

Contemporary themes in hedgerow research in the UK

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Abstract

Hedgerows are an important element of the landscape both as a habitat and as a visual component contributing to the character of the countryside. The aim of this paper is to identify key areas of contemporary research into hedgerows in the UK, to assess progress being made in each area, and to highlight areas that need more attention. Key themes were extracted from Barr *et al.* (1995) and recent papers were assigned to eleven distinct groupings. Two areas were found to have had the most published papers: ‘autecological studies’ and ‘landscape ecology’. Recommendations for future areas of research include the need for a national classification of hedgerow vegetation, long-term large-scale studies on the effects of management and different restoration techniques, and research into population dynamics at the landscape-scale including that into the role of hedgerows as supplementary woodland habitat and as movement corridors.

Introduction

Hedgerows are an integral component of the UK landscape and are valued by a wide cross-section of society (Pollard *et al.*, 1974; Oreszczyn & Lane, 2000). A massive decline in hedgerow length in the second half of the 20th century, the scale of which was disputed by different government agencies (Barr & Parr, 1994), led to calls for stricter conservation measures. The Government’s response was to commission a definitive survey of the whole countryside and the resulting Countryside Survey confirmed that hedgerows were still being lost at an alarming rate. However, the Survey highlighted that the net reduction of 23% in hedgerow length between 1984 and 1990 was not exclusively due to the deliberate removal of hedgerow – a large proportion was being lost due to other factors, such as grazing pressure or inappropriate management (Barr & Gillespie, 2000). The latest figures indicate that that, although hedgerows continue to be lost, the overall stock is now being maintained by woody features being put back into appropriate management and by planting in other areas (Haines-Young *et al.*, 2000).

Hedgerows have various functions but those of major interest here are their role for the conservation of biodiversity and the way they contribute to the character of the countryside (Baudry *et al.*, 2000; McCollin 2000a). It has been estimated that the total length of hedgerows in GB is equivalent to an additional 40% of woodland cover hence their role for maintaining woodland biodiversity may be of paramount importance (Barr *et al.*, 1995; Dover and Sparks, 2000; Hinsley & Bellamy, 2000;

Maudsley, 2000; McCollin *et al.*, 2000). Hedgerows also play a pivotal role in visual amenity and help define the character of landscapes. Only seven of the 135 so far published descriptions of Countryside Agency's Countryside Character Areas for England contain no reference to hedgerows (Countryside Agency, 1999); in Northern Ireland more than half of the Landscape Character Areas contain reference to hedgerows (Environment and Heritage Service, no date); and in Scotland, despite a reduction of hedgerow length from 40,000 km in the 1940s to 20,000 km in the 1980s, hedgerows and lines of trees are still classified as one of nine key characteristics of land use (Scottish Natural Heritage, no date).

There has been a long-standing interest in hedgerows in the UK and a number of books and publications have been published that either wholly, or partly, cover aspects of hedgerow ecology, history and natural history (e.g., Pollard *et al.*, 1974; Rackham, 1976; 1986; Dowdeswell, 1987; Muir and Muir, 1987; Watt and Buckley, 1994; Barr *et al.*, 1995; McCollin, 2000b). The purpose of this paper is to review contemporary hedgerow research in the UK with the aim of highlighting key themes and identifying other areas yet to be addressed.

Identifying Research Themes

The basis for this analysis is a summary of recommendations for future priority research areas published in a review of the effects of hedgerow management and adjacent land on biodiversity by Barr *et al.* (1995). Here I update the progress that has been made in each of the research areas identified by Barr *et al.* (1995), identify other areas, and review research priorities.

It should be noted that, for reasons of brevity, this analysis relies on the final classification of 'overall research priorities' by Barr *et al.* (1995) and cannot in the space allowed give due breadth to the wealth of the original review. Table 1 shows the groupings outlined by Barr *et al.* (1995). I have numbered these from (i.) to (ix.) - although it is worth noting that Barr *et al.* (1995) suggested that the first three categories should be part of multidisciplinary projects that require an integrated approach.

