Preface

Field margins mean different things to different people. To the livestock farmer, the field margin is a barrier to prevent stock wandering, which may also provide some shelter. Field margins have often been viewed by arable farmers as a source of weeds, pests and diseases, best removed or at least kept in check by annual applications of herbicide. Nowadays, attitudes are changing and the benefits of marginal habitats as reservoirs of beneficial invertebrates, predators of pest species or crop pollinators, are becoming more widely appreciated. To the general public, the more obvious field boundary structures such as hedges, shelter belts and stone walls are major elements in the landscape, defining features of the countryside we have come to regard as "traditional". To the landscape ecologist, field margins are corridors forming a network through which organisms can move between larger habitat patches. To the conservationist, field margins may represent the last haven for some types of wildlife in an otherwise hostile environment created by intensive modern farming, whilst to the agricultural historian boundary structures can give a clue to the practices of a former age.

The role and management of field margins in agriculture has changed in recent years. Many formerly mixed farms have become entirely arable, and hedges or other field boundaries have lost their previous purpose. The resulting large scale removal of hedges in some areas has caused widespread public concern. At the same time, increased labour costs have led to a decline in the practice of traditional labour-intensive maintenance techniques such as hedge-laying and dry stone-walling, causing the gradual dereliction of many remaining field boundaries. This has been accelerated in stock rearing areas by increased stocking rates, resulting in intensive grazing pressure on hedge bases. Such hedges may eventually lose their effectiveness as stock-proof barriers, and be replaced by post and wire fences. Increased use of inorganic fertilisers and pesticides on crops may have effects on the fauna and flora of field edges via drift, surface run off or leaching into drainage ditches.

The changing status of field boundaries in agriculture has coincided with an increased awareness amongst the wider public of the conservation potential of field margins in the widest sense. Commodity surpluses have shifted agricultural support policy away from productivity orientated incentives to production stabilising mechanisms, with environmental benefits becoming an increasingly prominent factor in policy and spending decisions at national and European level. There is now a wide range of grants and incentives available to farmers to establish, manage or maintain field margins to provide wildlife, landscape and public amenity benefits. Over the last decade, research into all aspects of field margin ecology and management has expanded considerably, providing a sound scientific basis to underpin policy decisions. This symposium provides an international synthesis of this research set in its wider social, political and economic context.

N D Boatman

Symposium Programme Committee

Chairman:	Dr N D Boatman	The Game Conservancy Trust/ Allerton Research and Educational Trust, Loddington House, Loddington, East Norton, Leicestershire LE7 9XE

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Poster Session Organiser:	Mr M A Lainsbury	BASF plc, Lady Lane, Hadleigh, Ipswich, Suffolk IP7 6BQ
Field Visit Organiser:	Dr N D Boatman	The Game Conservancy Trust/ Allerton Research and Educational Trust, Loddington House, Loddington, East Norton, Leicestershire LE7 9XE
Field Visit Organiser:	Dr R Feber	Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS

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Field Margin Terminology

(Adapted from Greaves & Marshall, 1987)

Field boundary

Hedge, grass bank, fence, wall, plus hedge bank if present with its herbaceous vegetation, plus ditch or drain if present.

Boundary Strip

Area of ground between boundary and crop. It may include a farm track, a grass strip, an unsown cultivated strip with naturally regenerated flora and/or a "sterile strip" of bare ground, maintained by cultivation or herbicide.

Crop margin (headland)

The outer part of the crop itself, usually considered as the area between the edge of the crop and the first tramline (tractor wheeling). The term "headland" is often used to describe this region, though strictly speaking this refers to the turning area used by agricultural machinery, and therefore only applies to two sides of a field. The crop margin is often managed differently in certain ways from the rest of the field.

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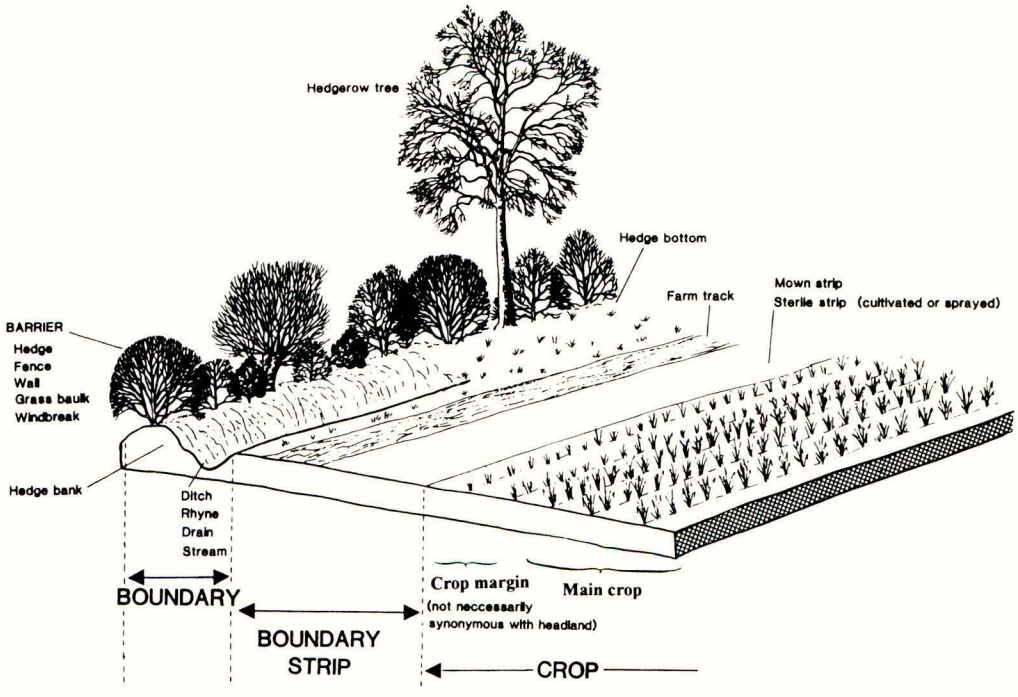

