PROGRESS ON BEETLE BANKS IN UK ARABLE FARMING

Sue Thomas from the School of Biological Sciences at the University of Southampton, UK, writes

What are Beetle Banks?

Beetle Banks are grass-sown ploughed ridges created to provide perennial, herbaceous hedgerow bottom vegetation in strips across large arable fields in a simple and inexpensive form. The amount of non-crop cover on farmland, especially hedgerows, has decreased enormously in the UK. Poor management of those hedges remaining means that many contain inadequate vegetation at their base, especially over winter. Dense, tussocky grass was found to be vital for the refuge and overwintering survival of crop pest predators such as carabid and staphylinid beetles, and spiders, particularly when given protection from water saturation by being raised above the surrounding field height. The invertebrates emerge from the temperature-buffering tussocks in spring, and disperse into the crop to feed. These grassy ridges were given the common name 'Beetle Banks' because of the high densities of beetles found sheltering in them in winter.

In a previous edition of *Pesticide Outlook*, Sotherton (1995) described the original design for the creation of Beetle Banks. In autumn, two plough passes are sufficient to create a well-drained earth ridge, around 40cm high and 1.5–2m wide, drilled with grass seed at a rate of approximately 3g m^{-2}. Initially, opportunist weeds can be sprayed out with a non-residual herbicide. Flowering heads can be topped in summer to limit spread into the crop, though the developing grass tussocks should not be damaged, and this practice is rarely needed. No further management should usually be necessary.

Beetle banks now have financial support within the Countryside Stewardship and pilot Arable Stewardship Schemes (Anon., 1999a & b).

This article is intended to provide an update on progress with beetle banks in the UK, based on a questionnaire and telephone survey of farmers across England who had established nearly 70 beetle banks on their land.

Survey of Beetle Banks in England

Dimensions

The current average dimension of a Beetle Bank was 434 m long and 3.5 m wide, with an age of around 6 years. One original pilot bank, created by Southampton University researchers collaborating with The Game Conservancy Trust (G.C.T.), is now 14 years old.

Sowing and establishment

95% of the banks used cock's-foot (*Dactylis glomerata*) in establishment, but 68% had some other seed incorporated, *e.g.* Yorkshire fog (*Holcus lanatus*), or red fescue (*Festuca rubra*). Pre-mixed 'Beetle Bank Mix' available from seed merchants was only sown in a few cases. Some sites used mixtures containing wild flowers, or allowed natural regeneration to complement grass sowing, which allowed barren brome (*Bromus sterilis*) to develop in a couple of cases.

Banks were hand-seeded rather than tractor-drilled in 73% of cases. Following establishment suggestions, 59% had trimming or topping of flowering grass heads, especially in the first few years since creation, possibly more frequently than was entirely necessary. It is now recommended that Beetle Banks should not be cut more than once every 2–3 years, so that as a dense tussocky sward structure develops, dead grass is accumulated which can provide camouflage for nesting birds (Vickery *et al.*, 1998). Many farmers are understandably cautious when they perceive possible weed problems. Cutting is supposed to limit the spread of grass seeds into the crop, and encourage the grass cover to become densely established, lessening development of problem perennials such as thistles. Even where this had not been carried out, there was no reported weed invasion. Herbicide-treated sterile strips placed along the crop edge may be important. 52% of Beetle Banks were supplemented by some kind of selectively sprayed headland alongside them, which can help protect the bank from spray drift and enhance natural enemy populations (Cardwell *et al.*, 1994; Sotherton, 1992).

Within the Countryside and Arable Stewardship Schemes it is suggested that the Beetle Bank sward should not normally need herbicide treatment. In particular, the Game Conservancy Trust strongly disapproves of the use of non-selective herbicides on grassy strips. However, approval will usually be given for control of species such as barren brome, blackgrass and wild oats, particularly where they can be spot-treated with a contact grass weed herbicide approved for use on non-cropped land. Beetle Banks should not receive any other agrochemical treatments, and had not in all cases surveyed.

Connectivity

Beetle Banks were originally designed to be placed in the middle of large arable fields, where predator populations are most impoverished, to reduce the field size and lower the edge-to-area ratio, in terms of invertebrate densities and dispersal, though not with respect to farming management. With a recommended spray boom-width gap at each end, they were planned so as not to hinder the manoeuvring of

Figure 1. **A newly created Beetle Bank, providing essential refuge for polyphagous predators in an otherwise impoverished landscape, incorporating existing trees in the field.**

Figure 2. **A dense cock's-foot stand of a 6-year-old Beetle Bank dividing an originally 46-ha field into areas of spring barley and winter wheat. Conservation headlands run alongside both the bank and field margins.**

large machinery within the field, allowing cultivation as one unit (Figure 1).

