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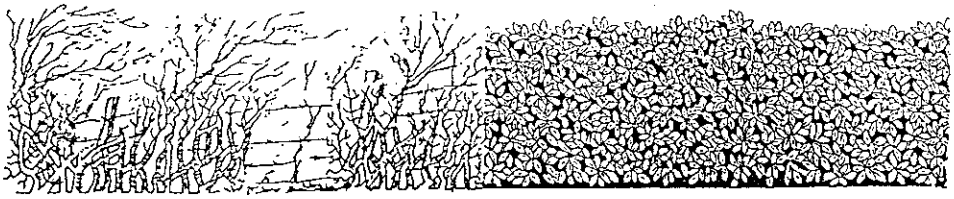
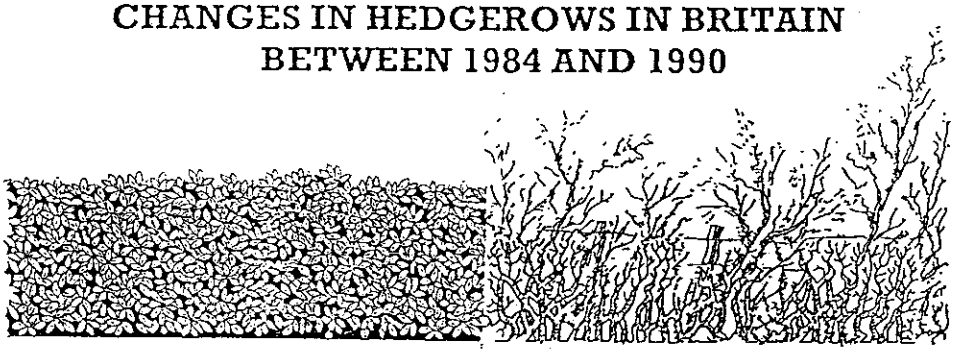


CHANGES IN HEDGEROWS IN BRITAIN BETWEEN 1984 AND 1990



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CHANGES IN HEDGEROWS IN BRITAIN BETWEEN 1984 AND 1990

A Report to DOE on work undertaken as part of 'Countryside Survey 1990'

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Introduction

1. This report summarises the results of work on changes in hedgerows which was commissioned by the Directorate of Rural Affairs, DOE, as part of the analysis of data collected during 'Countryside Survey 1990'.

2. The primary purpose of the report is to present data on change, and to provide descriptions of the methods used to obtain them. Discussion of results, and especially their relevance to countryside policy matters, is minimal although a short comment section is included to cover research and methodological aspects.

Background

3. In 1977 and 1978, the Institute of Terrestrial Ecology (ITE) carried out an ecological survey of Great Britain (GB) (Bunce 1979). The primary purpose was to collect information on vegetation and soils, and the survey used a sampling approach based on the ITE Land Classification (Bunce et al 1983). A secondary activity was the collection of land cover and landscape feature information from each of the 256 1km sample squares. This included the mapping of "hedges" as a field boundary type.

4. In 1984, ITE completed a repeat survey of the 256 1km squares and also surveyed a further 128 squares, increasing the sample number to 384. The survey was designed to answer questions on land use issues and so concentrated on land cover and landscape feature mapping, rather than data collection at the detailed quadrat level of the previous survey. Records on hedgerows were made using combinations of attributes to describe each boundary length (Annex A). The field methodology was identical to that described below, and is given in Barr et al (1985).