Abbreviations

acid equivalent	a.e.
active ingredient	AI
boiling point	b.p.
British Standards Institution	BSI
centimetre(s)	cm
concentration x time product	ct
concentration required to kill 50% of test organisms	LC50
correlation coefficient	*r*
cultivar	cv.
cultivars	cvs.
day(s)	d
days after treatment	DAT
degrees Celsius (centigrade)	°C
dose required to kill 50% of test organisums	LD50
dry matter	d.m.
Edition	Edn
Editor	Ed
Editors	Eds
emulsifiable concentrate	EC
freezing point	f.p.
gas chromatography-mass spectrometry	gcms
gas-liquid chromatography	glc
gram(s)	g
growth stage	GS
hectare(s)	ha
high performance (or pressure) liquid chromatography	hplc
hour	h
infrared	i.r.
International Standardisation Organisation	ISO
Kelvin	K
kilogram(s)	kg
least significant difference	LSD
litre(s)	Litre
litres per hectare	l/ha
mass	*m*
mass per mass	*m*/*m*
mass per volume	*m*/*V*
mass spectrometry	m.s.
maximum	max.
melting point	m.p.
metre(s)	m
milligram(s)	mg
millilitre(s)	ml
millimetre(s)	mm
minimum	min.
minute (time unit)	min
molar concentration	M
nuclear magnetic resonance	nmr
number average diameter	n.a.d.
number median diameter	n.m.d.
organic matter	o.m.
page	p.
pages	pp.
parts per million by volume	mg/l
parts per million by weight	mg/kg
pascal	Pa
percentage	%
post-emergence	post-em.
power take off	p.t.o.
pre-emergence	pre-em.
probability (statistical)	*P*
relative humidity	r.h.
revolutions per minute	rev./min
second (time unit)	s
standard error	SE
standard error of means	SEM
soluble powder	SP
species (singular)	sp.
species (plural)	spp.
square metre	m^2
subspecies	ssp.
surface mean diameter	s.m.d.
suspension concentrate	SC
temperature	temp.
thin-layer chromatography	tlc
tonne(s)	t
ultraviolet	u.v.
vapour pressure	v.p.
variety (wild plant use)	var.
volume	*V*
weight	*W*
weight by volume (mass by volume is more correct)	*W*/*V* (m/*V*)
weight by weight (mass by mass is more correct)	*W*/*W* *(m/m)*
wettable powder	WP

approximately	c.
less than	<
more than	>
not less than	<
not more than	>

Multiplying symbols-		Prefixes
mega	(x 10^6)	M
kilo	(x 10^3)	k
milli	(x 10^{-3})	m
micro	(x 10^{-6})	µ
nano	(x 10^{-9})	n
pico	(x 10^{-12})	p

FIELD MARGINS - AN HISTORICAL PERSPECTIVE

JOHN CHAPMAN

Department of Geography, University of Portsmouth, Buckingham Building, Lion Terrace, Portsmouth PO1 3HE

JOHN SHEAIL

Institute of Terrestrial Ecology (Natural Environment Research Council), Monks Wood, Huntingdon, Cambridgeshire PE17 2LS

INTRODUCTION

According to The Times Countryside Correspondent, there is no more potent symbol of rural England than its hedgerows, the green sinews of the countryside that Wordsworth called 'little lines of sportive wood run wild' (The Times, 17 August 1993). And yet, according to a survey recently undertaken by the NERC Institute of Terrestrial Ecology, for the Department of the Environment, barely half the 500,000 miles of hedgerow estimated to have been in existence at the end of the war, now survive. A third of the entire loss was sustained between 1984 and 1991. In England, the survey estimated that, whilst some 2,000 miles might be planted each year, about 4,000 miles had been destroyed (Department of the Environment, 1993).

The Hedgerow Incentive Scheme launched by the Countryside Commission, and other endeavours to secure some form of statutory protection, are likely to stimulate further appraisals as to the character and importance of this diminishing resource. As with previous studies of the hedgerow and field margins, as published, for example, in the Collins New Naturalist series (Pollard et al., 1974) and by the British Crop Protection Council (Greaves & Marshall, 1987), there will continue to be reference to the origins and development of this landscape phenomenon, one taken so much for granted in Lowland England and found so rarely in other parts of the world, beyond Western Europe, New England and Tasmania.

THE UTILITY OF HEDGES

In a paper, published in the Journal of the Royal Agricultural Society in 1985, Dr E.J.T. Collins took conservationists and ecologists to task for regarding the inauguration of the ploughing-up campaign of the second world war as necessarily the benchmark from which to measure change in the agricultural environment. Collins (1985) argued that many of the changes since 1940 had been in effect a resumption of a trend that had begun in the seventeenth and eighteenth centuries. Through the destruction of the commons, reclamation, and the adoption of tighter systems of crop and animal husbandry, the British landscape had become, by the time Victoria ascended the throne, second only to the Dutch in western Europe, in being so tamed and intensively worked. If the years of agricultural depression after 1870 are regarded as the 'middle past', when progress was interrupted and in some instances

reversed, the decades since 1940s may be seen as a time when lost ground was regained and surpassed.