I assigned papers on hedgerow research in the UK published since Barr *et al.* finished their work to these nine categories. Papers included in this analysis are ordered by Category in the Bibliography below. Papers were included if they were directly concerned with hedgerows, or if they were on other areas but included hedgerows as part of the analyses (e.g., Fitzgibbon, 1993; Hinsley *et al.*, 1995; 1996). The main problem with assigning individual papers to these categories was with work that could easily 'fit' one or more groupings. For example, Paul Bright's paper, in which he describes the results of a radio-tracking study on dormice moving along hedgerows (Bright, 1998), could have been assigned to Category ii.) *Surveys and population studies* or v.) *Landscape ecology*. Similarly, Smart *et al.*'s (2000) paper on larval food plants of butterflies could have been assigned to ii.) *Surveys and population studies*, or to iii.) *Examination and further analysis of existing data sets* because they used data from Countryside Survey. In cases such as these the final choice was somewhat arbitrary but given that most studies tend to be autecological in nature, where a choice existed, it was decided to give priority to categories other than (ii.).

Table 1. Summary of overall research priorities identified by Barr *et al.* (1995). Some of the original categories have been modified slightly.

Theme	Outline
<i>i.) Effects of hedge cutting / trimming on wildlife</i>	The need for a national network of sites across the UK at which long-term standardised experimental studies of the effects of management regimes on flora and fauna can be undertaken.
<i>ii.) Surveys and population studies</i>	The need to update baseline information on species in hedgerows and on population ecology of 'critical' (i.e., rare or declining) species which are dependent on hedgerows to some degree. 'We need to know whether these populations are increasing or decreasing and whether changes in agricultural management are likely to reverse any undesirable trends'.
<i>iii.) Examination and further analysis of existing data sets</i>	'Data collected as part of some large, national surveys... need to be re-examined and analysed with hedgerows in mind.' Such analyses on pre-existing large, national data-sets may act as a stimulus for further research.
<i>iv.) Adjacent land use, headlands, field margins and set-aside</i>	Further work needed on the effects of differing land uses adjacent to hedges on hedgerow species.
<i>v.) Landscape ecology</i>	The value of hedgerows as part of the wider countryside needs to be evaluated further, e.g., in terms of their potential value as corridors, or as supplementary woodland habitat. To this can be added studies at the regional scale including empirical studies of landscape change.
<i>vi.) 'Quality' and desirable composition of hedgerow flora</i>	Agreement is needed on when and under what circumstances it is appropriate to restore hedgerows, and in particular what species should be considered desirable and when and where high species diversity should be appropriate. Assessment of quality necessarily involves evaluation, hence agreement is needed on what constitutes an objective evaluation method.
<i>vii.) Planting methods and choice of species for new hedgerows</i>	'Certain aspects of hedge establishment need further work, including choice of provenance, protection of young plants, sizes of gaps to be planted, and desirable species composition.'
<i>viii.) Value of hedges in winter</i>	The value of hedges in winter, in particular for birds, requires further attention including more work on contrasting hedge shapes.
<i>ix.) Herbicide use and environmentally-friendly weed control</i>	Further research on weed control in hedgerow restoration is needed. To this is added other aspects of agriculture and the impact of agricultural practice on hedgerows.

Table 2 presents data on the number of papers published in each of the categories. Two areas stand out with by far the most papers, Category (ii.) *Surveys and population studies*, and Category (v.) *Landscape Ecology*. Studies classified into the former grouping include research into species causing concern due to recent population declines (e.g., Yellowhammer: Kyrkos *et al.*, 1998) or detailed autecological accounts of species we need more information on (e.g., Yellow-necked Mouse *Apodemus flavicollis*: Kotzageorgis & Mason, 1996), reviews (e.g., Dover & Sparks, 2000) and broader studies relating aspects of species diversity to the structure and composition of hedgerows (e.g., MacDonald & Johnson, 1995; Sparks & Parish, 1995). The latter grouping includes more descriptive surveys carried out at the farm or regional scale (e.g., Bickmore & West, 1999; Millard & Rigley, 2000) and also includes empirical evidence for the ways hedgerows potentially operate as supplementary woodland habitat or as movement corridors (e.g., Doncaster *et al.*, 2001; Fuller *et al.*, 2001). Hence, both these categories encompass rather a broad range of studies, and could probably be usefully broken down further.

