 **Question 4: What evidence is there that length of hedges declined between 1990 and 1993 and increased between 1993 and 1998 in England and Wales?**

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DUE START DATE:

- March 2002

DUE FINISH DATE:

- June 2002

OVERALL PROGRESS

- Work completed

DEFINITIONS

- A Hedge is defined as ‘A more or less continuous line of woody vegetation that has been subject to a regime of cutting in order to maintain a regular shape. This category includes both recently-managed and other hedges, including hedges with walls or fences.’
- Summary groupings, including ‘hedge’, have been used as described in ‘*Accounting for nature: assessing habitats in the UK countryside*’ (Haines-Young *et al.* 2000).

POLICY CONTEXT STATEMENT

- 1 The following Policy Context Statement was drafted in May, and takes account of comments made by attendees at the May FOCUS Workshop:
- 2 Estimates of the length of hedgerow in the UK, and in countries within the UK, have been derived from successive Countryside Surveys and related projects since 1984. Results are given in a number of papers and reports (and, most recently, web sites) (see References, below).
- 3 The most recent report was ‘*Accounting for nature: assessing habitats in the UK countryside*’ (Haines-Young *et al.* 2000) which presents results from Countryside Survey 2000. In this report it is stated that, in contrast with the period 1984 to 1990, there is no statistically significant change in the length of hedgerows in England and Wales or in Scotland, between the two most recent Countryside Surveys in 1990 and 1998. There was a reported loss in N Ireland.
- 4 However, the report also includes reference to a partial survey in England and Wales in 1993 which visited a sub-sample of survey sites and recorded hedgerow length. The results of this survey showed a continuing reduction in hedgerow loss. The ‘*Accounting for nature*’ report says “Although there was no net change for hedges in England and Wales over the full period from 1990 to 1998, there is some evidence from the interim survey of hedges in 1993 that net losses, recorded in the first part of this period, 1990-93, were reversed in the latter part. The apparent increase in hedges between 1993 and 1998 needs to be confirmed by a more detailed

analysis of the data from 1993, and comparison with other sources of information on hedgerow planting within agri-environments schemes.”.

- 5 Given the introduction of policy measures in the early 1990s designed to halt the decline of hedgerows, in both quantitative and qualitative terms, it is important to know from a policy perspective whether there has been a real increase in the length of hedgerows in England and Wales between 1993 and 1998, or whether the results from the 1993 survey are unreliable and are giving a false picture of trends.
- 6 This piece of work will therefore re-examine aspects of the databases from the 1990, 1993 and 1998 surveys (including case studies of individual sites) and will also re-assess the statistical reliability and robustness of the results, taking into account the construction of the sampling frame and the adequacy of feature definitions, used in the three surveys. The outputs will give a definitive statement on trends in hedgerow change in the 1990s in England and Wales.

References (in date order)

(2001) <http://www.cs2000.org.uk/>

(2000) Barr C.J., Gillespie M.K. Estimating hedgerow length and pattern characteristics in Great Britain using Countryside Survey data. *Journal of Environmental Management*, 60, 23-32.

(2000) Haines-Young R.H., Barr C.J., Black H.I.J., Briggs D.J., Bunce R.G.H., Clarke R.T., Cooper A. Dawson F.H., Firbank L.G., Fuller R.M., Furse M.T., Gillespie M.K., Hill R., Hornung M., Howard D.C., McCann T., Morecroft M.D., Petit S., Sier A.R.J., Smart S.M., Smith G.M., Stott A.P., Stuart R.C., Watkins J.W. Accounting for nature: assessing habitats in the UK countryside. London:DETR Countryside Survey 2000

(2000) McCollin D., Jackson J.I., Bunce R.G.H., Barr C.J., Stuart R. Hedgerows as habitat for woodland plants. *Journal of Environmental Management*, 60, 77-90.

(1995) Barr C.J., Britt C.P., Sparks T.H. Hedgerow management and wildlife: a review of research on the effects of hedgerow management and adjacent land on biodiversity. Ministry of Agriculture, Fisheries and Food. 130pp.

(1994) Barr C.J., Gillespie M., Howard D. Hedgerow Survey 1993 (stock and change estimates of hedgerow lengths in England and Wales, 1990-1993). Department of the Environment. Published by the DOE.

(1994) Barr C.J., Parr T.W. Hedgerows: linking ecological research and countryside policy. In: Hedgerow management and nature conservation, edited by T.A.Watt & G.P.Buckley, 119-136. Wye: Wye College Press.

(1994) Bunce R.G.H., Barr C.J., Howard D.C., Hallam C.J. The current status of field margins in the UK. In: Field margins: integrating agriculture and conservation, edited by N.Boatman, 13-20. (BCPC monograph no.58). Farnham: British Crop Protection Council.

(1994) Bunce R.G.H., Howard D.C., Barr C.J., Cummins R.P., French D. Botanical diversity in British hedgerows. In: Field margins: integrating agriculture and conservation, edited by N.Boatman, 43-52. (BCPC monograph no.58). Farnham: British Crop Protection Council.

(1993) Barr C.J., Bunce R.G.H., Clarke R.T., Fuller R.M., Furse M.T., Gillespie M.K., Groom G.B., Hallam C.J., Hornung M., Howard D.C., Ness M.J. Countryside Survey 1990: main report. (Countryside 1990 vol.2). London: Department of the Environment.

(1993) Parr T.W., Barr C.J., Bunce R.G.H., Fuller R.M., Furse M. Countryside Survey 1990: summary report, edited by A.P.Stott. London: Department of the Environment.

(1992) Barr C.J., Bunce R.G.H., Cummins R.P., French D.D., Howard D.C. Hedgerow changes in Great Britain. Annual Report of the Institute of Terrestrial Ecology 1991/92, 21-24.

(1992) Barr C.J., Howard D.C. Changes in hedgerows in Wales between 1984 and 1990. Countryside Council for Wales Natural Environment Research Council

(1992) Cummins R.P., French D.D., Bunce R.G.H., Howard D.C., Barr C.J. Diversity in British hedgerows. Department of the Environment. 75pp.

