Guidelines for hedge management to improve the conservation value of different types of hedge

Based on results of DEFRA Project BD2102

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Background

Species-rich hedges have an approved Habitat Action Plan under the UK Biodiversity Action Plan, reflecting their importance for wildlife conservation and landscape. Hedgerows are a noted semi-natural feature of lowland agricultural landscapes in Britain, and are important as refugia for plant diversity and support many taxa of fauna, including farmland bird species. The cultural importance of hedges is reflected in their protection under the UK Hedgerow Regulations. At the two extremes of over-management and lack of management, reduced diversity may occur in hedgerows.

British hedges have been divided into eleven categories according to the dominant shrub species present. The four major types are a) hawthorn dominant, b) mixed hawthorn, c) mixed hazel dominant and d) blackthorn predominant. There are also a number of other types, such as elm and gorse hedges, some of which are specific to different areas, for example the beech hedges on banks in Devon. Current management of hedges is based on trimming with flail cutters. The traditional techniques of laying are largely abandoned on the basis of cost, though hedge laying societies maintain the skill in many parts of the country. Work by FWAG has produced some useful data on the techniques that may be used for hedge management. In particular, a reduction in frequency of trimming to biennial cutting has benefits for wildlife. These results require further confirmation on different hedge types in different conditions. The timing of cutting will certainly affect fruiting in shrubs. Arable farmers try to trim hedges after crop harvest in early autumn, when access to field margins is easy. Grassland farmers tend to trim hedges earlier in the year. In previous times, hedge management was a winter operation, when farm labour was available. Advice on the management of hedges has been available for many years. An important aim of this project was to update this advice to include aspects of the best maintenance and to increase farmland biodiversity. Although there is a wide variety of advisory material available to farmers and agricultural advisors, there is relatively little quantified, scientific information on the impacts of current hedge management on farmland wildlife.

Hedgerow Protection

The Hedgerow Regulations were introduced in England and Wales in 1997 in order to protect this characteristic element of the British countryside. Landowners are no longer allowed to remove hedges, except with the approval of the local authority. If the hedge is of value, as defined under the regulations, for wildlife, history or landscape, then the hedge will be protected. It is estimated that at least one fifth of the hedges in England and Wales fall under the definitions and are protected. Currently, the regulations are being reviewed.

The following is extracted from the DEFRA website:
http://www.defra.gov.uk/wildlife-countryside/rddteam/rddthf.htm

Under the Hedgerows Regulations 1997, it is against the law to remove most countryside hedges without first getting the permission of your local council.

A leaflet - *The Hedgerows Regulations: Your Question Answered* - provides a brief summary of the law (available from DETR Free Literature). More detailed guidance is in *The Hedgerows Regulations 1997: A Guide to the Law and Good Practice* (£5.50

from DETR Publication Sales Centre). Neither of these publications are currently on the DEFRA website.

The Regulations have been reviewed by a group of experts, who reported on their ideas for improving the system of hedgerow protection in 1998. A free summary of their report, published by the then Department for Environment, Transport and the Regions, has been published and is available online (or by calling 0870 1226 236). Full report, priced £10, can be obtained from Unit 21, Goldthorpe Industrial Estate, Rotherham, S63 9BL, telephone 01709 891318.

Results of research into the review proposals, published in 1999, will help to inform decisions on how the current Regulations should be revised. Hard copies of this research report cost £15 from Unit 21, Goldthorpe Industrial Estate, Rotherham, S63 9BL, telephone 01709 891318.

Outline and experimental design

Many previous studies, have focussed on correlative studies between different hedgerows, e.g. between bird species and hedgerow variables. However, this project uses an experimental approach in order to reveal the specific role of cutting management, and has investigated the impacts on hedge growth and fruiting, the associated herbaceous flora and the insect fauna. Manipulated and replicated treatments of cutting frequency (annual, biennial and triennial) and timing (September or February) were implemented, with independent experiments on representative hedges across southern Britain (Table 1). All sites except one had a history of annual flail cutting. The remaining site (Leicestershire) had a hawthorn hedge that had been uncut for four years prior to the experiment. Two hedge regeneration techniques, coppicing and laying, were included in the treatments at this site. Subsidiary experiments on methods of regenerating the herbaceous flora of species-poor hedge bases were implemented on arable and grass hedge bases.

Table 1. Details of hedge study sites established in 1996 and 1997.