If that longer time perspective is adopted, it comes as no surprise to discover that the utility of hedgerows was keenly debated during the period of 'High Farming' in the mid-nineteenth century. In 1845, the Royal Agricultural Society offered a prize for the best essay on hedges. The winning essay was simply entitled, 'On Fences' (Grigor, 1845). Another focused 'On the Advantages of Reducing the Size and Number of Hedges' (Cambridge, 1845), and a third more dogmatically 'On the Necessity for the Reduction or Abolition of Hedges' (Turner, 1845). All were united in their condemnation of hedges, which took up so much land, made the use of machinery difficult, acted as weed magazines and asylums for pests, impoverished the soil, and prevented the free circulation of air. The prize winner, James Grigor, estimated that, on the basis of a sample survey of four arable districts of Norfolk, there were 25 miles of hedgerow per square mile, covering over 10% of the surface area. Applying the formula to 'the forty divisions of England', the total area occupied was equivalent to 'two of the largest counties'.

To others, it seemed extraordinary that a feature, so widely admired on the Continent, should be threatened with destruction. Richard Jefferies protested at the 'modern agricultural endeavours', in arable districts, to cut down trees and grub up hedges', on the pretext that crops were shaded by the foliage and damaged by their roots. They afforded abundant shelter to sparrows and other pest species (Jefferies, 1879). Claims that the hedges had to be removed so as to allow English farmers to compete more successfully with foreign producers reflected the wisdom of city counting-houses, and scientific lecture-rooms, which looked upon the land as little more than 'a manufactory of agricultural produce' (Johnston, 1851). Fortunately the mercantile spirit and middle-class devotion to profit did not always prevail. In the words of William Johnston, the countryside was held in such affection by the great body of people.

The debate as to the utility of hedgerows was likely to become even fiercer, in the last quarter of the nineteenth century, as the increasing competition from the growing volume of imported American grain called for the greatest economies in the use of capital and labour. On the premise that £1 per acre had to be invested in farm boundaries, and a further 3 shillings per acre in their annual upkeep, one authority estimated that the fencing required for some 45 million acres of enclosed farmland in the United Kingdom represented an investment of nearly £50 millions of capital. A further £6,750,000 were required for annual upkeep. Account had to be taken of both the thickness and layout of the field boundaries. A hedge of only 2 feet in width, with a margin of 1 foot left on each side, might occupy a 55th part of the area of a holding of 250 acres, where laid out in 25 fields of 10 acres in size (Scott, 1883). The optimal size of fields was generally reckoned to be between 20 and 25 acres - fields should not be smaller than 5 acres nor larger than 40 acres. A square field saved frequent turnings on short ridges. Where there were long ridges, horses became fatigued and the soil badly washed by the strong currents

which heavy rains formed in the long furrows. In determining the exact size and shape, account had to be taken of the nature and use of the land. Whilst on light, sandy soils, the value of hedges in retaining moisture might increase with their number, they could be injurious on naturally damp and wet soils (Stephens 1890).

Whatever the conclusions drawn from such computations, the rate of hedgerow loss remained small, compared with that recorded in surveys some hundred years later. Whilst some might be destroyed when fields were enlarged to accommodate machinery, particularly following the introduction of the steam plough, A.D. Hall, in his Pilgrimage of British farming, written in 1910-12, continued to be astonished at the extent to which hedgerows survived as obstacles to farming. A green sheltered country of little fields might make for a charming property but, to the farming eye, such a spectacle denoted 'the same retail way of business as the endless tiny shops in the suburbs of a manufacturing town' (Hall, 1913).

PRESCRIPTIONS FOR THE MAKING OF BOUNDARIES

The author of a paper on 'Hedges and hedge-making', published in the Journal of the Royal Agricultural Society in 1899, looked for seventeen qualities in a quick hedge (Table 1). No species possessed so many of these qualities as the whitethorn or hawthorn. Since the thorns deterred all forms of livestock, the hedge could be cut into a very compact form, thereby ensuring its branches offered little refuge for birds and insects. Whilst it grew less vigorously on thin soils, it was only at high altitidues that the whitethorn encountered difficulty in establishing itself. The fact that it was the only shrub used as fencing along the entire length of the railways, through a great variety of soils, topography and climates, provided ample evidence of its adaptability (Malden, 1899).

Among the many changes which the construction of the railways had brought to the customs of the countryside, Henry Stephens, in his Book of the farm, identified the most important to be the way that hedgerows were planted and established. The practice had been to plant the hedges on banks composed of material excavated from an adjacent ditch. Whilst this had the effect of immediately providing some kind of barrier, the sides of the bank inevitably fell away, exposing the rooting system. The railway companies had provided an 'excellent object lesson' in how the first consideration should be the welfare of the hedge. The quicks were planted on the level, with a ditch cut only where needed for drainage. However planted, the ground should be at least fallowed, limed and manured. Every effort had to be made over the first few years to stir the soil, so as to prevent the quicks from being choked by weeds (Stephens, 1890).

