Create and manage more effectively linear and boundary features to enhance the connectivity of the landscape.

MANAGING ECOSYSTEM SERVICES

LOWLAND AGRICULTURE

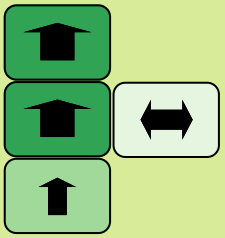
ENHANCE BOUNDARY AND LINEAR FEATURES

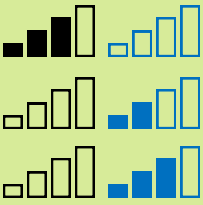
GOODS & SERVICES

Biodiversity

Disease & Pest Control

Pollination





These pages represent a review of the available evidence linking management of habitats with the ecosystem services they provide. It is a review of the published peer-reviewed literature and does not include grey literature or expert opinion. There may be significant gaps in the data if no published work within the selection criteria or geographical range exists. These pages do not provide advice, only review the outcome of what has been studied.

Full data are available in electronic form from the Evidence Spreadsheet.

Data are correct to March 2015.

KEY

Quality of Evidence

Good

Medium

Poor

Quantity of Evidence

Number of sources showing direct evidence

Number of sources showing indirect evidence

Magnitude and Direction of Effect

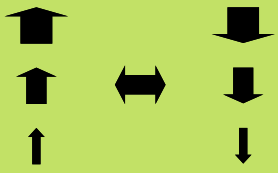
Direction

Magnitude

Strong

Medium

Low



MANAGING ECOSYSTEM SERVICES

LOWLAND AGRICULTURE

ENHANCE BOUNDARY AND LINEAR FEATURES

Provisioning Services—providing goods that people can use.

Cultural Services—contributing to health, wellbeing and happiness.

Regulating Services—maintaining a healthy, diverse and functioning environment.

CULTURAL

Biodiversity: ***Strong Evidence:-*** Linear features, such as hedgerows are used by some species of foraging bats in the UK[1]. The extent of use depends on the density of trees within the hedge for the soprano pipistrelle (*Pipistrellus pygmaeus*) while this was not important for common pipistrelles (*P. pipistrellus*). For birds, species richness and diversity in the UK was positively associated with woody hedges and the maintenance of these should provide the most benefit to the greatest number of bird species[2]. The suggested management is infrequent trimming every two years in late winter for most bird species. Other linear features such as grass margins, uncropped wildlife strips, set-aside margins, game cover crops and conservation headlands in the UK are also of benefit to a range of bird species, but some species such as lapwings (*Vanellus vanellus*) and skylarks (*Alauda arvensis*) avoid boundary features[3]. Game cover crops in the UK can also provide foraging habitat to a range of farmland birds[4]. In the Scottish lowlands, six summer game crops contained on average 2.9 songbirds ha^{-1} compared with 0.14 songbirds ha^{-1} in adjacent arable fields[5]. A range of different boundary feature types are suggested to maximise the year-round benefits for birds in the UK, including the combinations of buffer strips with hedgerows[6]. A modelling approach applied to German farmland bird diversity found that increasing hedge density in combination with a reduction in spring cereals could improve the bird species diversity index[7]. In Canada, natural hedgerows were compared with planted hedgerows[8]. Plant diversity was higher in natural hedgerows, but planted hedgerows had greater species richness per quadrat. While diversity was higher in natural hedgerows, planted hedges still contained birds and plants of conservation interest unlike herbaceous (perennial and annual herbs) hedgerows. Mid-field overwintering refuges (beetle banks) in the UK were compared with conventional hedgebanks[9]. The highest diversity of beetles was found in the bands composed of the grasses *Arrhenatherum elatius* and *Dactylis glomerata*. Green lanes, trackways bounded on both side by hedges, were found to have higher bumblebee abundance than on the adjacent field margin, largely due to the abundance of flowers which was higher in the green lane habitat[10]. Green lanes also supported 30% more plant species in a 200m quadrat than other linear features and butterfly abundance was double[11]. For beetles, the diversity of *Carabidae* was higher in hedgerows compared with post and wire boundaries while *Staphylinidae* were more abundant in post and wire boundaries[12]. Such boundaries are often considered of low conservation value but can actually maintain important beetle communities[13].

REGULATING

Disease and Pest Control: ***Strong Evidence:-*** The densities of predatory beetles were compared between beetle banks and established conventional hedge-banks over a five year period in the UK. Predator densities in the beetle bank were similar to, or greater than those in the hedge-bank but fluctuated more over time[14]. In a similar UK study, aphid populations in winter wheat from which beetles were excluded from an adjacent beetle bank were 34% greater than areas from which they had not been excluded[15]. Grass margins can also aid the control of cereal aphids by predatory beetles. On farms in the UK, levels of control were positively related to the proportion of linear grass margins[16]. Short rotation coppice, often used on UK organic farms, is also effective as a reservoir for aphid parasitoids[17]. A long term study of British beetle banks found that it takes ten years for a beetle bank to reach the same botanical diversity and species richness as a field margin but that they can also act as a refuge for weed species[18]. Sown grass or wildflower strips in southern England were shown to reduce the abundance of a number of pernicious agricultural weeds[19]. The management of buffer strips can influence the spread of agricultural weeds in the UK, with scarification being an effective management option to encourage the co-existence of perennial and annual species but also encouraging the spread of weeds[20]. ***Weak Evidence:-*** The effectiveness of mid-field refugia (beetle banks) in British fields to allow the overwintering of predatory beetles depended on the composition of the grasses they were sown with[9]. In France, a modelled approach found that the predatory beetle *Pterostichus melanarius* had higher populations where uncultivated grass margins were sown in addition to the crop[21].

Pollination: ***Strong Evidence:-*** Field margins in northern England were given a range of treatments to investigate responses of bumblebee pollinators[22]. Margins sown with a grass and wildflower mixture had the highest bee abundance. An unsown margin subject to natural regeneration only attracted bees in the second year, and then only because of thistles. Overall, margins sown with nectar and pollen producing plants were more successful at attracting bees than other forms of sowings[23]. The size of sown pollinator patches were important, with smaller patches (0.25 ha) attracting higher densities than larger patches (1 ha) in a UK study[24]. The findings suggest that more smaller patches are more effective that single larger patches in intensively farmed landscapes. Green lanes in farming landscapes were found to be important in England, with higher numbers of bees and butterflies than field margins alone[10]. In the USA, the importance of hedgerows for bees was investigated[25]. Species assemblages of pollinators in hedgerows were more similar to those from woodlands than fields, and most attractive to bees in early summer. In the UK, uncropped and naturally regenerated field margins were compared with unsprayed conservation headlands with naturally occurring weed species[26]. In all cases, naturally regenerated margins were more attractive to bees than conservation headlands, though the different plants in the natural vegetation varied widely in their attractiveness to bees. In the UK, 42 fields were studied, half with 3 year old margin strips[27]. Bees were more abundant within strips, and more abundant in fields containing strips. Strips in British arable fields containing wildflower mixes had higher numbers of pollinators[28,29], though specific management such as timed cuts and reduced grazing may be necessary to maximise the benefit to pollinators[30,31].

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