Site	Hedge type	Farm type	No. of plots	Frequency treatments
Hampshire	Mixed hawthorn	Arable	21	1/1; 1/2; 1/3; uncut
Buckinghamshire	Hawthorn/ dog rose	Arable	18	1/1; 1/2; 1/3
Norfolk	Hawthorn/ maple	Arable	15	1/1; 1/2; uncut
Leicestershire	Hawthorn dominant	Arable	15	1/1; layed; coppiced; uncut
Somerset[1]	Blackthorn dominant	Grassland	15	1/1; 1/2; uncut
Powys, Wales	Mixed hazel	Grassland	15	1/1; 1/2; uncut
Exmoor	Beech dominant	Grassland	15	1/1; 1/2; uncut

1/1 = annually cut; 1/2 = biennially cut; 1/3 = triennially cut; [1]abandoned in 1998.

Research findings and management implications

Hedgerow berries

Berries are an important winter food supply for a wide range of farmland bird and small mammal species. Therefore increasing the abundance and availability of berries in hedges is a desirable conservation target. Larger wintering birds will feed on a range of berry types in hedges, but some specialisation amongst different bird species also exists. Most hawthorn berries are generally removed by early December; other species may be available longer.

In woody hedge species, such as hawthorn (*Crataegus monogyna*), berries are produced on second year growth. Thus hedges that are left uncut for one year or more produce many more berries than annually-trimmed hedges. In contrast to some current management advice, this was found to be equally so for both September and February cutting times. Hedge cutting in September removes formed berries directly, whereas cutting annually in late winter reduces flowering and thus largely prevents autumn fruit-set. As there are differences in when berries are produced depending on the time of the cut (September vs. February), hedges cut on a biennial cycle must be cut at the same time each year.

In general the longer the hedge is left, the more berries are produced on woody hedge plants. However, in hedge sections left unmanaged for three years (or more), berry production in the year after eventual cutting is particularly low. Coppicing, and to a significantly lesser extent laying, reduces hawthorn berry production in the immediate following years. However, these are long-term management techniques and berry numbers would be expected to increase with time.

Bramble (*Rubus fruticosus*) and other deciduous climbing plants are less affected by cutting frequency, and there is evidence that regular management (including annual trimming) is beneficial for fruit production. September cutting significantly reduces availability of these berries in the autumn. Management practice may need to reflect such responses where bramble is dominant, and/or where the conservation of a particular bird species that feeds on these types of fruit is targeted.

Fruiting in woody species is highly variable between years and along individual hedges. Summer flowering species such as bramble are much more consistent in the amount of berries produced each year and per area of plant. *Rosa canina* (dog rose) also has low variability in berry production, but generally acts like woody shrub species in its response to frequency and timing of cutting. Variation is likely to be a combination of genetic control and environmental influences. Therefore local provenance hedge material may present berry producing hedge plants best adapted to regional conditions. Mixed species hedgerows will provide more consistent berry availability each year, but not necessarily highest numbers of berries per length of hedge.

- Avoid large-scale annual trimming as this drastically reduces the availability of berries on woody hedge species.
- February cutting is not necessarily better for berry production than September cutting.
- Hedges uncut for longer produce more berries on shrubby plant species.
- Berry production in bramble is enhanced by regular management (at least biennial cutting)
- Overall results suggest rotational management is required to ensure some berry availability in hedgerows each year.

Hedgerow flora

i) Hedge shrubs

There is no consistent evidence that timing of cut affects hedge size. However, hedge dimensions, measured as height x width, increase with time since last cut. Differences in growth are apparent between hedge types. In this study, the mixed species hedge in Hampshire increased most in the first year after cessation of cutting whereas the beech hedge in Exmoor increased more steadily over the study period (Fig.1.). The Norfolk arable hedge showed most rapid growth, which may reflect fertiliser inputs into the hedge base. At Leicestershire, coppiced and laid plots reached approximately the same dimensions as annually trimmed plots after 4 years. The generally wet spring and summer of 2000 encouraged extra prolific hedge growth in that year, highlighting the role of climatic conditions.