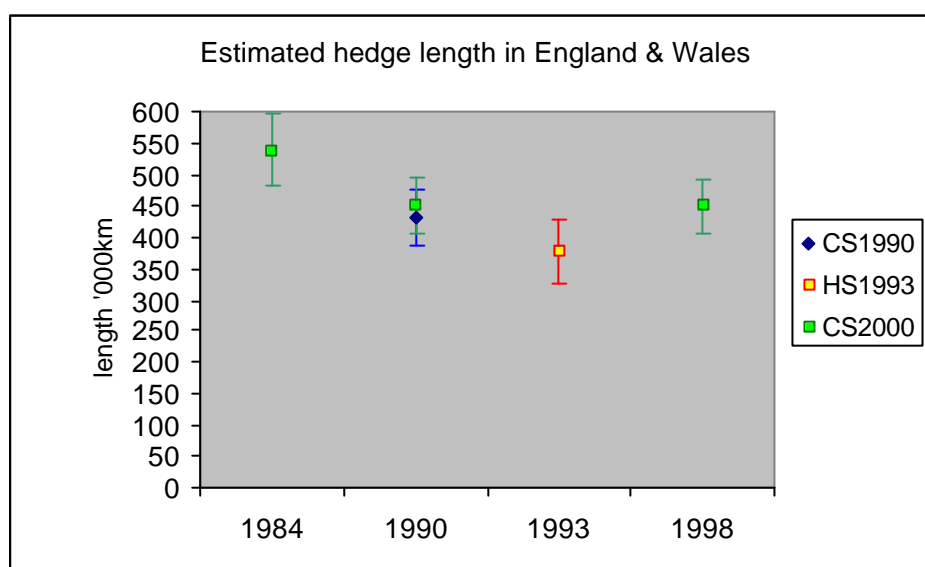
(1991) Barr C.J., Howard D.C., Bunce R.G.H., Gillespie M.K., Hallam C.J. Changes in hedgerows in Britain between 1984 and 1990. Department of the Environment.

(1986) Barr,C.J., Benefield, C.B., Bunce,R.G.H., Ridsdale,H.A. & Whittaker,M. Landscape changes in Britain. Abbots Ripton, Huntingdon: Institute of Terrestrial Ecology.

Background to published figures for length of hedge in England and Wales to date.

- 7 Published stock estimates for England & Wales of length of 'Hedge' for 1984, 1990, 1993 and 1998 are available from three separate surveys and are shown in Figure 4.1.

Figure 4.1 Estimates of length of hedge in England & Wales by year, by survey. CS1990 = Countryside Survey 1990, HS1993 = Hedgerow Survey 1993, CS2000 = Countryside Survey 2000. The estimate for 1990 was revised during CS2000 analysis due to changes to the sampling stratification and updated records. See Annex 4.2 for data.



- 8 All estimates of length of hedge are derived from the largest available sample size for each survey. These are shown in Table 4.1.

Table 4.1 Sample sizes for England & Wales hedge estimates for 1984, 1990, 1993 and 1998. * only change estimates for 1984-90 were published during CS1990,. ** Although Hedgerow Survey 1993 surveyed 108 1km squares the sample size was boosted by applying a weighted mean change from 1990 (derived from the 108 sample) to a further 57 1km squares that contained 'hedge' between 1984-90. This gave a boosted sample size of 165.

Survey	1984	1990	1993	1998
Countryside Survey '90	-*	n=311	-	-
Hedgerow Survey '93	-	-	n=108 (165)**	-
Countryside Survey 2000	n=219	n=311	-	n=366

SCIENCE OUTPUTS

Approach:

All relevant analyses from CS2000 Module 1 were re-visited and re-validated, especially in relation to the 'allocation procedure' used to categorise each hedge.

- 9 Spatial data held in the GIS for linear boundary features from the 1993 Hedgerow Survey had been previously combined with the 1990 and 1998 data set during summer 2000. This combined data set was checked against the original 1993 data set for consistency of length. A loss of 1.5% in raw data length was found and attributed, in the main, to spatial discrepancies with comparable existing lines in the 1990/98 dataset. However, for a time-series comparison based on the same features this would not bias the results for any one year.
- 10 The combined data set enables a time series analysis per feature from 1990-1993-1998. Due to refused access, one survey square was not surveyed in 1998 so the original sample of 108 squares was reduced to 107 squares for time-series analysis.
- 11 An automated allocation programme for linear boundary features devised for CS2000 Module 1 was used to produce a 1990, 1993 and 1998 dataset. The allocation for each row of data (each individual feature length) is derived from a single, fixed rule-base taking into account field-codes present as shown in Table 4.2

Table 4.2 Automated allocation programme rule-base for allocation of linear features from field-codes.

<i>Primary code</i>	<i>Secondary code(s)</i>	<i>Summary Group Allocation</i>
Hedge (>50% hawthorn / >50% other / mixed)	None / Derelict	Hedge (Managed / Other)
Hedge (>50% hawthorn / >50% other / mixed)	Line of relict hedge (no line of trees/scrub on Forestry map)	Remnant Hedge
Hedge (> 50% hawthorn / >50% other / mixed)	Line of relict hedge + Line of trees/scrub on Forestry map	Relict Hedge
Line of trees / scrub	Line of relict hedge	Relict Hedge
Line of trees / scrub	none	Line of trees/scrub

- 12 Adaptations made to the original programme were the ability to read data from the 1993 data-tables and write allocations out to project-specific 1990, 1993 and 1998 data-tables. Therefore, consistent allocations were made based on field-codes read in from either of the three data-tables (1990, 1993 and 1990). Summary groupings used are those given in Haines-Young *et al.* 2000.
- 13 To validate the automated allocation a manual check on 10% of the squares was made. A manual allocation was made using the field-codes recorded (up to 8 codes recorded per year) in the field assessment booklets for each year and applying the rule-base. Manual allocations made were compared to the automated allocations for 150 records checked. Although the total checked is less than 2% of the total records with 'hedge' in any one year this would be sufficient to check the limited combinations of field-codes. Inconsistencies found were due to miscodings in the GIS or database and were not specific to any year, sample square or type of feature.
- 14 Allocations were made to the following Summary groupings:

- HEDGE - A more or less continuous line of woody vegetation that has been subject to a regime of cutting in order to maintain a linear shape.
 - REMNANT - A woody field boundary feature with a residual hedge structure but without evidence of recent hedge management .
 - LINE of TREES/SCRUB and RELICT HEDGE - Line of trees or shrubs, including those originally planted as hedges but lacking any significant hedge structure and with a fence forming a field boundary.
 - OTHER – any linear boundary feature not including a ‘woody feature’ e.g. fence
 - CURTILAGE – a feature within an area of ground that is associated with a building and which has a use linked with that building e.g. gardens, ‘grounds’, forecourts etc.
 - NO FEATURE – no linear boundary feature recorded
- 15 Due to partially refused access to 3 survey squares in 1998 a total of 619 rows of data were discounted for comparison. The final data set has 22629 records containing allocations for all three years.
- 16 A sub-set was created of ‘woody features’, that is, features where a either a hedge, remnant hedge or relict hedge and/or line of trees/scrub was present in any of the three years. There were 13524 features in this sub-set, of which 9852 records (43% of total , 73% of the ‘woody features’ subset) were where a ‘hedge’ was allocated in any one year. 39% were allocated as ‘hedge’ in all three years with no other combination of allocations individually accounting for more than 5%. A frequency summary of the chronological allocations for the ‘hedge features’ sub-set are shown in the column entitled ‘Original allocation’ of Annex 4.1.