Some of the most detailed prescriptions were to be found in Farm roads, fences and gates. A practical treatise, published in 1883 by John Scott, the one-time Professor of Agriculture and Rural Economy at the Royal Agricultural College, Cirencester. Whilst

quicks of one, two or three years of age were commonly used, they took a long time to develop into a hedge, and would certainly perish unless well fenced and nursed. Where available, Scott recommended the use of stock of at least 6 years, and ideally over 10 years, in age. Rather than mixing them up (as often happened), it was easier to give more attention to the weaker plants, where they were segregated from the stronger. Opinion was sharply divided as to the advantages of planting in one or two rows. Optimally, the distance between each quick was 6 to 10 inches. Whilst closer planting would help establish the hedge more quickly, and help compensate for any gaps that might occur, say, through the browsing of hares and rabbits, the longer-term effect was to encourage the plants to be drawn upwards, with less lateral growth. The pernicious practice of planting trees within the line of the hedge should be resisted. Most trees grew faster than the whitethorn. With roots and branches spreading in all directions, they would soon overshadow and deprive the young quicks of nourishment (Scott, 1883).

TABLE 1. The seventeen most important attributes of a hedge according to W.J. Malden, in his paper, 'Hedges and hedge-making', published in 1899.

The hedge would:

1 develop in a reasonably short time,
2 be long-lived,
3 be easily repaired, if neglected,
4 be uniform in growth,
5 be easily kept within suitable bounds,
6 present a compact front,
7 prevent animals from escaping, ideally by having thorns,
8 be easily grown from seed,
9 be adaptable to most soils,
10 be able to withstand severe weather,
11 afford shelter to livestock in cold winds,
12 produce shoots close to ground for containing small animals,
13 afford little harbourage for insects,
14 be able to withstand fungal and other diseases,
15 have reasonably compact rooting systems,
16 be able to withstand browsing by livestock or game,
17 be able to regenerate, when cut down, to or near its stump

Even where pruned, hedges might be woefully mismanaged. Whilst the height and severity of cutting might vary, the overriding object was to promote new growth. If too much old wood was left, the heart of the hedge tended to become hollow as the younger growth on the outside smothered that of the inside. Wherever practicable, the wood was best cut with an upward stroke. Water would then run easily off the smooth surface. The vibration caused by a downward cut would cause the wood to splinter, leading to dampness and often considerable decay. Over time, it might become a chief cause of gaps in the hedge. In broad terms, one of two management systems might be adopted. The more common was to train the hedge into an

upright, triangular section, that followed closely the natural form of the hawthorn tree. It might reach a height of 4 or 5 feet, without ceasing to be thick and well-clothed at the very bottom. Not only did this produce an effective barrier for livestock, but whitethorn shoots were seriously damaged by the shade cast by growth above them. Since lateral growth had the effect of curbing the natural tendency of sap to flow to the upper shoots, the bottom of the hedge, once weakened, rapidly became weaker. The alternative method of management, and the one preferred by railway companies, was to cut, rather than grow, the hedge into shape. It was first allowed to grow to a height of 6 to 8 feet, and then 'wattled' at an angle of about 40 degrees, stakes being left at 2 feet intervals, the wattling rods being hacked close to the ground, and woven in between the live stakes. The hacking encouraged a strong growth of young shoots from the base.

HEDGEROW-NEGLECT AND REPLACEMENT

A particular feature of the hedgerow survey, carried out by the Institute of Terrestrial Ecology in 1990, was the significance attached to hedgerows that might have survived removal, but had nevertheless been abandoned through neglect. As Malden noted, almost a century earlier, hedgerows had always been subject to neglect even in pastoral areas. They were obvious targets for economies in the straitened circumstances of Agricultural Depression.

One of the more obvious signs of agricultural depression was the neglect or skimping of management work. Whilst, on the one hand, the hedges might be overgrown with 'every weed that gets leave to shed its seed for miles around', there were, on the other hand, so many gaps as to render them useless for containing stock, unless infilled with slabs, paling or loose stones. Observers commented on how, between Oxford and Thame, the hedgerows, once kept 'so painfully low and well-trimmed', had been allowed by the 1890s to grow high. Through neglect, the hedges in parts of Essex and Suffolk had taken on the appearance of 'shaws', or lines of woodland, growing up to 25 feet in height, and encroaching onto fields and roadside wastes (Hissey, 1891; Collins, 1985).

Whilst understandable, commentators stressed the short-sightedness of neglect. Once a weakness or gap developed, the whole purpose of the hedge was lost and remedial action might be costly. Re-planting on the site of a thoroughly-neglected or worn-out hedge was rarely successful. Whilst there was no actual evidence that injurious matter accumulated in the soil, it was usually presumed so. The only course was to remove and replace the top soil with fresh soil from nearby, mixed with well-rotted dung. On thin or barren soils, well-rotted turf or sod was useful. The better course was to ensure the hedgerow never reached the point where it needed replacing. Much of the work could be performed when there was little alternative employment for the farmer's best labourers. The most effective method of dealing with overgrown, yet gappy, hedges was to plash them, the long rods being suitable for wattling. Any decaying stumps should be cut level with the ground, so as to

encourage regeneration. If laid well, some judicious thinning and keeping the ground clear at the base should be enough to keep the hedge in shape for 20 to 40 years. All too often, however, it was again allowed to become large and straggly.