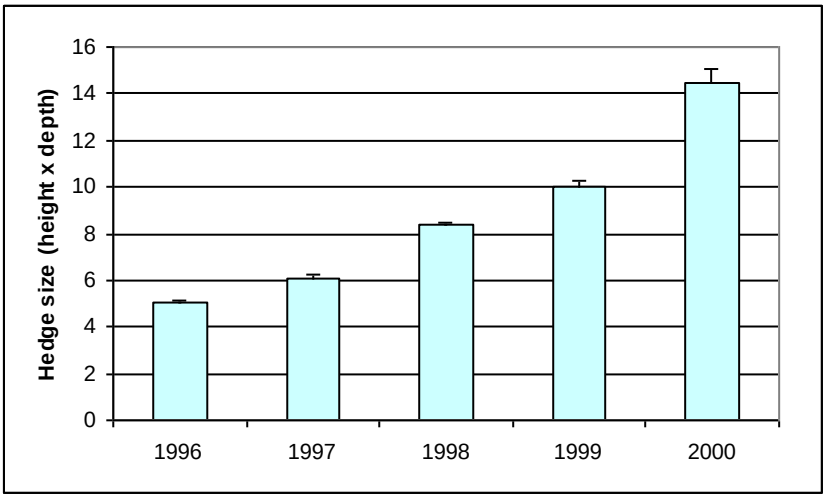

Fig 1. Growth in cross-section of uncut plots of the Exmoor hedge, 1996-2000.

There is evidence that hedge size continues to increase after 10+ years, but that the *rate* of increase declines. Other studies have shown that hedge size is an important determinant for the number of species of birds utilising hedgerows. It has been estimated, as a general trend, that one additional species of bird will be encouraged for every $2m^2$ increase in hedge cross-sectional area. On average from the data in this

study, this would equate to 2 species accruing per year left uncut. However, the relationship between bird diversity and hedge size may level out in the largest hedges.

The amount of new vegetative growth produced by hedge shrubs each year increases with increasing cutting frequency, which may have implications for the herbivorous insect fauna (see below).

In mixed species hedges, there are also differences in the response to cutting between the different hedge shrub species. Hawthorn and dog rose regrow strongly immediately after cutting, and appear to be tolerant of regular cutting, whereas other species such as spindle and buckthorn are positively responsive to being left uncut for longer (2+ years). Blackthorn grows extremely vigorously each year if left uncut, and may encroach on other hedgerow plant species and adjacent farmland. Scrambling hedge species such as bramble and black bryony decreased in abundance with time left uncut.

- Decreased cutting frequency increases the size of hedges and their suitability as a habitat for most birds.
- Geographical and hedge type differences suggest that optimal cutting regime may vary. E.g. an upland beech hedge could be left uncut for longer than a lowland hawthorn hedge.
- Mixed species hedges in particular should be cut biennially or less often in order to encourage non-cutting tolerant species, such as spindle.
- Bramble and other scrambling type hedge plants respond well to regular management.

ii) Hedge-base flora

Hedge base habitats generally contained very high botanical diversity, higher than in the shrubby part of the hedge. No significant effects of hedge cutting on botanical diversity in the hedge base are apparent. Analyses of individual herbaceous species may reveal more subtle effects associated with the change in width of the hedge relative to the verge, and therefore the light climate, but no consistent effects have been established. At Leicestershire, coppicing and laying both increased the species diversity of hedge base plants, presumably in response to ground disturbance and increased light levels. There were no differences between these treatments and control plots by the end of the experiment.

Analysis of the composition in hedge-base floras between sites shows that different hedgerows have distinct hedge-base plant communities. Differences appear to be largely determined by adjacent land-use. Arable hedgerows are less diverse than grassland ones, although uncropped field margins next to the hedgerow may increase botanical richness in the hedge base.

- Hedge base habitats can be botanically rich.
- Coppicing and laying can increase plant diversity in the short-term.

- Adjacent land-use and field operations are important in determining plant composition of hedge bases.

Hedgerow Invertebrates

The high diversity and variability in invertebrate communities within hedgerows, as well as between years, makes detecting clear management effects more difficult than with plants. Differences of response to cutting management are apparent between different hedges, invertebrate groups and time of year. However, some notable patterns are discernible, with important implications.

i) Summer distributions

Plant diversity is an important determinant of invertebrate diversity. This is evident at the farm scale, where the high botanical diversity in hedges equates to high invertebrate diversity compared to other agricultural habitats. This study also showed that plant and invertebrate diversity are positively related between different hedge types. However, at the plot-scale within hedges this relationship is less apparent, presumably due to mobility of many species and the distribution of individual host plants. Importantly the hedge-base flora is found to be related to the species composition of some insects, suggesting that in order to enhance or maintain the biological diversity of hedgerows, both the hedge and the hedge base need to be managed sympathetically. Restorative hedge management that increases plant diversity, such as gapping-up with new shrub species or hedge base restoration (see below), will thus have positive knock-on effects for invertebrate diversity.