Exploration of the relationship between differences in stock, change and change using different sample sizes.

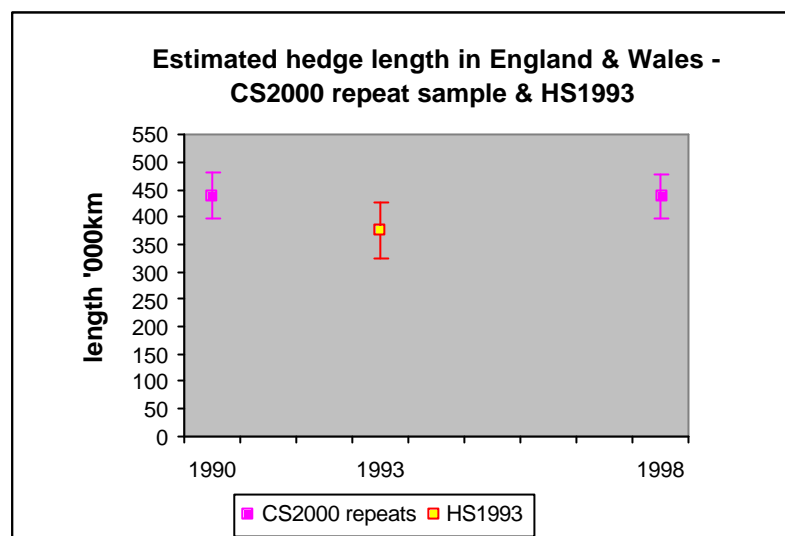
- 17 Sample sizes for England & Wales vary depending on year surveyed, whether repeat surveyed and whether the sample previously contained hedge in 1990. Table 4.3 shows sample size available.

Table 4.3 Sample size for England and Wales by year.

Year surveyed	Sample size (1km ²)
1990	311
1998	366
1990+98	308
1990+98 (with hedge)	249
1993	108
1990+93+98	107

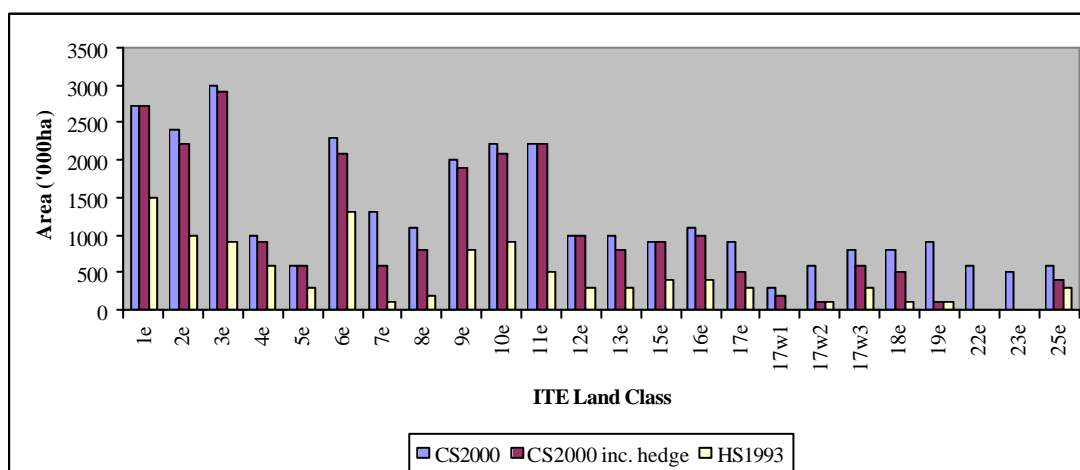
- 18 The previously published results for 1990 and 1998 from CS2000 and for 1993 from HS1993 are based on the largest sample available for each year.
- 19 Restricting the sample for the 1990 and 1998 estimates to the 308 squares repeated in both years shows little difference in overall stock figures, nor trend, as shown in Figure 4.2.

Figure 4.2 Estimates of length of hedge in England and Wales based on stock figures from largest repeat sample available for 1990-1998 (n=308) and largest sample available for HS1993 (n=108). See Annex 4.2 for data.



- 20 The sample of 107 squares repeat surveyed in 1990, 1993 and 1990 represent 34% of the total repeat squares (43% of those containing some hedge) and 90% of land classes represented in England and Wales. See Figure 4.3.

Figure 4.3 Area in England and Wales sampled by Countryside Survey 2000 (repeat survey in 1990 and 1998) and Hedgerow Survey 1993 shown by ITE Land Class. England & Wales contains 24 ITE land classes from a total of 40 covering Great Britain.



- 21 Comparisons were made between the following stock estimates:
- At the time of the 1993 Hedgerow Survey the sub-sample of 108 squares were allocated to amalgamated land classes in order to produce national estimates that were comparable to

those produced from a much larger sample for 1990. Amalgamating land classes is not necessary when producing estimates for 1990, 1993 and 1998 based only on the sub-sample of 107 squares as they are directly comparable.

- b) The mean change per amalgamated land class (from the Hedgerow Survey 1993) for 1990-93 and 1993-98, derived from the 1993 sub-sample of 108 squares, has been applied to the further 142 squares in England & Wales. This boosted sample size has been used to create national estimates.

National estimates of stock

- 22 A number of comparable national estimates of length of hedge in England & Wales for 1990, 1993 and 1998 were produced using differing sample sizes (Table 4.4).

Table 4. 4 Sample sizes for different surveys producing national estimates of hedge length.