The cost of establishing and maintaining hedges was an obvious incentive to finding substitutes. From the 1840s, factory-made iron railings and posts, and wire for strengthening fences, became increasingly available. Whilst too expensive for ordinary farm purposes, the iron-bar fencing was in much demand for use around parks and pleasure grounds, and along roads. It combined great strength with good appearance. Increasing quantities of galvanised wire-netting were used for protecting paddocks and turnip fields, and for fencing rabbit-warrens, poultry yards and pheasantries.

According to Scott (1883), wire fences had, in late years, become the most convenient and profitable of boundary-materials. They were relatively cheap, durable and easy to erect. A drawback was the way in which the wire, fixed to straining and intermediate wooden-posts, soon gave way to pressure from livestock, particularly as the posts began to decay. Scott commended the far superior fencing developed by New Zealand colonists, that only required posts at intervals of as much as 12 to 22 yards. 'Droppers' were fixed at intervals of 6 feet, so as to prevent the wires being pushed apart. Since the 'droppers' did not reach the ground, the fence retained a degree of elasticity.

The future was, however, with steel barb, or barbed wire, fencing. Because livestock soon learnt to keep well clear of the barbs, perhaps only a quarter to a half of the number of fence posts might be needed. Since its introduction in 1873, the fencing had come to consist of at least two barbs, of no more than 5 or 6 inches apart, twisted not around, but between, two strands of wire so as to prevent their being loosened. As Scott remarked, one or two lengths of this barbed wire, within an ordinary, plain-wire, fence, or entwined in the line of a hedge, could have a magical effect on the efficiency of the whole. Costing perhaps under one penny per yard, barbed wire was the only certain way of keeping full-sized horses, oxen and cattle within, and the enemies of sheep, including prowling dogs, outside an enclosure.

Although unequalled in its efficiency and cheapness, many owners of stock soon abandoned the use of barbed wire. Whilst ordinary wire, lodged on the top, or stapled to the sides of the posts, presented little hazard to fox-hunting, barbed wire might seriously injure a horse. Arrangements were made by most Hunts to remove the strands during the hunting season. The Fernie Hunt set up a special Wire sub-committee in 1895, and contemplated the appointment of a wire inspector in 1904. Whilst there was no possibility of a general curb being placed on the use of barbed wire, a Bill was introduced by a group of members of parliament in 1893, making it easier and cheaper to obtain legal redress where injury was caused by 'any wire with jagged projections' beside a public highway. The preamble to the draft Bill recalled how there had been many accidents, as well as 'danger, injury and cruelty to animals'. The Act, as amended by the Local Government Board, enabled local authorities to seek the removal of such wire, where

it constituted a nuisance to users of the highway (Public Record Office, HLG 29,41; Parliamentary Debates, 4th series, XII, 302-7; Barbed Wire Act, 1893, 56 & 57 Victoria, c.32).

LANDSCAPE ECOLOGY OF FIELD MARGINS

Beyond providing confirmation that hedgerows have always been the subject of contention as to their utility, however prosperous farming might be, what significance may be attached to these earlier prescriptions as to how hedgerows might be established and maintained, and the merit of replacing them with, say, a barbed-wire fence? The paper concludes by noting two initiatives currently being developed by the agricultural historian and ecologist, and their possible implications for interpreting, say, the changing species composition of the rural mosaic.

Historians have tended to understate the importance of the enclosure movement to landscape change in the eighteenth and nineteenth centuries. They have concentrated on the Parliamentary aspects, namely those schemes carried out by private act or under the auspices of the public general enclosure acts of 1836 and 1845. Such Parliamentary enclosures were certainly of considerable significance. The 5,500 individual Acts or Orders affected some 25% of the total surface area of England, and 12 to 15% of Wales (Chapman, 1987; 1992). There is, however, growing evidence of a contemporaneous and substantial amount of enclosure by private agreement, by the actions of the lord of the manor, and by piecemeal withdrawal of land from the open fields and common wastes. A recent study of south-central England has indicated that 42% of open-field enclosures were achieved by non-Parliamentary methods. Although it would be unwise to project such figures to the country as a whole, it seems likely that a third, rather than a quarter, of the English landscape may have been enclosed during that period (Chapman & Seeliger, 1993).

The environmental impact of the movement depended on the type of land involved. For Parliamentary enclosure, almost 60% of the land was 'common waste', in other words, moorland, heath, downland, or fen. The aim here was to convert the land to more productive use. It did not always succeed. Extensive areas of 'waste' survived in upland areas, such as Central Wales and the Pennines. But for the most part, the grass, heath and scrub were replaced by fields of arable and improved pasture, divided by hedgerows. A further 33% of the land enclosed consisted of open arable, where reallotment was intended to increase productivity of both soil and labour. Although land-use change was less dramatic, open landscapes of some 200 to 300 acres might be converted into hedged fields of no more than a tenth of that size. The remaining 7% consisted of common meadow, or of land already held individually but which was exchanged so as to secure a better layout of estates. The proportions of land involved in non-Parliamentary enclosures are not known with any certainty, but it seems likely the proportion of open field was somewhat higher. The changes were also more piecemeal. Without an overall plan, the new fields were almost invariably smaller, often of no more than two or three acres. The length of hedgerow was consequently far higher.

Beyond the aspirations of individual landowners, enclosures were justified as being the only means of feeding a growing population. Famine could only be avoided through greater efficiency. This single-minded policy, and the loss of the common 'wastes' for public recreation was only challenged in the late nineteenth century, when parliament placed restrictions on further enclosures. By that time, the new hedged-landscapes were reaching some degree of maturity on so large and intimate a scale as to be mistaken, by later generations, for an integral part of 'our natural heritage'.