The remaining research areas are under-represented. There have been few long-term studies (*Category (i.)*). This probably reflects a reluctance of funding bodies to fund such projects for more than about three years. Examination of existing data sets, *Category (iii.)*, is probably an area that will grow. This category includes only two papers, both of which use Countryside Survey data, but could have been augmented by other studies using other national data sets such as those on birds, classified elsewhere (e.g., Fuller *et al.*, 1997; Fuller *et al.*, 2001).

Category (iv.) has received some attention especially in relation to the potential value of field margins (Nb. other published papers on field margins without an obvious hedgerow component have been omitted from this grouping). *Category (vi.)* is under-represented: there is an obvious lack of a definitive botanical classification of hedgerows in the UK (a National Vegetation Classification-type of hedgerow vegetation, including both woody species and hedge-bottom flora). Rich *et al.*'s paper (Rich *et al.*, 2000), however, was a valuable addition to the science of hedgerow evaluation. On a related issue, how to restore damaged hedgerows (*Category (vii.)*), again there is very little scientific evidence to guide us. The value of hedges in winter (*Category (viii.)*) is of particular importance to birds and work is just beginning in this area. Finally, there has been a reasonable number of studies in *Category (ix.)* looking at aspects of herbicide and pesticide application.

After assigning published work to these categories there were a number of papers left over. I have divided these into two new areas: (*x.*) *Different stakeholder perspectives*, and (*xi.*) *Agricultural systems*. (Table 3). The former includes the work of Sue Oreszczyn and Andy Lane looking at the views and perceptions of different interest groups and how they might be reconciled, as well as the survey by MacDonald & Johnson (2000) into loss of non-productive habitats in relation to farmers' attitudes. *Category (xi.)* is a broad group covering agricultural systems and their economic and/or environmental impacts. To some extent this reflects an increasing interest in alternative production systems such as organic agriculture perhaps reflecting a growing disenchantment with conventional intensive production systems.

Table 2. Summary of overall research priorities identified by Barr *et al.* (1995) and the number of papers published since. The categories to which each paper was assigned is given in the Bibliography below.

Theme	No (and %)
<i>i.) Effects of hedge cutting / trimming on wildlife</i>	5
<i>ii.) Surveys and population studies</i>	40
<i>iii.) Examination and further analysis of existing data sets</i>	2
<i>iv.) Adjacent land use, headlands and set-aside</i>	10
<i>v.) Landscape ecology</i>	21
<i>vi.) 'Quality' and desirable composition of hedgerow flora</i>	2
<i>vii.) Planting methods and choice of species for new hedgerows</i>	5
<i>viii.) Value of hedges in winter</i>	4
<i>ix.) Herbicide use and environmentally-friendly weed control</i>	8
Total	97

Table 3. Other categories of hedgerows research in the U.K. not identified previously.

Theme	Outline	No (%)
<i>x.) Different stakeholder perspectives</i>	Attitudes and values of differing interest groups and their perceptions of hedgerows	4
<i>xi.) Agricultural systems</i>	Analysis of environmental and/or economic impacts of conventional vs alternative systems	6

Assessing Priorities

The analysis presented here provides data on the number of papers published in each of the areas identified by Barr *et al.* (1995). The scope for work in each area, however, is not equal. Clearly, it is difficult to estimate how much work is possible in any one area. Hence, whilst the data provides an indication of the amount of work that has been done so far it tells us nothing about whether any areas are being over- or under-worked, or how much more effort should be put into each area, or indeed it tells us little about what direction future research should take.