5. Information collected on hedgerows in the 1977/8 survey was not sufficiently detailed to make conclusions about subsequent changes in the condition or management of hedges. However, by comparison with the 1984 data, it was possible to identify those boundaries which had been classified as hedges and which had been established, or removed, between the two survey dates. Using the results from the sample squares, estimates were derived for GB and for major regions within it. These are described in Barr et al (1986) and may be summarised as follows:

	Hedgerow gain	Hedgerow loss
England	3,200 km	22,300 km
Scotland	<100 km	3,300 km
Wales	400 km	2,600 km
Great Britain	3,600 km	28,200 km

6. In 1990, DOE and NERC, with support from the Nature Conservancy Council, funded a further field survey of GB, carried out by ITE (Barr, 1990). The sample number was again increased, resulting in 508 rural squares being visited, with an additional 25 urban squares being surveyed as part of a separate study. The field survey was part of a larger project, called 'Countryside Survey 1990' which also contributed to work being undertaken at ITE Monks Wood (co-funded by DTI and RSNC) to produce a land cover map of GB from satellite imagery. Surveys of soils and freshwater biota in the ITE squares were also included in the work programme. As part of the field survey, hedgerows were mapped in an identical way to methods used in the 1984 survey.

7. The handling of data recorded during 1990, and subsequent analysis, is planned to be completed during 1992. However, given the current political interest in countryside matters, and particularly in hedgerows, analysis of the hedgerow data has been brought forward, and considered in isolation from all other surveyed information.

Methods

8. A full description of the field survey methods is given in a Field Handbook (available by arrangement through ITE). The methods follow closely those used in the 1984 ITE survey. The following paragraphs summarise only those methods which are relevant to this report.

9. In summary, ITE surveyed the 384 1km squares which had first been visited in 1984, and mapped boundary features. Each length of boundary was mapped using OS 1:10,000 scale maps enlarged to about 1:7,000, and described using a combination of codes as shown in Appendix A. This boundary information was mapped on a separate page from other field data, as shown in Figure 1.

10. Boundaries were mapped and coded as 'single lines' on the map, even though there may have been several different elements associated with each (eg a hedge and a fence on top of a stone bank). For adjacent lines to be mapped individually, then a clear gap between all elements of the two boundaries had to be identified.

11. The length of each boundary, or boundary segment, was determined by the constancy of a combination of codes, along the length; where any one description differed, then a new length was demarcated and a new combination of codes was used. The minimum length of boundary to be described was 20 metres and the ends of each length were marked using 'tic' marks at right angles to the mapped feature. The same coded descriptions were used in both 1984 and 1990 except that additional codes for 'regrowth from stumps' and, on another page of the recording booklet, 'line of shrub', were introduced in 1990.

12. To assist in field mapping, limited aerial photographic interpretation was carried out for each square. Using photographs of various dates, but all taken since the 1984 survey, boundaries that were no longer present, and those that were new to the map, were marked on a 'master map' which was used as a base for field recording.

13. Boundaries of land associated with buildings (curtilage) were not mapped in detail. Boundaries within woodland were not mapped.