The original design, in which a bank divides a large, single-crop field, is apparently no longer strictly followed (Figure 2). Many banks are now either used to create two separately cultivated fields and thus aid farm rotations, as a hedgerow might, or are sometimes positioned at the edges of fields to create more extensive wildlife refuges, blurring the distinction between sown grass margins and Beetle Banks.

Permanence

In 96% of surveyed cases, the Beetle Bank have become a permanent feature, although it is reputed that a few farmers have established Beetle Banks and then subsequently removed them, claiming that encroachment of weeds occurred from the bank into the crop. This is despite recent work indicating that arable field margins are unlikely to affect weed levels in the crop, especially when sown with non-invasive perennial species (Smith *et al*., 1999; Marshall, 1989).

Benefits

Some farmers accept that Beetle Banks act as overwintering refuges for polyphagous predatory invertebrates, and are undoubtedly useful in biocontrol. Their low establishment costs were frequently recognised.

One of the reasons that banks had been set up was in the hope of encouraging wildlife, and there were many mentions of the use of banks specifically for game. Financial gains from increased game populations may easily compensate for small crop area losses. Provision of ground nesting cover was considered important, especially for grey partridges. One farmer commented that his banks could provide habitat and food for barn owls known to live on the farm. Farmers have noted elevated raptor presence over banks, where increased small mammal densities are providing more prey. Harvest mice populations, in particular, appear to thrive in the ideal habitat provided by beetle banks (Bence *et al*., 1999), and nests have been seen in a few of the sites.

Conclusions

The small but increasing number of Beetle Banks is contributing to an expansion in the area of non-cropped habitat available for the benefit of farmland biodiversity, including invertebrates, birds and mammals.

Polyphagous predators are known to limit pest species population growth. Beetle Banks can provide ideal habitat where high numbers of such invertebrates can develop and better permeate the field. However, evidence that fields with Beetle Banks can lead directly to fewer pest outbreaks and insecticide reductions is still elusive, because of the difficulty in the unequivocal quantification of this. Variability in fields, crops, management histories and climatic conditions can all lead to ambiguity in the interpretation of experimental research. Aphid densities were found to increase at distance from a bank, though there was little evidence for good predator control when aphid populations had reached outbreak level (Collins *et al*., 1997). Ultimately, farmers may be principally concerned about impacts on yield, and relationships between pests and predators are not always clear. Concurrent with the survey work described here, I carried out field-scale experiments to quantify the spatial and temporal distributions of predators dispersing from Beetle Banks into cereal crops, and results are providing further support that Beetle Banks can be of significant value to the farmer.

Acknowledgements

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Similar habitat in other countries

Beetle Banks, defined as raised, mid-field, tussock-grass sown strips; are currently only present within the UK. Many other European countries have established similar kinds of habitat, either as part of agri-environment schemes or merely experimentally as part of current research projects.

Some farmers in Sweden have set up non-raised grass-sown strips, primarily as partridge nesting habitat, although also to increase the availability of predator overwintering sites. Non-inclusion within agri-environmental protection schemes, and a lack of financial incentive has limited farmer enthusiasm, with whom field size reduction is yet to appeal. France has also introduced grassy strips, again primarily for game, and they have made an appearance in Switzerland, Denmark, and only experimentally in Italy.

A combination of grass species with and without wildflowers may be grown. Germany has been experimenting with 'weed', i.e. florally diverse, strips, to enhance both ground-active and flying beneficial invertebrates and their diffusion into crops to aid pest reduction. These may much more closely spaced than the distances suggested between Beetle Banks and the field edges, and have been introduced in a variety of crop habitats, from cereals to orchard. Grass and wildflower strips are found as far afield as the USA, where the main desire is to encourage crop pollinators.

Both in the UK and internationally, a great deal more research is continuing specifically into field margins, rather than in habitats placed across field centres. Following schemes where crop margins are non- or selectively- sprayed, to allow a more extensive floral diversity to re-establish, many countries are developing and researching the use of a variety of actively sown or naturally regenerated grass or herbaceous strips around the edges of arable crops. Experimental raised tussocky field margins in Norway contained greater predator populations than other habitat areas, supporting the Beetle Bank design. Austrian grassy strips adjacent to organic fields increased beetle and spider diversity within them. Frequently, such as in France, Denmark and Finland, sown grass margins provide a buffer zone alongside watercourses, as well as protection of hedgerows from agro-chemical applications in the field and other conservation functions. Ireland, Belgium and Sweden are all investigating the value of uncultivated or unsprayed crop edges. In the Netherlands, grass strips at the field edge may be sown to limit soil erosion. Marshall & Moonen (1998) give an extensive review of the different kinds of field margin strips that can be established for biocontrol and conservation purposes.

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Sue Thomas worked on the MAFF 'Link' Integrated Farming Systems Project at the G.C.T., then on the 'ARABLES' Project at Southampton University, re-evaluating the benefits to the farmer of establishing Beetle Banks on arable land. She is currently completing a PhD examining the biodiversity of Beetle Banks, including invertebrates, plants & mammals.