Although increases in invertebrate diversity with decreasing management intensity were not found in the study, annual cutting in a previously uncut hedge site (at Leicestershire) reduced the number of invertebrate taxa in the first year. Furthermore, the abundance of individual invertebrate groups was widely, but not uniformly, negatively affected by regular cutting. This was particularly noticeable for flying insects, such as Diptera (flies) and Hymenoptera (parasitic wasps), in early summer, which may reflect both a reduced flowering of woody hedge shrubs and/or diminished wind shelter in annually trimmed hedge sections

Timing of hedge cutting is also important. Cutting in February reduces the numbers of insect larvae found in early summer compared to September trimming; notably the larvae of Lepidoptera (moths and butterflies) and to some extent Diptera (true flies) (Fig. 2). Late winter cutting is likely to entail the removal of insect eggs laid during the autumn (after a September cut), and will have important consequences for nesting birds that preferentially forage for such insect larvae in hedges at this time of year.

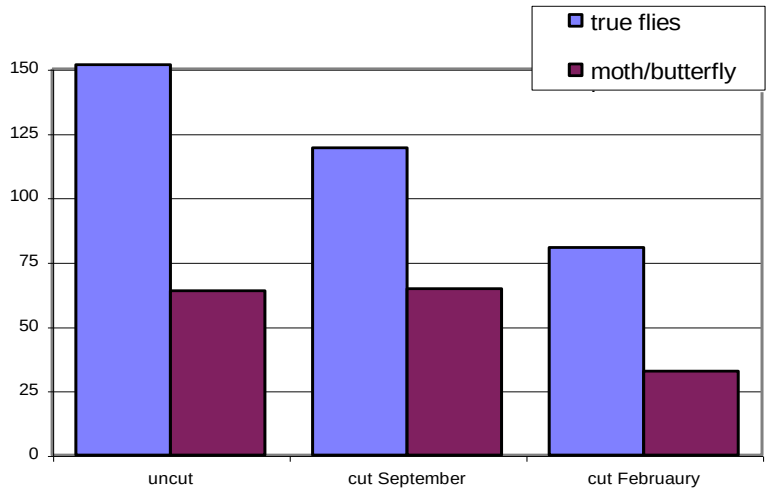

Fig. 2. Mean number of hedge invertebrates sampled per plot (Exmoor site, May 1998).

In mid-summer there is contrasting evidence that annual cutting increases the abundance of some invertebrate types, notably herbivores closely associated with the hedge vegetation, such as Coleoptera (beetles), Heteroptera (plant bugs) and Collembola (springtails). This may be a response to the stimulated new hedge growth following cutting providing a more suitable habitat and food source for such invertebrate species groups. In some cases, annually cutting in February appears to be particularly beneficial for invertebrates.

Hedge laying is particularly beneficial for invertebrate communities, maintaining high taxonomic diversity as well as high total invertebrate abundance. This hedgerow rejuvenation technique may represent a combination of stimulated new shrub growth and good physical structure. In contrast, coppicing, with a drastic reduction in vegetation, appears to be detrimental to hedgerow invertebrates, at least initially.

- Encourage plant diversity in the hedge and hedge base, either through direct management (e.g. gapping up) or indirectly through sensitive field management.
- Avoid wholesale annual hedge cutting as this is detrimental to a range of invertebrate groups.
- Late winter cutting can reduce insect larval populations in spring. Do not undertake all cutting management at this time.
- Active hedge management can increase populations of herbivorous insects; adopt an appropriate rotational management regime.
- Based on the Leicestershire site, hedge laying can maintain high diversity and abundance of associated invertebrates.
- Hedgerow features need to be managed as an integrated unit.

ii) Overwintering invertebrates

Apart from some species that overwinter as eggs, most invertebrates occur in the base of hedges during winter. These include many groups found in the shrub layer later in the year, as well as those that migrate to adjacent farmland in spring. Hedge cutting has little discernible effect on overwintering invertebrates, although at Leicestershire overall abundance was reduced by coppicing in the short term. Vegetation biomass is positively correlated the numbers of invertebrates overwintering in hedge bases, therefore direct (e.g. autumn cutting of hedge base vegetation) and indirect (e.g. herbicide drift) management will have detrimental effects on the quality of this habitat for overwintering invertebrates. There is evidence that some overwintering invertebrate groups are spatially limited within individual fields, therefore simultaneous hedge base management at the field scale is not appropriate.