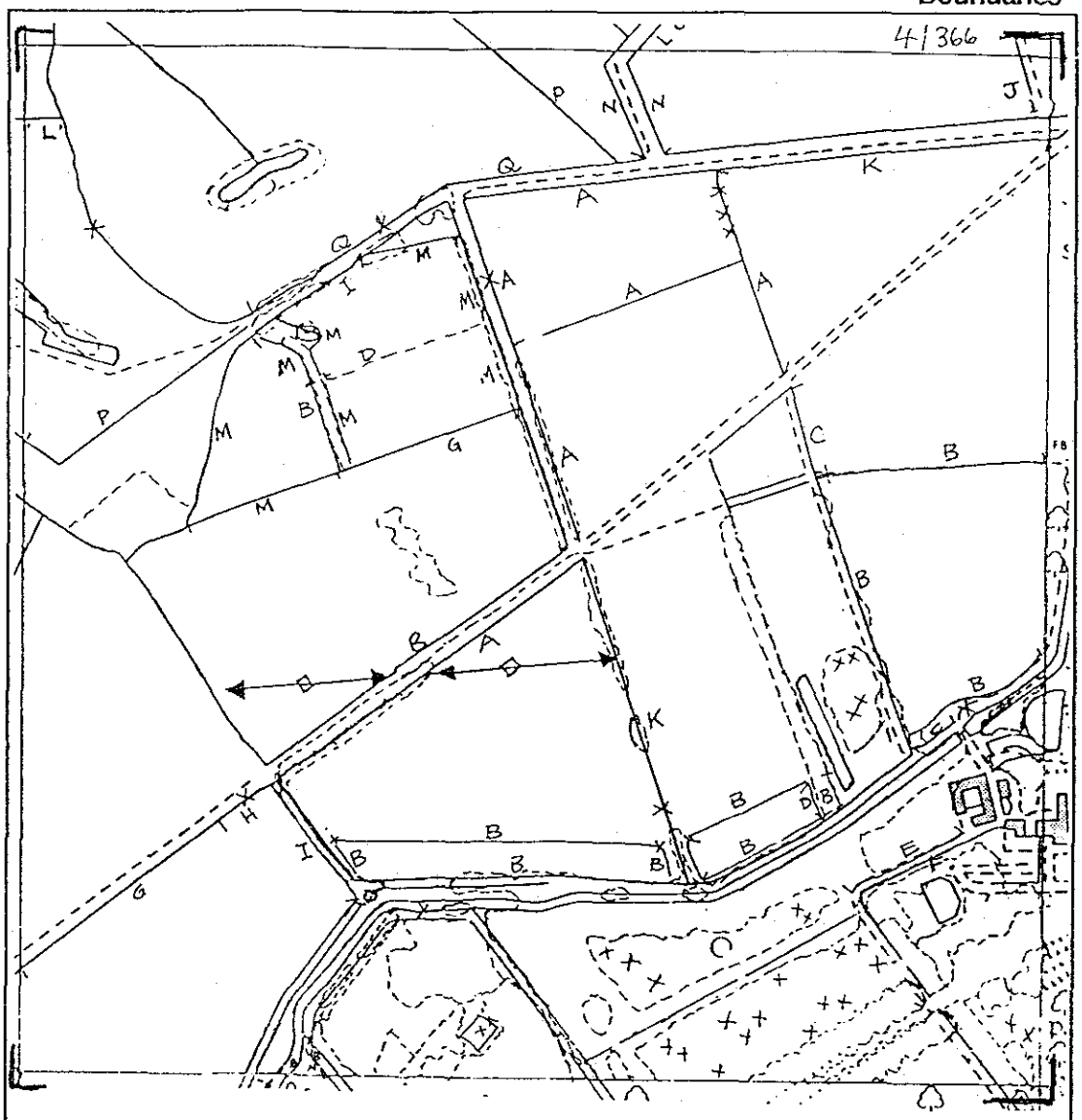
Figure 1. Example of completed 'Boundaries page' from ITE field survey booklet

Boundaries

Square : 4/366

Extra codes :

322 PRUN SPIN
324 TAXA BACC
325 FAGU SYLV
326 SAMB NIGR
327 ACER CAMP



1ha ○ □ mmu

A	321	341	352	357			B	313	342	351		C	321	342	351	357	
D	999				F	325	341	351	357								
E	322	324	342	351	357												
G	321	341	352	358			H	322	341	351	358						
I	321	341	352	358	359						J	333					
K	323	341	352	357		L	326	341	352	358							
M	311	342	351		N	327	342	352	358	360		P	323	341	352	358	360
Q	323	341	352	358	359			R	321	341	360	352					

Boundaries

Definitions

14. A boundary in this context is defined as a physical barrier, having a height and width, usually intended to prevent farm stock from moving from one area to another. A hedge is a boundary, or part of a boundary, which comprises a row of bushes or low trees growing closely together, and which have been managed through cutting to maintain a more or less dense, linear barrier. Hedgerow is used synonymously with hedge, although more strictly it should be used as a broader term, encompassing other features associated with hedges, such as trees and gates etc (Hooper, 1968). Only hedgerows occuring in rural situations are considered in this report.

15. It can be difficult to distinguish between unmanaged hedgerows and lines of trees. When hedge management is abandoned, and the natural shape of the tree is regained, then the feature can no longer be described as a hedge and is likely to be coded as a line of trees (on the trees/ woodland/forestry page of the recording booklet).