Far from being the product of countless numbers and generations of farmers, the enclosure landscapes were the responsibility of a comparatively few individuals. Whilst over 4,000 people were employed as enclosure commissioners under the various acts, most of the work was done by some 50 of these, who became effectively full-time professionals. Their power to replan the landscape was enormous. They re-drew property boundaries, realigned roads and streams, and dictated the type of hedge or fence to be used. It is to their overwhelming insistence upon hedges as the means of separating properties, often even in districts where walls or ditches were the norm, that so much of our landscape owes its form. Men such as George Barnes of Andover or John Outram of Burton Agnes are obscure figures compared with, say, Capability Brown, but they planned a far greater acreage than any of the landscape gardeners (Chapman, 1989). The rudiments of their landscapes survive relatively intact, and, indeed, those with Parliamentary sanction are subject to a degree of legal protection, for the awards usually specify that the owners and their successors shall maintain the hedges in perpetuity.

As historians provide a better understanding of the complexity and scale of change in recent agricultural landscapes, so a new discipline has begun to emerge in ecology. Whereas attention once focused on the conceptual beauty of well-balanced, homogeneous ecosystems, the ecologist now attaches increasing importance to the differing properties and behaviour of the patches, or mosaic, that make up the ecological systems that constitute the landscape. The first step in determining how patch dynamics work is to define more fully the patches that comprise the landscape, how they are bonded together, the relative importance of geometry and other landscape characteristics, and how far the boundaries might influence communication and interaction between the component patches. As Turner remarked, 'clever empirical studies' are required to answer such questions. 'Like looking at the world through a keyhole', ecologists were already peering through small spatial and temporal windows to understand what was, in effect, large-scale dynamics (Turner, 1987; Hansen & Castri, 1992).

A landscape of hedgerows of varied density, size and composition provides an obvious testbed for such explorations in landscape ecology. Drawing on both historical and ecological insights, a better understanding might emerge as to how animal and plant life might have reacted to the evolution of the hedged landscapes of the eighteenth and nineteenth centuries. There is some documentary evidence to suggest that the rabbit, an alien

species, may have first become established and abundant as a wild animal in many parts of the country, during the period some historians call the Agricultural Revolution of the eighteenth and nineteenth centuries. As the hedges developed, they provided an ideal retreat for the animals, which had to move only a few yards from their burrows to graze the vetches and winter corn. When disturbed in the harvest fields, the animals found refuge close by (Sheail, 1971). Clearly much else was also happening. Game preservation and fox-hunting became important over extensive parts of the country. Whilst the rabbit shared the same natural predators, and benefitted from their large-scale slaughter by game keepers, the status of the animal may also have been enhanced through further changes in the layout and texture of the landscape, as game and fox coverts were established within a hedged landscape.

As the ecologist and agricultural historian come, from their separate perspectives, to take fuller account of the complex spatial and temporal trends in the countryside, and seek more rigorous ways of recording and interpreting the dynamics involved, a clearer understanding is beginning to emerge as to the processes that determine how the landscape is occupied by so large, varied and mobile an array of plant and animal life.

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THE CURRENT STATUS OF FIELD MARGINS IN THE UK

R G H BUNCE, C J BARR, D C HOWARD & C J HALLAM

Institute of Terrestrial Ecology, Merlewood Research Station, Grange-Over-Sands, Cumbria LA11 6JU

ABSTRACT

A review is presented of the available ecological information on field margins in Britain. Hedgerows and streams are well covered, with information on both botanical and faunistic composition. Other features such as walls and grass strips, are not so well covered, although the 1990 Countryside Survey carried out by the Institute of Terrestrial Ecology will provide some basic information. It is concluded that field margins not only contain a major resource of botanical capital in British landscapes, but also represent a potential source of biological diversification.

INTRODUCTION

Throughout Europe, at the present time, there is a trend in agriculture towards intensification and a contrasting environmental pressure towards the maintenance, and recently enhancement, of diversity. The debate about the expenditure under the Common Agricultural Policy emphasises the link between policy and what will happen on individual farms and their associated semi-natural areas and field margins. These must first be defined in order to understand how they fit into the overall ecology of different types of landscape.

Hedges have generally been regarded in Britain as the most ecologically significant field margins. Recently, however, the botanical significance of other features has been assessed (Bunce & Hallam, 1993). Not only did they contain species not present elsewhere in the open landscape, but they also contained a wide range of variation in terms of the vegetation types present. It was concluded that linear features still contained much botanical capital in comparison with the surrounding landscape, and were especially important in the lowlands where the vegetation is often impoverished.

The objective of the present paper is to summarise the available information on field margins in Britain and then to indicate their overall ecological significance.