<i>Sample size</i>	<i>Comment</i>
107	Largest sample of squares repeat surveyed in 1990, 1993 and 1998
249	107 sample plus 142 squares that had hedge in 1990, with length in 1993 derived from ratio-ed mean change 1990-93 of 108 sample
164	107 sample plus 54 squares from original HS1993 sample selection that had hedge in 1984&1990, with length in 1993 derived from ratio-ed mean change 1990-93 of 108 sample

National estimate of stock based on sample of 107 squares:

- 23 The sample is restricted to squares repeat surveyed 1990-1993-1998, the resulting estimates being directly comparable (Figure 4.4). The ITE Land Classes have not been amalgamated as this is unnecessary due to the sample being treated equally for all years. Although the comparison of stock shows a slight decrease in 1993 the variation within the sample would mean that statistical tests would not detect a significant change between any year.

National estimate of stock based on boosted sample of 164 & 249 squares:

- 24 Using the 108 sample a mean change in length per ITE Land class between 1990 and 1993 was calculated (Figure 4.5). The sample size could then be boosted by calculating an estimate for 1993 raw data length from the known 1990 length for further Countryside Survey squares. The 107 sample was boosted to 165 by estimating 1993 hedge length for 58 squares that were originally identified for the Hedgerow Survey 1993 but not surveyed. The sample was then reduced by 1 square not surveyed in 1998 to equal 164. This sample included some squares where no length of hedge was present. Another boosted sample (n=249) was produced by estimating 1993 length for a further 142 squares repeat surveyed in 1990 and 1998 that contained hedge in 1990.

Figure 4.4 Estimates of length of hedge in England and Wales based on stock figures from largest repeat sample available for 1990-1993-1998 (n=107).

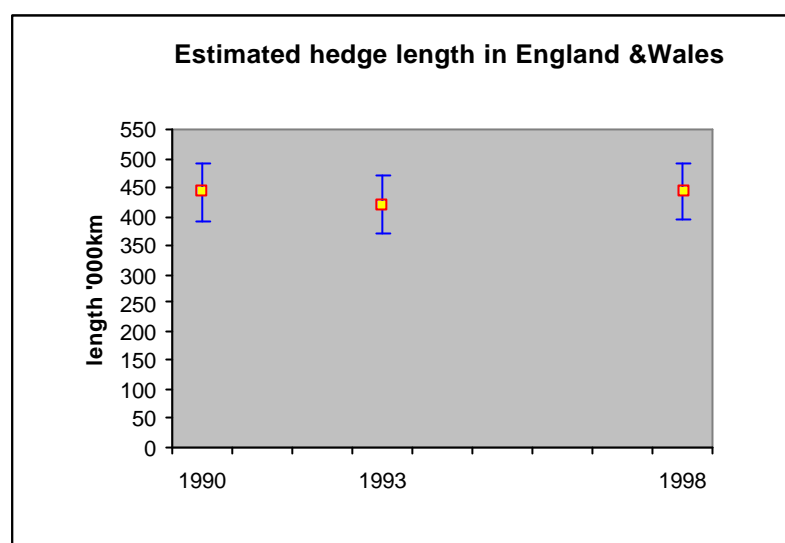
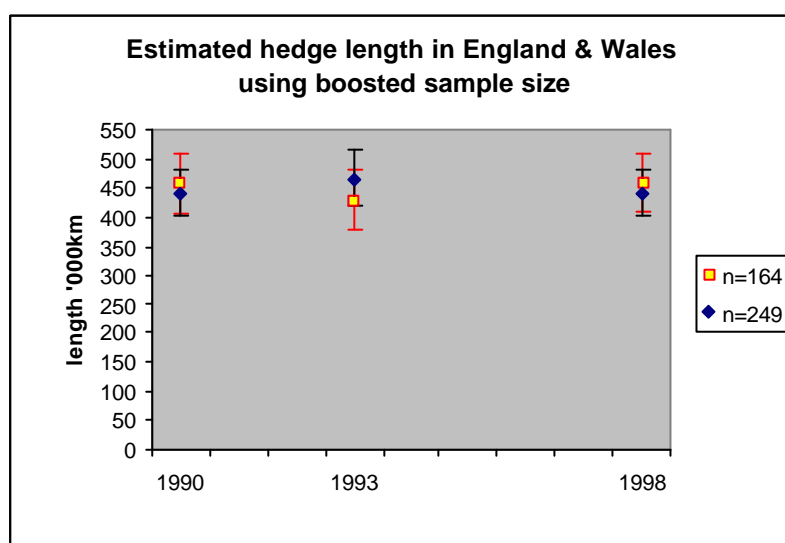


Figure 4.5 Estimates of length of hedge in England and Wales based on stock figures from largest repeat sample available for 1990-1993-1998 (n=107) boosted by applying weighted mean change to remaining Countryside Survey repeat squares that included hedge in 1990



- 25 Using the boosted sample of 164 squares the figures suggest a trend similar to that of the original 107 squares, a decrease from 1990 to 1993 followed by an increase back to the 1990 level in 1998. However, when using the boosted sample of 249 squares the figures suggest an opposite trend with an increase from 1990 to 1993 followed by a loss from 1993 to 1998 to the 1990 level. This is due to additional squares having a large effect on the land class means, themselves calculated from a relatively small number of squares initially. However, again the variation in the samples would mean that statistical tests would not detect a significant change between any year from the range of sample sizes used.

National estimate of stock based on full sample from 1990 and 1998 using HS 1993 amalgamated land classes

- 26 Background work had been carried out to enable the full sample of 1990 and 1998 survey squares to be allocated to the same amalgamated land classes used to produce results in the Hedgerow Survey 1993. These would be compared to the published Module 1 results to assess the effects of amalgamating land classes in order to produce national scale estimates from the Hedgerow Survey 1993 sample. However, as the completed time-series analyses provide comparable results this was deemed a low priority and was not completed due to time constraints.

Possible discrepancies resulting from the 1990 - 1993 - 1998 allocation

- 27 From the 'hedge' sub-set shown in Annex 4.1, 1705 records (17%, 7.5% of total and 13% of 'woody features') had unchanged 1990 and 1998 automatic allocations but the 1993 allocation differed. The interpretation of this is that the 1998 surveyor confirmed that the feature had not significantly changed since 1990 but the 1993 surveyor had recorded codes showing a major change from 1990. These possible discrepancies are shown in Table 4.5

Table 4.5 Chronological allocations for 1990-93-98 which were identified as unlikely to have occurred.