What is clear, is that despite the seemingly large literature concerning the ecology of hedgerows we are still a long way off fully understanding all their ecological functions. Traditionally, the focus of ecology has been at the scale of the habitat. Landscape ecology offers an approach for research that will inform us about the role of hedgerows that transcend the physical boundaries of habitats and could provide information about the potential of hedgerow networks to support viable metapopulations. The whole countryside is becoming fragmented, e.g., by transport infrastructure, yet we do not understand how wildlife populations are to be maintained in the light of such changes. There are many question still to be answered. Do

hedgerows de-fragment the countryside? How much habitat is needed to maintain populations, and for woodland species is there compensation between the amount of woodland and the amount of hedgerow? Do hedgerows act as population sinks (or sources) for woodland species?

This sort of information is contingent upon knowledge about movements of wildlife into, and along, hedgerows. The sort of work done on small mammals in Canada by Gray Merriam and co-workers (e.g., Middleton & Merriam, 1981; Fahrig & Merriam, 1985; Bennett *et al.*, 1994; Henein *et al.*, 1998) needs to be repeated here although a start has been made by radio-tracking dormice (Bright, 1998) and hedgehogs (Doncaster *et al.*, 2001). Modelling is needed to establish how many species are dependent on hedgerows for their continued survival, i.e., if all the hedgerows were removed today, would their (meta)populations be sufficiently connected to enable them to maintain viable populations? This sort of work also needs to be expanded to taxonomic groups other than mammals. Can hedgerows facilitate movement of dragonflies, pollinators, plants and diseases, for example? The alternative may also need to be considered in certain circumstances, i.e., do hedgerows act as a barrier to movement?

The latest Countryside Survey results raise concerns over inappropriate management and neglect (Haines-Young *et al.*, 2000; The Wildlife Trusts, 2000). Hedgerows are often no longer managed in the traditional manner and hence fail to function as stock-proof barriers as they did formerly. There is need to establish how much traditional management goes on, where, and what types of hedgerows are being managed this way? We all 'know' that traditional management is beneficial for wildlife but what is evidence? We 'know' that an 'A-frame' hedge is the preferred shape, but again, where is the evidence? Flail-mowing produces a gappy structure which may also contribute to an erosion of ecological functions. This raises the question, how gappy can we let hedgerows become before they fail to act as a corridor for different species (if indeed they act as corridors at all)?

Anecdotal evidence increasingly points to ploughing encroaching upon the base of hedgerows resulting in the loss of marginal habitats and damage to hedgerow trees. What are the effects of this on hedgerows? What are the effects of browsing damage by over-stocking with livestock and horses? Can hedgerows recover from short-term damage and what forms of remedial action need to be taken in order to re-instate hedgerows? What are the effects of spray drift and the use of herbicides, pesticides and fertilisers up to the base of the hedgerow?

Whilst the latest data from Countryside Survey indicates that losses have been balanced by gains, data suggests that internal hedgerows continue to be removed to enlarge field systems (Barr & Gillespie, 2000). Further research is needed to confirm whether this is really happening, and what effects this changing pattern is likely to have on wildlife.

This paper has focussed largely on ecological issues: but what effects do changes have for visual amenity, and what about historic field patterns? Research is needed on how hedgerows contribute to the visual amenity of the countryside and how changes in hedge pattern affect this amenity value. Can we identify good examples of historic field patterns, such as parliamentary enclosure landscapes or open-field systems, and

are there mechanisms in place to conserve them? Finally, I wholeheartedly endorse the views expressed by Hinsley & Bellamy's (2000)(and authors cited therein) that many of these issues operate over large spatial and temporal scales and need solutions that operate over a similar spatial and temporal dimension. Without policy change any conservation measures are likely to be piecemeal and/or fragmentary.

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