TYPES OF FIELD MARGIN

Hedgerows

Hedgerows were identified as important linear features at an early date, not only for their ecological content, but also because of their visual contribution to the landscape. This importance was recognised in the book by Pollard *et al.* (1974), which summarised the available information at that time. Losses of hedgerows were reported, but it was not until

1986 in the Monitoring of Landscape Change project (Huntings Surveys and Consultants (1986)) that they were quantified for England and Wales and later for Great Britain by Barr *et al.* (1986). Further losses were reported by Barr *et al.* (1991) and changes in the species composition by Cummins *et al.* (1992). There was also a major conference at Wye College in 1992 summarising the available information, the proceedings of which are currently being published. In ecological terms the botanical contribution of hedges can be divided into the woody and the herbaceous hedge bottom flora. The majority of hedges are of hawthorn (*Crataegus monogyna*) but there are also mixed hedges typical of both western and eastern Britain which contain other woody species usually only found elsewhere in ancient woodland. In addition there are hedges typified by single species, such as *Ulex* spp. and *Fagus sylvatica*. The hedge bottoms contain almost 300 species, some of which are from woodlands, e.g. *Digitalis purpurea*, but also from surrounding habitats such as damp grassland, e.g. *Filipendula vulgaris*. Overall therefore, as Bunce & Hallam (1993) point out, hedges are of major significance to botanical diversity in Britain, except in the uplands.

In terms of management, hedges were maintained by traditional methods, such as cutting, laying and then trimming the regrowth. This practice has now declined because of labour costs and most hedges are now trimmed by flail cutters. In many respects therefore, the hedge is maintained in a coppice type cycle, with regular openings of light which help to maintain diversity. Cummins *et al.* (1992) point out that dereliction leads to the domination of the hedge base by relatively few shade-tolerant species and the current trend for a decline in management therefore is likely to reduce diversity. Furthermore, once a hedge has lost its role as a barrier, it seems more likely to be removed from the landscape.

Streams

The vegetation of streams and rivers has long been celebrated in literature but has only recently begun to be recorded quantitatively. Holmes (1983a) describes an appropriate methodology for recording riverside vegetation and its application to different systems. Haslam (1978) describes the vegetation growing actually in the water. The Institute of Freshwater Ecology have also developed a procedure for recording the vegetation in the water, because of its importance to other river life (Bolton & Dawson, 1992). Bunce & Hallam (1993) describe the first comparisons of riverside vegetation throughout Great Britain, concluding that it contributes much to diversity in all major landscape types. As with hedgerows, there are specialist species, especially those growing in the water, for example *Sparganium* species, that cannot survive anywhere else in the landscape. In addition, there are other species which are able to grow elsewhere, but may have now become restricted. Further details of such species and their contribution to diversity will become available with further analysis of the Countryside Survey 1990 data.

The management of streamsides varies according to the type of landscape. Thus, in the lowlands, the banks are managed separately from the arable fields. In lowland grasslands, the banks are often grazed to the edge of the water, or fenced off to some degree. In both such areas, trees or woodland may grow right up to the waters' edge. In the uplands there is usually no separate management, with the vegetation along the stream being continuous with that elsewhere, unless next to a gorge. The differences in vegetation are thus often due to nutrient enrichment and water level, rather than management.

Roadsides

As with streams there are many references in the literature to the attractiveness of British roadsides, especially country lanes, many of which border farmland directly. In this case the construction of motorways stimulated the first extensive work described by Way (1977). Otherwise there is much information on management techniques, for example Parr & Way (1988). Bunce & Hallam (1993) compare roadside verges with hedges and streamsides, concluding that overall, they contained more species than either of the previous category. They were especially rich in mesotrophic meadow species. In some areas the verges have maintained fragments of formerly widespread grassland types, e.g. chalk grassland on the South Downs. There are many types of management, with flail mowers most widely used on approximately the first two metres; behind this area there is often scrub invasion or coarse competitive species. Many minor roads are no longer cut at all, with consequent changes in species composition. Few modern cutting methods remove the dead material, whereas the previous regimes were similar to hay cutting, leading to a rich flora.

Walls

Walls have received much attention for their visual appeal but little from a botanical point of view. General texts are available, e.g. Rackham (1986), as well as some local surveys, but a literature search revealed no papers. There is, firstly, the flora growing actually on the wall itself, mainly lichen and bryophytes, but species of fern and flowering plants may grow in the wall if there is soil between the rocks. Secondly, there is the area at the base of the wall, which may be unmanaged with shrub development or residual unimproved grassland because of protection from fertiliser application.

The ecological significance of walls therefore remains to be assessed in terms of vegetation. As with other linear features, they may also act as barriers or corridors to species in the landscape.

Grass strips/fences/banks

The former occur mainly in arable landscapes between crops, whereas the latter are either to divide grass paddocks or along hedges and walls to restrict stock movement. Their botanical significance has not been assessed in Britain, although Smith *et al.* (1993) have produced some general conclusions. They mainly consist of different assemblages of grassland species. There has, however, been work on their zoological significance, e.g. Thomas *et al.* (1992). The ITE Countryside Survey will provide an overview of the botanical composition in Britain.

Boundary margins

Narrow strips are present around many arable fields. Bunce & Hallam (1993) showed that they can contain unusual ruderal species lost from the surrounding fields. Marshall (1989a; 1989b) has also studied them from a weed invasion viewpoint and summarised their management implications. Other gaps can be quite wide and converge with headlands at the

corners of fields where tractors turn. Further information would be useful on their extent and species composition. The work by the Game Conservancy on headlands is relevant to these margins, there being a close relationship between them.

Green roads

These are sunken old roads that have now fallen out of use. Richard Mabey has lectured about them and Raistrick (1978) has described them in the Pennines. They are a rich source of shady woodland plants absent elsewhere in many lowland landscapes. Other unsurfaced or grassed tracks on farms may support a range of plant and animal species, if disturbance is not too severe. Rackham (1986) describes the significance of trees which are often present along green roads or any of the above margins.