1990-93-98 allocation	Frequency of occurrence	Total length in database (km)
HRH	667	30.8
HNH	242	11.2
HOH	233	8.9
NHN	222	9.0
OHO	168	6.1
RHR	101	4.6
LHL	68	2.6
HLH	4	0.1
total	1705	73.3

Key: H = hedge R = remnant hedge N = no feature C = curtilage O = other feature
L = line of trees/scrub/relict hedge

- 28 The allocation programme was discounted from having contributed to discrepancies as it had been found to be consistent in the use of surveyor codes across all three surveys.
- 29 A manual check was made from 10% of the squares of original field record sheets and maps. It was apparent that the high number of scenarios where the 1990 and 1998 allocations remained unchanged but the 1993 allocation differed were due to differing field codes recorded for the same spatial feature in the 1993 records.
- 30 Whilst it was considered possible for a feature to undergo a major change from 1990 to 1993 and then be restored to the original feature by 1998 two factors suggested that these may be improbable changes:
- had the feature been restored to its 1990 condition since 1993, new management codes would likely be recorded in 1998 e.g. recently laid, trimmed, filled gaps etc.
 - the large number of records exhibiting this apparent unusual change
- 31 It was surmised that there may have been four factors responsible for these apparent improbable changes, which were then checked:
- a) different field code use during the 1993 survey
 - b) different field code definitions during the 1993 survey

- c) different interpretation of the field-codes during the 1993 survey
 - d) different historical data given to field-surveyors and their instructions for recording change
- 32 The field-survey handbooks from each survey were checked for consistency:
- a) Field codes used that were taken into account during the allocation procedure were identical in all three surveys. There was a change of one feature code from ‘trimmed’ in 1990&93 to ‘recently planted’ and the addition of 7 new codes to describe the shape of the hedge in 1998, however, these do not affect the allocation procedure.
 - b) Definitions given for codes used in the field-survey handbooks for each survey are consistent in the main with some minor changes made resulting in more exact definitions from 1993 onwards. These definitions are given below (changes shown in ***bold italics***):
 - o CS1990 Field Handbook:
 - o HEDGE - Woody vegetation that has been subject to a regime of cutting in order to maintain a linear shape. 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.
 - o Use of ‘Derelict’ code – Still obviously a hedge but all attempts at management have been abolished.
 - o LINE OF RELICT HEDGE – usually a line of shrubs showing where a hedge has once been (see definition of hedge; can be used in addition to forestry codes).
 - o HS93 & CS2000 Field Handbook:
 - o HEDGE - A more or less continuous line of woody vegetation that has been subject to a regime of cutting in order to maintain a linear shape. When hedge management is abandoned and the ***overall*** natural shape of the ***component*** tree species has been regained , ***or when the bottom 2m (or less) of the feature is no longer continuous*** , then the feature can no longer be described as a *hedge (and might be considered as, for example, a scattered line of shrubs or trees)*.
 - o Use of ‘Overgrown’ code – Still obviously a hedge but all attempts at management have been abolished.
 - o LINE OF RELICT HEDGE – usually a line of shrubs showing where a hedge has once been (see definition of hedge; can be used in addition to forestry codes).
 - c) Surveyors may have put more emphasis on recording change, especially in relation to ‘relict’ hedges during the 1993 Hedgerow Survey (because the identification of ‘relict’ hedgerows was a major objective of this interim survey).
 - d) Field-surveyors were provided with different levels of historical spatial and attribute data and instructions for mapping in each of the surveys. The 1990 surveyors mapped and recorded attribute data from basic base maps only. The 1993 surveyors were given the spatial locations of features from the 1990 survey but no data indicating what features had previously been recorded there. The 1998 surveyors were supplied with maps and attribute data from 1990 only and instructed to record change where absolutely sure. This approach was taken to reduce the likelihood of features changing due to subjectivity (even taking into account the definitions in the field-guide and the one week training course for surveyors).
- 33 Two datasets of a sub-sample of the overall population were created of codes used to describe the same hedge at each of the three survey dates. The first was created manually from the actual surveyors records in the Field Assessment Booklet and is a smaller sub-sample. The second was created from Database queries and was cross-checked to the manually created dataset for validation.

- 34 From these data, changes in codes used and /or changes in allocation were looked for. Fifty examples of previously identified apparent improbable change scenarios between allocation in 1990 – 1993 – 1998 were looked at and some general conclusions reached.

1990-93-98 allocation of Hedge-Remnant-Hedge

- 35 A number of cases suggested the 1993 surveyors were more inclined to record a line of scrub/relict hedge whereas the 1998 surveyors would make no changes to the main 1990 codes other than to record new condition or management codes e.g. Derelict (as opposed to a line of Relict Hedge) , Unfilled gaps >10%. These records account for 7% of all records where a hedge was present in any year (Annex 4.1).

1990-93-98 allocation of Remnant-Hedge-Remnant :

- 36 Most cases showed that the 1998 surveyor reaffirmed the 1990 codes showing a remnant hedge with little change but the 1993 surveyor recorded a hedge feature. Checks with surveyors maps from CS2000 and Hedgerow Survey 1993 showed correct spatial correlation. These records account for just 1% of all records where a hedge was present in any year (Annex 4.1).

1990-93-98 allocation of Hedge-Other feature/no feature-Hedge:

- 37 Most cases showed that the 1998 surveyor reaffirmed the 1990 codes showing a hedge with little change but the 1993 surveyor recorded no hedge or other linear woody feature. Checks with surveyors maps from CS2000 and Hedgerow Survey 1993 showed correct spatial correlation. These records account for 5% of all records where a hedge was present in any year (Annex 4.1). It is difficult to offer any explanation in these cases.
- 38 A number of cases were due to incorrect spatial correlation between the datasets, accounting for less than half of 1% of the total records. In the majority of cases these were short lengths of lines (less than 5m) amongst a complexity of other lines in the GIS and would likely cancel each other out when stock totals by feature by year for the sample square were computed.

