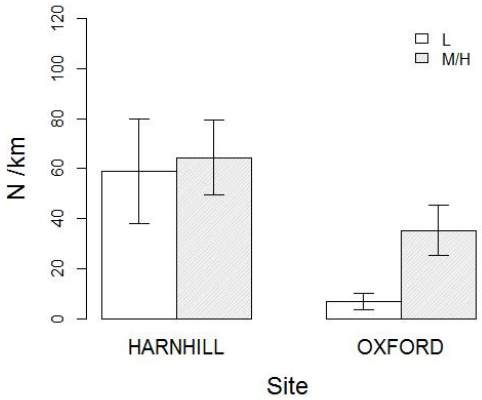

Fig. 3. Butterfly abundance (N/km) on woodland edges with low (L) or medium/high (M/H) bramble abundance at Harnhill (organic) and Oxford (conventional).

Discussion

Woodlands can have an important function as part of a mixture of habitat elements within the landscape, increasing habitat connectivity, facilitating dispersal and supporting populations (Feber 2017). In our study, all butterfly species were recorded as visiting woodland edges at some time; woodland edges were particularly important for the comma and the speckled wood, the latter of which was never recorded on open field margins.

The planting and management of farm woodlands is supported by Rural Development Programme funding, so optimising their benefits for biodiversity is important. The quality of woodland edges was important, affecting their use by butterflies. Soft woodland edges that had woody shrub species such as bramble, elder, dog-rose and blackthorn, rather than a hard woodland edge directly adjacent to the crop, had more butterflies. Bramble was a particularly important woody shrub, especially benefitting butterflies on the conventional farm (which overall supported fewer butterflies). Butterflies were attracted to both its flowers and fruit, feeding on them over the period of our study from summer to early autumn. Our study did not cover the spring period when it is likely that tree and shrub blossom on woodland edges may be particularly important for nectar feeding insects. Although we did not find a significant effect of woodland edge aspect in our summer study, a southerly aspect has been shown to benefit field margin butterflies and should be considered when siting woodlands and field margins.

Our results showed that small woodlands can provide resources for a range of wider countryside species and contribute to overall biodiversity on farmland. Encouraging the planting of small woodlands could be a useful approach for ecological restoration in agricultural landscapes (Benayas and Bullock 2012).

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