16. The codes used in describing hedgerows are given in Annex A. The following definitions of each feature are based on those given in the field handbook but may have been supplemented with additional information resulting from a concensus agreement of the use, or limitations to use, of the code during the 1990 field survey.

    321. **>50% Hawthorn:** used where Hawthorn constitutes more than half of the length of hedge under consideration.

    322. **>50% Other:** .... used where a species other than Hawthorn constitutes more than half of the hedge, the species being recorded.

    323. **Mixed hedge:** used for any length of hedge where no single species dominates.

    341. **>2m high:** the height codes apply to the height of the hedge at the time of survey. If different heights apply on either side of the boundary, then the code should refer to the side on which stock are kept; otherwise, the lowest height should be coded.

    342. **<2m high:**

    343. **<1m high:**

    351. **Stockproof:** applies to the stock that would normally use the surrounding fields; if type of stock not clear, then assumed to be sheep.

    352. **Not stockproof:**

    353. **Filled gaps <10%:** used to show that the boundary has had gaps which have been filled in an attempt to make it stockproof (eg by short lengths of wooden fence). The percentage of gaps is of the boundary unit being coded.

    354. **Filled gaps >10%:**

355. **Signs of replacement:** used where there is evidence that one boundary type has been replaced by another (eg fence replacing hedge).

356. **Signs of removal:** used where there is clear evidence of boundary removal, eg grubbed-out hedge.

357. **Trimmed:** signs of management within the previous 12-24 months and a neat, cropped appearance.

358. **Uncut:** has had recent management but has been 'let go' over more than two seasons.

359. **Derelict:** still obviously a hedge but all attempts at management have been abandoned.

360. **Line of relict hedge:** usually a line of trees or shrubs showing where a hedge has once been (see definition of hedge; can be used in addition to codes on the forestry page).

361. **Laying (recent):** to be used if it appears likely that the hedge has been layed in the last five years.

362. **Flailing:** to be used if flailed in the last year; recognisable by smashed and shattered ends to cut branches.

363. **Regrowth from stumps:** this applies to hedges that have been cut to ground level but have grown again, often at intervals along the old boundary.

Data entry and analysis

17. All mapped linework was digitised using ARC/Info GIS software. To ensure spatial integrity, the 1990 data were digitised and labelled first, and then each coverage was copied, edited, and re-labelled with 1984 information. This minimised technical differences such as boundary mis-matches and overlaps during overlaying (Howard & Barr, 1991).

18. All data codes were punched twice, cross-checked, edited and a single version entered into an Oracle Database Management System which could be integrated with the digitised data.

19. The 1990 coverages were compared with those from 1984 using modified ARC overlaying procedures. Analysis was carried out on all boundaries to which a hedge code had been ascribed (except for relict hedges which were treated as a separate boundary type) even though other boundary features, such as walls and fences, may have contributed to the boundary (see paragraph 10 above).

Results

20. The results of the comparisons of boundaries which contained a hedge component in 1984 and/or in 1990 are given in Table 1.

Table 1. Estimates of net change in hedgerow lengths in GB, England, Scotland and Wales between 1984 and 1990 (lengths and Standard Errors (±) in '000 km)

	England	Scotland	Wales	GB
Total hedge length in 1984	410.5 (±25.1)	67.6 (±8.8)	71.1 (±8.4)	549.0 (±32.7)
Total hedge length in 1990	325.2 (±21.5)	49.6 (±7.0)	53.3 (±6.8)	428.0 (±28.3)
Net change between 1984 and 1990	85.3 (±8.5)	18.0 (±3.0)	17.8 (±3.3)	121.0 (±11.6)

21. Table 1 shows that the net change between 1984 and 1990 amounts to nearly one quarter of the length of 1984 boundaries which contained hedges. However, the net change is a balance of gains and losses, and details of these are presented in Table 2. (Estimates for GB, and totals, are derived separately from estimates for each country).