- Avoid routine cutting of hedge-base vegetation, or cut in spring where applicable.
- Always leave some areas of hedge base unmanaged per field as a refuge for recolonisation of hedge shrubs and adjacent habitats by invertebrates. Similarly, avoid widespread hedge coppicing in any one year.

Regenerating herbaceous hedge bases

In degraded arable hedge bases, sowing seed mixtures to re-establish a diverse perennial flora can be successful. In grassland, resowing hedge-bases with seed mixtures is less successful and natural regeneration techniques are probably more appropriate. Reducing fertiliser contamination of the hedge base can also maintain plant diversity. Where annual weeds, such as cleavers (*Galium aparine*) and barren brome (*Bromus sterilis*), dominate the herbaceous flora, selective herbicides can effectively reduce their abundance. Negative relationships between abundance of weed species and associated insect diversity suggest that control of such species in hedge bases may have an ecological as well as an agronomic basis.

As agricultural practices are a crucial determinant of the field boundary ecology, even where a diverse habitat is successfully restored sensitive applications of field operations will be necessary to prevent continued degradation of such habitats in agricultural landscapes.

- Restoring botanical diversity in degraded arable hedge-bases is best achieved through resowing with wild flower seed mixtures and use of selective herbicides.
- In grassland sites, encouraging natural regeneration is more effective than resowing.
- Control of annual weeds in hedge bases is important to maintain the wildlife value of hedges.

Economic considerations

Although there is evidence of yield reductions at the edges of fields, assessment of yields of adjacent crops did not show significant effects of hedge management within the scale and timing of this study. Hedge management represents a cost for farmers. Averaged over the whole cutting cycle, measures of cutting time showed that total

time taken was 40-50% lower in hedges left uncut for two or three years compared to annual cutting. Thus there are cost advantages in relaxing hedge cutting from annual trimming. Not cutting the hedge-base vegetation each year will also have an associated management cost saving

Overall summary of findings and recommendations

- Hedge trimming using flail cutters should be relaxed to biennial and triennial cycles where safety and sightlines are not compromised
- Mixed species hedges should be encouraged, either through new planting, gapping up or appropriate field edge management.
- A mixture of cutting regimes should be planned on each farm, including at least some September cutting to allow insect larvae to survive in spring.
- Where possible, allow some sections of hedge (e.g. hedge nodes) to be left uncut for longer time periods (10+ years) to allow extra berry production and to support specialist species dependent on these features (e.g. greater horseshoe bat).
- Hedge laying should be encouraged as a regeneration technique that enhances farm wildlife. In contrast, coppicing has short-term detrimental effects on wildlife.
- Hedge bases are an important habitat for plant and invertebrate diversity, and consequently other wildlife. There are important ecological interactions between hedge and hedge base, such that an integrated approach to hedgerow management should be adopted.
- Cutting of hedge base vegetation, particularly in autumn, should be avoided where possible. Rotational cutting can be adopted where necessary, ensuring undisturbed habitat refuges.
- Degraded hedge bases may be enhanced by restorative techniques such as resowing. However, minimising ongoing damage through sensitive field operations remains a priority.
- Reduced cutting regimes are likely to result in financial savings.

Farm-scale hedge management

The application of beneficial hedge management at the farm-scale has not been directly investigated, although a number of useful indications can be highlighted. In particular, the diversity of responses to management between wildlife groups, especially within invertebrate communities, suggests a rotational approach to farm hedge management. Each farm will need a tailored management plan based on the type and location of hedgerow, the specific wildlife objectives alongside practical and financial considerations. In general, bi or triennial cutting regimes, with allowance for some sections of hedge left uncut for longer periods, should be achievable on most farms.

The importance of second year growth of shrubby hedge plants for berry production and egg laying insects from this study, suggest two other approaches to the

application of mixed cutting management regimes (given below). These may be practically applied to hedges where some cutting management is required each year. Furthermore, the high degree of small-scale spatial variation in invertebrate distributions within hedgerows indicates that such management procedures will allow refuges from unfavourable management events.

i) Incremental cutting. This allows some increase in the hedge shrubs each year, thus preserving some second year woody growth. Hedges would retain a 'tidy' appearance and would only need to be severely cut infrequently.

ii) Differential top and sides cutting. If cut in alternate years, this would leave part of the hedge uncut each year, allowing a diversity in management condition across the farm.

Further studies of these techniques under different conditions are indicated.