THE ECOLOGICAL VALUE OF FIELD MARGINS

As mentioned above, some linear features have a sufficient level of botanical capital to be important in their own right. Even the poorer features contain species either not present in the surrounding landscape or of restricted distribution. In the present context, these features are of particular significance in their potential for the expansion of their constituent species into the wider countryside, if agricultural management pressure declined.

The evidence of the rate and pattern of such colonisation is incomplete, since most studies until recently have assumed agricultural expansion. Concerning the process of colonisation from linear features the proceedings of the conference on setaside (Clark 1992) gives an up-to-date summary of recent work. Baudry & Bunce (1991) also summarise abandonment. Otherwise, Marshall (1989b) has carried out detailed studies of the movement of species from hedgerows, especially weeds, because of their agricultural significance. Movement into crops was relatively limited, with only a small of a number of species; but this was into crops. Otherwise evidence of movement tends to come from observation, with motorway verges providing some good examples eg the expansion of *Primula veris* and *Chrysanthemum leucanthemum* from field margins onto embankments. An important principle is that individuals move rather than assemblages and whilst the movement of some species eg indicators of ancient woodland from hedgerows can be predicted, many others cannot. Rackham (1980) suggests that such movement is likely to be very slow. The richness of the feature is also of importance since a wider complement of species is available for expansion. The actual seed supply is also a limiting factor and the subsequent composition of vegetation following colonisation is usually determined by the propagules available.

Different linear features have different potential for expansion eg a roadside verge of chalk grassland species are unlikely to expand into an abandoned field because of competition from ruderal species, whereas hedges have greater potential. The processes are also different for example van Dorp & van Groenendael (1991) have shown how species can spread from river banks by flooding.

The value of linear features as corridors for movement of species has only been proven in a few cases. Verkaar (1990) for example describes the movement along streambanks. Holmes (1983) also points out that few aquatic aliens have been successful although some exotics, eg *Mimulus* species have colonised fast flowing rivers. Observational evidence exists eg oil seed rape along motorways and *Senecio squalidus* along railways. In hedges the true hawthorn content of many post enclosure hedges shows virtually no colonisation by woody species for almost 200 years.

RELATIVE FREQUENCY OF FIELD MARGINS

During the Countryside Survey 1990 programme (Barr *et al.* 1993) ITE surveyed 508 1 x 1 km squares throughout Great Britain in a four month period between June and October 1990. In each square, as part of the broader work programme, the land cover and landscape features were recorded and mapped. At a more detailed level, vegetation was recorded in up to 27 plots in each square. Five 200 m^2 quadrats in five random locations were recorded within each square and 1 x 10 m linear plots were placed beside field margins where these were within 100 m of the plot. These data therefore give an estimate of the relative frequency of the different field margins in Britain, although more accurate estimates could be made in due course by further analysis of data now available. The results are presented in Table 1.

Table 1 presents the boundary plot types by Land Class groups (Barr *et al.* 1993) showing the dominance of the hedge series in the two lowland groups, whereas fences extend into the marginal uplands and uplands; walls are present throughout, whereas most of the other types are dominated in the two lowland groups.

This Table characterises the four groups which each show different patterns reflecting their ecological character. Thus the uplands have few boundaries reflecting the continuous nature of the semi-natural vegetation, the marginal uplands are dominated by fences and walls, showing a degree of dissection. The lowland grass series is dominated by fences but with many hedgerows and contributions from other types. The lowland arable series also has fences most commonly but with a high proportion of hedges and water - perhaps surprisingly, as it is often considered that the arable areas have a lower number of hedgerows.

Table 1 Relative occurrence of different types of field margins in linear plots placed within 100 m in 5 random 200 m plots within 508 1 km^2 in Britain. The four landscape types are described by Barr *et al.* (1993)

Land class group	Hedge	Fence	Wall	Water	Grass strip	Bank	Verge	Other	Total
Lowland arable	200 26%	265 35%	39 5%	127 17%	24 3%	15 2%	79 10%	8 1%	757
Lowland grass	168 23%	333 46%	82 11%	47 7%	12 2%	43 6%	23 3%	10 1%	718
Marginal upland	18 9%	126 60%	51 24%	8 4%	0 0%	2 1%	5 2%	1 0%	211
Upland	0 0%	85 70%	28 23%	6 5%	0 0%	0 0%	2 2%	0 0%	121
Total GB	386 21%	809 45%	200 11%	188 10%	36 2%	60 3%	109 6%	19 1%	1807

CONCLUSIONS

Although there is a wide range of data now available on field margins the above review shows that there is much work yet to be carried out.

Linear features are not only important for flora but also for fauna. Some species such as the phytophagous insects are directly dependent upon plants; others depend upon them for shelter and movement. Examples of these inter-relationships have been presented by Schreiber (1988).

The role of many linear features, as a refuge for species which have not been able to survive in the fields, is important in terms of the response of vegetation to changes in agricultural practices, such as set-aside. For example, a decline in management of grasslands could lead to the expansion of species from field boundaries, as seen in the derelict areas in the Pyrenees. The mobility of different species and their ability to colonise existing vegetation will determine which are successful.

Field margins still retain much botanical capital that can be utilised to replace species lost from open landscapes. They need, therefore, to be incorporated into the development of landscape design, for maintaining and enhancing ecological diversity. While it is recognised that designated conservation areas for specific habitats are essential, even intensively farmed landscapes still contain many species and offer many opportunities for conservation.

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