Table 2. Estimates of hedgerow gains and losses in GB, England, Scotland and Wales between 1984 and 1990 (lengths and Standard Errors (±) in '000 km)

	England	Scotland	Wales	GB
a) 1990 hedges gained				
New hedges	19.7 (±2.0)	3.3 (±0.5)	3.4 (±0.6)	26.4 (±2.5)
Change in boundary type	18.5 (±2.3)	3.2 (±0.7)	3.3 (±0.6)	25.0 (±2.9)
Buildings/curtilages	1.4 (±0.3)	0.2 (±0.1)	0.3 (±0.1)	1.9 (±0.4)
TOTAL GAIN	39.6 (±3.3)	6.7 (±1.0)	7.0 (±1.1)	53.3 (±4.3)
b) 1984 hedges lost				
Hedged removed	39.4 (±3.5)	6.1 (±0.9)	6.7 (±1.1)	52.2 (±4.5)
Change in boundary type	77.8 (±7.4)	17.2 (±2.7)	16.6 (±2.8)	111.5 (±10.1)
Buildings/curtilages	7.3 (±1.2)	1.4 (±0.4)	1.4 (±0.5)	10.1 (±1.7)
TOTAL LOSS	124.8 (±8.6)	24.7 (±3.4)	24.8 (±3.5)	174.3 (±12.0)

22. Table 2 gives estimates of the lengths of hedges that have been planted as well as those that have been removed. In addition, some boundaries have changed in their nature and appearance leading to increases and decreases in boundaries that can be defined as hedgerows. For example, lines of immature trees that have been thinned out and then laid as hedges, will lead to an increase in the estimate of hedgerow length. Conversely, where a former hedge has been unmanaged over a number of years, it will grow into a line of trees (a relict hedge). Other examples of change in boundary type include where a hedge has become "gappy" and has been recorded as a line of shrubs, and not a hedge, and where vegetation growing on the top of a bank has been cut in such a way that a hedge is formed.

23. Also shown in Table 2 are the lengths of hedgerow that have been lost to the countryside by the development of buildings (both urban and agricultural), including those that have become 'curtilage' boundaries and are no longer defined as hedges for the purpose of this study. In some cases, where there has been a change in land use, some boundaries have been re-defined as part of the countryside and so have lead to a hedgerow gain.

24. Boundaries that were recorded as hedges for the first time in 1990 (other than those resulting from change in boundary type) totalled 26,400 km. Complete removal of hedgerows between the two dates amounted to 52,200 km, or 9.5% of the total 1984 hedgerow length. This report does not consider in any detail how or why these hedgerows have been removed, or whether the loss is balanced by new planting.

25. Close inspection of the results shows that most change is associated with management of hedgerows. About 111,500 km, or 20% of the 1984 hedgerows in GB were coded in 1990 as a different type of boundary (eg lines of trees or shrubs, or as relict hedgerows). Conversely, only some 25,000 km of 'new' hedges in 1990 came from the re-defintion of boundary types (see paragraph 22 above). This suggests that hedgerows were subject to less active management in 1990 than in 1984. Details of the physical characteristics of hedgerows are given in Table 3.

26. Data in Table 3 suggest that in GB as a whole, the distribution between height and management classes of the lengths of boundary containing hedges, remained similar between the two dates. However, in considering "gappiness", Table 3 shows that the lengths of incomplete hedges have increased between 1984 and 1990.

27. Examination of Tables 1-3 show that there are differences in hedgerow characteristics between England, Scotland and Wales. For example, hedgerows in Scotland and Wales appear to have undergone more change, proportionally, than those in England (Table 1), but the proportion of hedges that have been removed is less (Table 2). In terms of management, the situation is also complex (Table 3); hedges in Wales, for example, tend to be taller than those in England, but the proportional reduction in the lengths of tall hedgerows is greater in Wales. The lengths of derelict hedges have declined, proportionally, in Scotland and Wales, but not in England.

28. Table 4 gives the results of an analysis of data on 'lines of relict hedges' (defined as "a line of shrubs or trees showing where a hedge has once been") which have been estimated independently from the hedgerow data, for 1984 and 1990.