1990-93-98 allocation of Other feature/no feature-Hedge-Other feature/no feature:

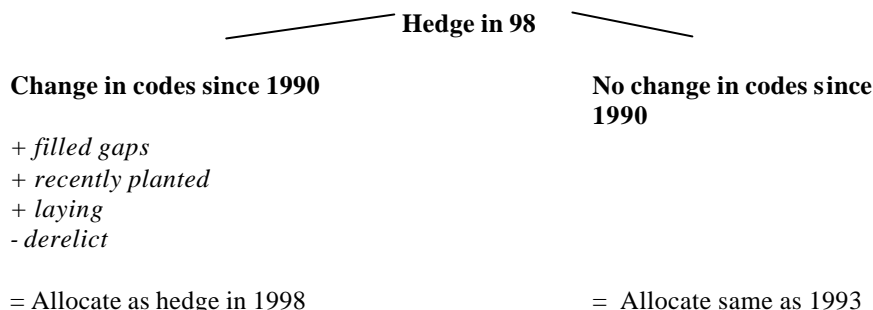
- 39 Many cases showed that the 1998 surveyor reaffirmed the 1990 codes showing no hedge or other linear woody feature with little change but the 1993 surveyor recorded a hedge. Checks with surveyors maps from CS2000 and Hedgerow Survey 1993 showed correct spatial correlation. These records account for 4% of all records where a hedge was present in any year (Annex 4.1). It is difficult to offer any explanation in these cases.
- 40 A number of cases were due to incorrect spatial correlation between the datasets. In the majority of cases these were short lengths of lines amongst a complexity of other lines. Each of these records would need manual checking in order to rectify but would likely be cancelled out by an opposite incorrect allocation record when stock totals by feature by year for the sample square were computed. In total these may account for 1-2% of the total number of records in the 'woody features' sub-set.

Alternative allocation codes for 1998.

- 41 As a result of the discrepancies an attempt was made at simulating the probable codes recorded by 1998 surveyors had they had the 1993 data in the field. A new data column was created for use as an alternative allocation in these cases, the original allocation for 1998 remaining unaltered.
- 42 Records showing an unchanged allocation in 1998 from 1990 but with a changed allocation in 1993 had been previously manually checked by referring to the field record sheets and maps from all three years and, using a decision tree (see Figure 4.6), creating an alternative 1998

allocation where directed. In summary, the 1993 allocation was carried through to 1998 unless the 1998 surveyor had recorded codes that were interpreted as there having been a change from the 1993 allocation.

Figure 4.6 Decision tree for creation of alternative 1998 allocation.



- 43 As a result of manual checking of the recorded codes in each of the three years , from the 1705 records with ‘hedge’ where the 1990 and 1998 automatic allocation had not changed but the 1993 allocation differed, a total of 1049 records (62%) had alternative allocations created. This represents 5% of all records, 8% of the ‘woody’ sub-set and 10% of records where a hedge was recorded in any year. The frequency and total length of records and the effect of manual checking are shown in Table 4.6.

Table 4.6. Original allocations and result of manual checks

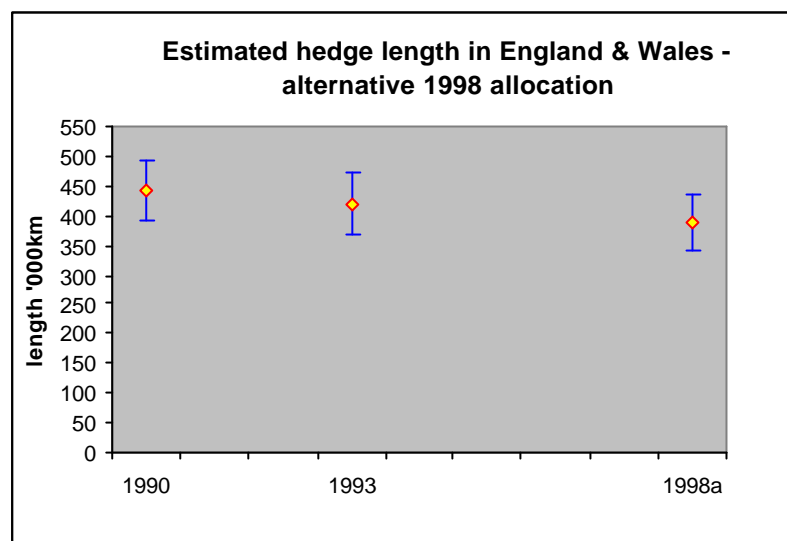
allocation 191990-93-98	Original allocation		Stayed same		Given alternative 1998 allocation	
	freq	length km	freq	length km	freq	length km
HRH	667	30.8	42	1.8	625	29
HNH	242	11.2	49	2.9	193	8.2
HOH	233	8.9	41	1.6	192	7.3
NHN	222	9	217	8.6	5	0.4
OHO	168	6.1	156	5.7	12	0.4
RHR	101	4.6	92	4.4	9	0.2
LHL	68	2.6	59	2.2	9	0.4
HLH	4	0.1	0	0	4	0.1
total	1705	73.3	656	27.2	1049	46

- 44 The frequency of allocations, for features with a hedge in any year, shown using the original and alternative allocations are summarised in Annex 4.1. The most frequent chronological allocation for a feature is a hedge allocated in all three years and accounts for 53% of all allocations where a hedge was present in any year. There is no percentage change in this group using the alternative allocation for 1998. The chronological allocation HRH accounts for 7% of the total but falls to less than 1% using an alternative allocation. HRR increase from 5% to 11% using an alternative allocation.
- 45 Comparable stock estimates for 1990-1993-1998 from a sample size of 107 squares based on the original 1998 allocation were shown in Figure 4.4. A further estimate of length of hedge in England & Wales in 1990-1993-1998 was produced using the alternative 1998 allocation

dataset based on simulated codes of what may have been recorded in the field in 1998 had the surveyors been provided with 1993 information.

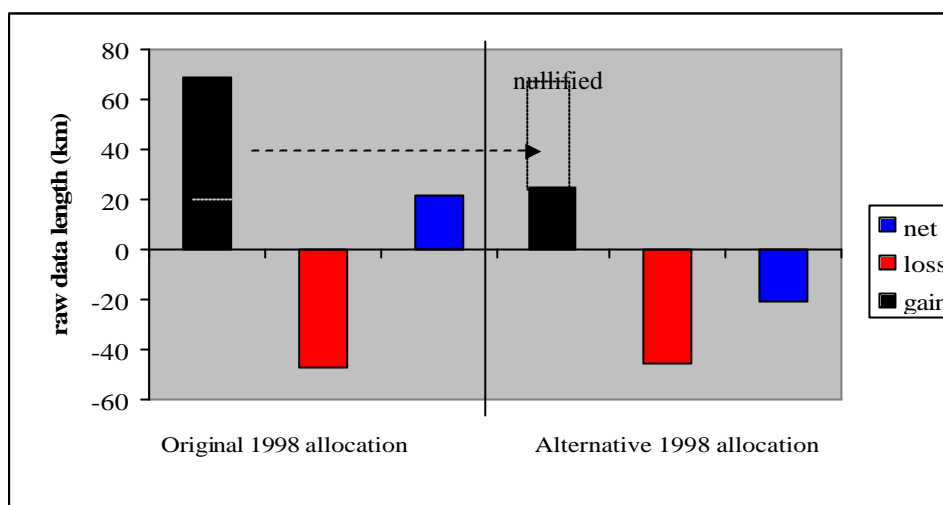
National estimate of stock using alternative allocations for 1998

Figure 4.7 Estimates of length of hedge in England and Wales based on stock figures from largest repeat sample available for 1990-1993-1998 (n=107). 1998 estimate is based on an alternative allocation – see text.