Table 3. Estimates of hedgerow characteristics in GB, England, Scotland and Wales for 1984 and 1990 (lengths and Standard Errors (±) in '000 km)

HEIGHT CATEGORIES	England	Scotland	Wales	GB
< 1 metre - 1984	20.5 (±3.3)	12.3 (±3.8)	1.7 (±0.6)	34.4 (±5.9)
- 1990	7.5 (±1.7)	0.9 (±0.3)	0.7 (±0.3)	9.1 (±2.0)
1-2 metres - 1984	214.9 (±17.3)	37.5 (±5.4)	31.7 (±4.3)	283.9 (±21.3)
- 1990	187.7 (±16.6)	36.1 (±5.6)	28.7 (±4.4)	252.5 (±21.4)
> 2 metres - 1984	175.0 (±13.9)	17.8 (±2.4)	37.8 (±5.5)	230.5 (±18.6)
- 1990	131.7 (±11.0)	10.7 (±2.0)	23.8 (±4.2)	166.1 (±14.1)
MANAGEMENT				
Trimmed - 1984	229.8 (±18.8)	37.8 (±5.8)	35.0 (±4.9)	302.5 (±23.5)
- 1990	183.6 (±15.3)	24.1 (±4.4)	28.5 (±5.1)	236.1 (±20.0)
Uncut - 1984	147.0 (±10.5)	17.7 (±2.2)	22.4 (±2.9)	187.0 (±12.8)
- 1990	110.6 (±12.1)	19.2 (±3.7)	19.4 (±2.7)	149.1 (±14.9)
Derelict - 1984	33.5 (±5.6)	12.1 (±2.7)	13.7 (±3.4)	59.4 (±9.0)
- 1990	32.9 (±4.3)	4.4 (±0.9)	5.3 (±1.6)	42.7 (±5.5)
"GAPPINESS"				
Complete - 1984	222.5 (±17.9)	40.3 (±6.0)	45.5 (±5.7)	308.2 (±22.7)
- 1990	156.0 (±15.8)	15.0 (±2.1)	31.6 (±4.7)	202.6 (±19.5)
<10% filled gaps - 1984	51.9 (±7.3)	9.4 (±2.3)	10.3 (±2.2)	71.6 (±9.9)
- 1990	34.2 (±5.0)	5.0 (±1.1)	6.9 (±1.8)	46.0 (±6.5)
>10% filled gaps - 1984	21.4 (±3.9)	3.9 (±0.9)	3.0 (±0.8)	28.2 (±4.7)
- 1990	15.1 (±3.6)	2.4 (±0.8)	1.8 (±0.5)	19.4 (±4.3)
Not stockproof - 1984	114.5 (±9.8)	14.0 (±3.2)	12.3 (±2.4)	140.8 (±11.5)
- 1990	121.8 (±10.8)	25.2 (±5.4)	12.9 (±3.4)	159.9 (±14.6)

Table 4. Estimates of lengths of 'Lines of relict hedgerow' in GB, England, Scotland and Wales for 1984 and 1990 (lengths and Standard Errors (±) in '000 km)

	England	Scotland	Wales	GB
1984	36.0 (±4.3)	7.3 (±1.5)	10.3 (±2.6)	53.5 (±6.3)
1990	63.1 (±6.3)	12.1 (±2.5)	15.2 (±3.6)	90.3 (±9.5)

29. As stated in paragraph 22, many former hedgerows were re-defined as lines of trees and shrubs in the 1990 survey. The figures in Table 4 support the contention that a relaxation of hedgerow management has led to an overall decrease in hedgerow length and a corresponding increase in lines of trees and shrubs.

30. An overall conclusion from the comparison of 1984 and 1990 data is that the rate of hedgerow removal between 1984 and 1990 is greater than that in the period 1978 to 1984. In addition, there has been an overall decline in the intensity of hedgerow management between 1984 and 1990, leading to an increase in the boundary type defined as relict hedgerow.

Comment

31. While the results of this analysis provide the most up-to-date figures available on recent hedgerow changes, caution should be used in their interpretation, as follows:

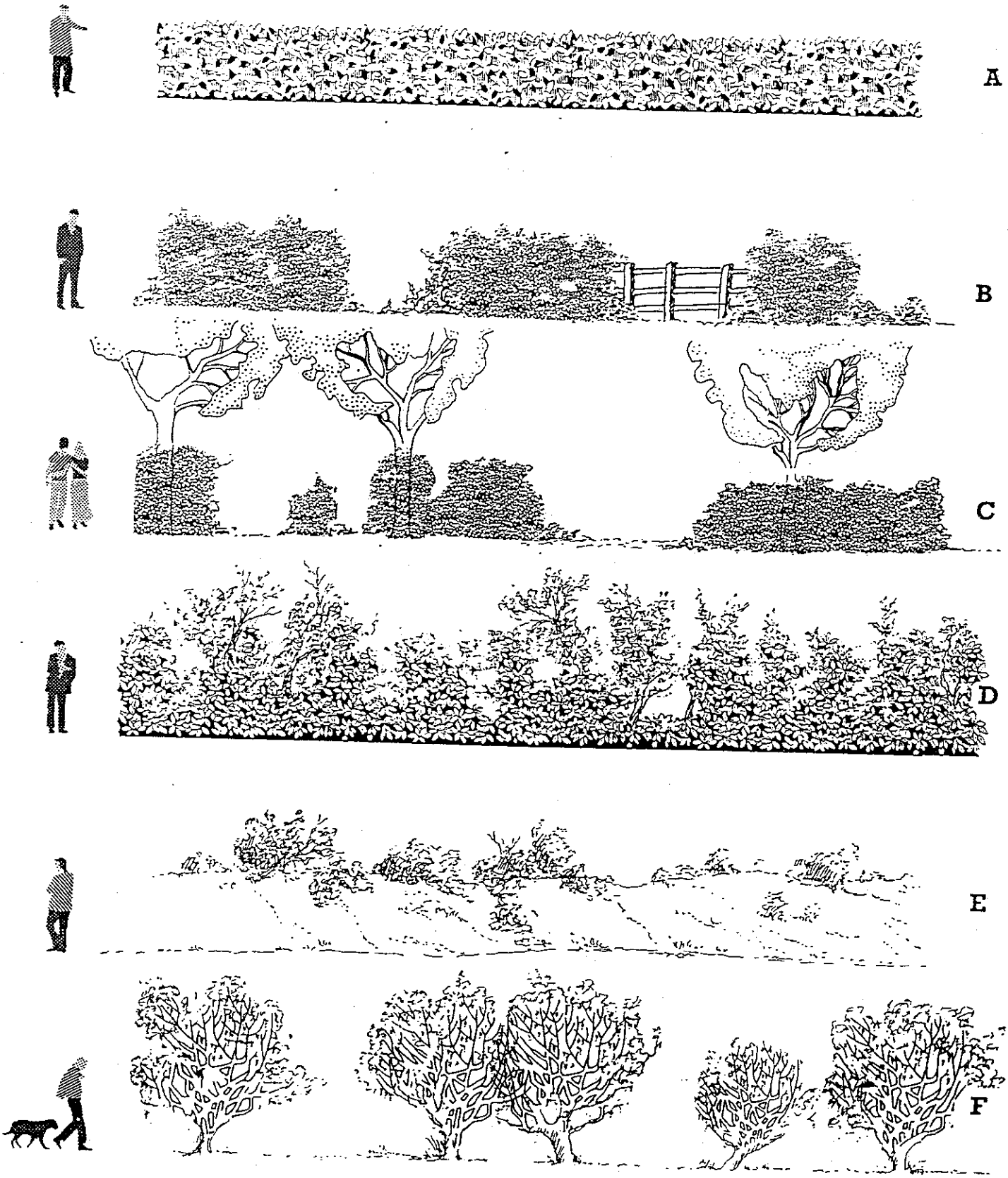
a) The estimates of change are derived from a sample-based survey. As with any such system, there are statistical errors associated with extrapolation from a sample to national estimates, and these should be considered when drawing conclusions from change data.