- 46 When the alternative 1998 allocation is used the figures suggest that the trend shows a further decrease in hedge from 1993 to 1998 (Figure 4.7) but the variation in the sample would mean that statistical tests would not detect a significant change between any year. The original 1998 total shows a net increase over 1993 because there are larger gross gains than losses. The alternative allocation nullifies the majority of the gains resulting in the gross losses becoming greater than the gains. This explains how the alternative 1998 stock figures are lower than the 1993 stock figures. Figure 4.8 shows the gross gains and loss of hedge for 1993 to 1998 using both estimates.

Figure 4.8 Gains and loss of hedge gross raw data length for 1993-1998 using original allocations and alternative allocation for 1998 (n=107). A large proportion of the gains resulting from the original allocations are nullified when using the alternative 1998 allocation, turning a net gain from 1993-98 into a net loss.

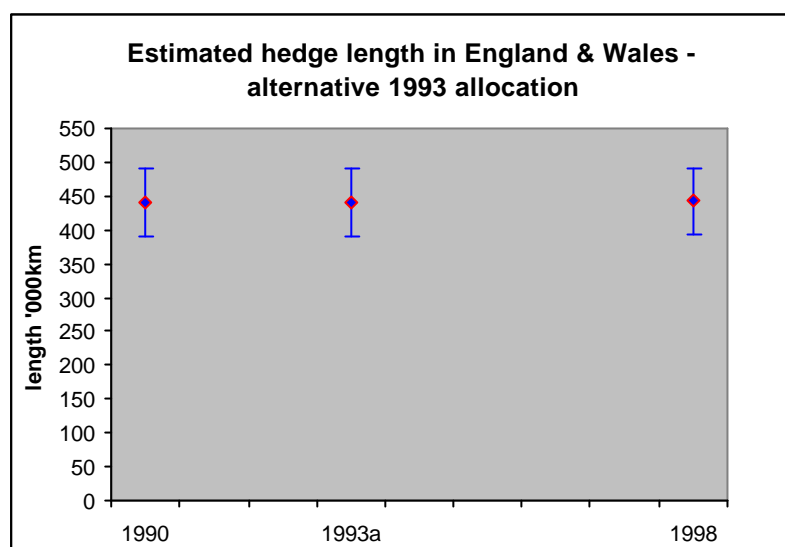


Alternative allocation codes for 1993.

National estimate of stock using alternative allocations for 1993

- 47 The FOCUS workshop of May 2002 recommended that the data re-analysis as a result of possible discrepancies between 1993 and 1998 be looked at a different way. An alternative allocation for 1993 was created, simulating the probable 1993 allocation had the 1993 surveyors had the 1990 data and been given the same instructions for mapping as in Countryside Survey. The alternative 1993 allocation was created for the sub-set of data that had been given an alternative 1998 allocation (1049 records, Table 4.3) as these were the records where the 1998 surveyor had confirmed no major changes from 1990. An alternative 1993 column was created equal to the 1990 allocation. In short, the 1993 allocation follows that of 1990. Statistics for frequency of allocations and changes are therefore the same as those given in Table 4.3 for 'Alternative 1998' allocation.
- 48 Frequencies of chronological allocations using the alternative 1993 allocation are shown in Annex 1. Using this alternative allocation the frequency of hedge in all years (HHH) increases to account for 63% of the total records with hedge in any year. The increase is due to changes from allocations such as 'HRH' to 'HHH'. The number of records in the 'hedge in any year' sub-set has decreased by 37 (less than 1%) due to certain records no longer containing a hedge in any year e.g. OHO becomes OOO using the alternative 1993 allocation.

Figure 4.9 Estimates of length of hedge in England and Wales based on stock figures from largest repeat sample available for 1990-1993-1998 (n=107). 1993 estimate is based on an alternative allocation – see text.



- 49 By estimating 1993 lengths using an alternative 1993 allocation the results suggest that the trend between all 3 surveys would be static (Figure 4.9). The variation within the sample would mean that statistical tests would not detect a significant change between any year.

Agri-environment schemes

- 50 As part of Question 17, available spatial datasets were gathered and GIS analysis performed to identify the extent of compatible agri-environment scheme and CS data. Figure 4.10. shows the extent to which agri-environment scheme data overlaps with the sample of 1990-93-98 repeat survey squares.

Fig 4.10 Agri-environment data and Countryside Survey data overlap

	<i>C.Stewardship</i>	<i>ESA</i>	<i>both</i>
No. survey squares with CS & Agri_env. data available (% of total sample)	28 (26%)	11 (10%)	5 (5%)
Area of land (ha) with CS & Agri_env. data available	789ha	482ha	n/a
Proportion of total area of survey squares (n=107)	7%	5%	n/a

- 51 Although one third of the 107 repeat sample squares had data for both Countryside Survey and agri-environment schemes the actual area within the squares that overlapped was low. Only 12% of land was covered by both datasets and of that the ESA data did not provide starting

dates for the scheme. No further work was undertaken with this dataset as it was unlikely to provide any informative information.

SUMMARY

- 52 The time-series analysis of directly comparable 107 samples between 1990, 1993 and 1998 indicates that there is no evidence that there has been a decrease in the length of hedgerow between 1990 and 1993 and an increase between 1993 and 1998. Although there is confidence in the definitions associated with field codes and in the allocation procedures, there is some uncertainty over the way codes were used by surveyors in different surveys. By re-interpreting the data in the light of these uncertainties the evidence would again indicate that there has been no change between 1990, 1993 and 1998 . The observed variations in the recording of features between surveys is outweighed by the variation within the sample.
- 53 The relatively small sample size of the Hedgerow Survey 1993, the sample of 107 squares where comparable estimates can be made, does not sufficiently represent land classes in many cases and, based on the size of the error estimates, cannot be said to be representative of trends at the national scale in England and Wales.