b) Although every effort was made to standardise recording procedures in the field (including: an extensive training course; use of a field handbook; use of aerial photographs; field supervision and checks; mixing of field teams, etc), there are likely to be some differences in the way that the data have been recorded by different observers. There is no reason to expect estimates of hedgerow recording to be biased in any particular direction and it is likely that any differences will 'balance out' over the whole dataset. (See also quality assurance in paragraph 34 below).

32. It has become apparent during the analysis of Countryside Survey 1990 data that while the definitions given in paragraph 16 are quite adequate to describe the features in most cases, there will always be occasions when the individual surveyor has to use an element of personal judgement because the feature is at the very extremes of the given definition. Figure 2 gives examples of the range of features that might be coded as hedges.

Figure 2. Diagramatic representation of different types of boundary feature that a surveyor might be required to code.

A = Hedge trimmed; B = Hedge uncut with filled gaps <10%, not-stockproof; C = Hedge derelict (or lines of shrub?); D = Hedge derelict; E = hedge on bank (or line of shrub on bank?); F = Line of relict hedge (and line of trees?)



33. When comparing the estimates made from ITE surveys with results from other studies, it is essential that definitions of categories in each survey are thoroughly understood. It is also important to know how and when each code has been applied. For instance, ITE has not included hedges that form part of a boundary between grounds associated with buildings (curtilages) and agricultural land.

34. ITE is currently undertaking a quality assurance exercise which will help to quantify the degree of confidence that can be placed in the recording of boundary data. In a sub-sample of the same 1km squares, boundaries have been recorded on a second occasion by different observers, and data will be compared with those obtained during the main survey. Estimates of consistancy of recording will be made.

35. There are several opportunities for further work associated with the hedgerow data collected in Countryside Survey 1990. These include:

a) Estimation of regional statistics.

b) Integration and cross-referencing with hedgerow data from other sources, eg results from the 'Monitoring Landscape Change' project, and work being undertaken by Dr Hooper at ITE Monks Wood.

c) Correlation with other types of data collected in the ITE sample squares (eg land cover, vegetation, trees etc) to characterise both the hedges and geographical regions in terms of species diversity, environmental quality, and nature conservation and landscape value.

d) Correlation with socio-economic data to determine the causes for identified changes in hedgerows.

e) The use of pattern analysis to assess the biological importance of hedges in the countryside.

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Annex A - Codes associated with hedges: comparison between 1984 and 1990

1984		1990	
310	Hedge >50% hawthorn	321	Hedge >50% hawthorn
311	Hedge >50% beech		-
312	Hedge >50% willow		-
313	Hedge >50% gorse		-
314	Hedge >50% other	322	Hedge >50% other .....
315	Mixed hedge	323	Mixed hedge
316	Hedge trimmed	357	Hedge trimmed
317	Hedge uncut	358	Hedge uncut
318	Hedge derelict	359	Hedge derelict
319	Line of relict hedge	360	Line of relict hedge
320	Laying	361	Laying
321	Flailing	362	Flailing
343	Burnt	144	Burnt (used from Veg page)
	-	363	Regrowth from cut stumps
331	Boundary >2m high	341	Boundary >2m high
332	Boundary <2m high	342	Boundary <2m high
333	Boundary <1m high	343	Boundary <1m high
335	Boundary stockproof	351	Boundary stockproof
336	Boundary not stockproof	352	Boundary not stockproof
337	Boundary with filled gaps <10%	353	Boundary with filled gaps <10%
338	Boundary with filled gaps >10%	354	Boundary with filled gaps >10%
339	Signs of replacement	355	Signs of replacement
340	Signs of removal	356	Signs of removal
341	No longer present	999	No longer on map