RECOMMENDED CHANGES TO CS METHODS

- 54 No changes to Countryside Survey methodology are necessary as a result of the work directed at this question although any method development that helps ensure a more consistent use of field codes would be helpful. The issues arising within the question are founded in the comparison of a sub-sample survey with a fuller sample survey for example, Hedgerow Survey 1993 was not expected to produce national scale estimates. This might be a valuable lesson when considering the advisability of introducing future interim sample surveys.
- 55 It has been observed that differing levels of historical information supplied to field-surveyors in different surveys may produce inconsistent and therefore questionable records. Consideration to this issue must be made in future surveys especially where records are available from interim sub-sample surveys. However, it has also been observed that the variations in the recording of features between surveys is outweighed by the variation in the sample.

ANNEX 4.1

Annex 4.1 Chronological allocations and frequency summary based on either original 1998 allocation or alternative 1998 allocation.

allocation	original allocation		alternative 1998 allocation		alternative 1993 allocation	
	freq	length km	freq	length km	freq	length km
1990-93-98						
HHH	5228	300.6	5243	301.5	6242	345.2
HRH	667	30.8	42	1.8	42	1.8
HRR	534	25.2	1087	51.3	534	25.2
OHH	292	13.5	304	13.9	292	13.5
NHH	288	13.1	296	13.6	288	13.1
HNH	242	11.2	49	2.9	49	2.9
HOH	233	8.9	41	1.6	41	1.6
NHN	222	9.0	217	8.6	217	8.6
RHH	194	9.4	203	9.6	194	9.4
OHO	168	6.1	156	5.7	156	5.7
HHR	131	6.0	113	5.1	131	6.0
HHO	115	5.6	111	5.4	115	5.6
HOO	110	4.5	246	9.3	110	4.5
RHR	101	4.6	92	4.4	92	4.4
LHH	84	4.2	93	4.7	84	4.2
OOH	75	3.7	75	3.7	75	3.7
HRO	69	2.9	95	4.0	69	2.9
HON	68	2.3	117	4.5	68	2.3
LHL	68	2.6	60	2.3	59	2.2
NHO	61	1.1	61	1.1	61	1.1
RRH	59	2.7	59	2.7	59	2.7
ORH	57	2.1	58	2.1	57	2.1
HNN	55	2.3	154	6.6	55	2.3
HHN	52	2.7	52	2.7	52	2.7
LRH	47	2.5	47	2.5	47	2.5
NRH	44	2.1	44	2.1	44	2.1
HNR	43	2.0	41	2.0	43	2.0
HRN	43	2.3	71	3.3	43	2.3
HRL	40	2.0	57	2.8	40	2.0
OHL	38	2.0	38	2.0	38	2.0
HNC	37	1.6	102	4.1	37	1.6
ONH	35	2.1	35	2.1	35	2.1
HNO	33	1.7	47	2.1	33	1.7
HHL	30	1.5	36	1.6	30	1.5
OHN	26	0.9	26	0.9	26	0.9
RHL	26	1.2	26	1.2	26	1.2
NOH	25	0.9	25	0.9	25	0.9
NHL	22	0.7	22	0.7	22	0.7
HOR	18	0.5	16	0.5	18	0.5
NHR	17	0.6	14	0.6	17	0.6
NNH	17	0.6	17	0.6	17	0.6
RHO	16	1.0	16	1.0	16	1.0
OHR	15	0.5	15	0.5	15	0.5
ROH	15	0.5	15	0.5	15	0.5

LOH	14	0.4	14	0.4	14	0.4
RNH	11	0.6	11	0.6	11	0.6
HNL	9	0.3	26	1.4	9	0.3
HHC	8	0.2	9	0.2	8	0.2
RHN	8	0.3	8	0.3	8	0.3
NHC	6	0.5	6	0.5	6	0.5
RHC	6	0.4	6	0.4	6	0.4
OHC	5	0.2	5	0.2	5	0.2
HLH	4	0.1	0	0.0	0	0.0
LHR	4	0.3	3	0.1	4	0.3
LNH	4	0.3	4	0.3	4	0.3
HRC	3	0.2	4	0.3	3	0.2
HOL	2	0.0	9	0.3	2	0.0
LHC	2	0.0	2	0.0	2	0.0
HLL	1	0.1	1	0.1	1	0.1
HLO	1	0.1	1	0.1	1	0.1
LHN	1	0.1	2	0.1	1	0.1
LHO	1	0.0		0.0	1	0.0
LLH	1	0.0	1	0.0	1	0.0
HLN			2	0.1		
HLR			2	0.0		
HOC			2	0.0		
total	9851	506.3	9852	506.3	9816*	504.9*

Key:

H = hedge R = remnant hedge O = other
N = no C =
feature curtilage L = line of trees/scrub/relict hedge

* The total number of records where a hedge is present in any year using the alternative 1993 allocation decreases due to a hedge no longer being present in any year e.g. OHO would change to OOO.

ANNEX 4.2

Data tables for Figures in text

Figure	Analysis	Sample size	year	length (000km)	SE	95% Lower limit	95% Upper limit
4.1	CS1984	219	1984	537.5	25.5	483.2	597.0
	CS1990	311	1990	431.8	22.3	n/a	n/a
	CS2000	311	1990	450.1	22.3	408.7	495.5
	HS1993	108	1993	377.5	25.5	n/a	n/a
	CS2000	366	1998	449.3	21.2	408.6	490.4
4.2	FOCUS	308	1990	439.5	22.4	399.5	479.6
	HS1993	108	1993	377.5	25.5	n/a	n/a
	FOCUS	308	1998	438.4	22.1	398.4	477.1
4.4	FOCUS	107	1990	442.5	30.7	391.0	492.5
	FOCUS	107	1993	418.5	30.8	369.6	471.8
	FOCUS	107	1998	443.0	30.0	394.1	492.0
4.5	FOCUS	164	1990	458.1	29.6	402.8	515.6
	FOCUS	164	1993	427.3	29.6	374.6	482.6
	FOCUS	164	1998	458.4	29.3	406.0	511.3
	FOCUS	249	1990	441.4	23.0	404.0	481.9
	FOCUS	249	1993	465.2	28.1	421.8	514.9
	FOCUS	249	1998	440.4	22.6	403.0	480.4
4.7	FOCUS	107	1990	442.5	30.7	391.0	492.5
	FOCUS	107	1993	418.5	30.8	369.6	471.8
	FOCUS	107	1998alternative	388.2	28.9	340.9	436.6
4.9	FOCUS	107	1990	442.5	30.7	391.0	492.5
	FOCUS	107	1993alternative	441.5	30.6	389.9	491.7
	FOCUS	107	1998	443.0	30.0	394.1	492.0

n/a = not available

