Question 16: Does the countryside around towns have a different ecological character and trajectory of change than more remote areas in similar environmental classes? Does CS2000 provide a representative sample of countryside around towns?

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POLICY CONTEXT STATEMENT

1. The land around urban areas is inevitably subject to both development pressure and 'people pressure' (Harrison & Davies 2002, Yokohari *et al.*2000). In some areas the land may have inherent ecological value due to its location or it may simply provide a valuable leisure resource for those in the adjacent urban area. Greenbelt areas around cities are seen to provide restrictions to sprawling urbanisation in the western world and development within those areas is often highly restricted. The areas around smaller towns may have fewer constraints in terms of urban development, but the habitats being affected by development may be ecologically valuable. As CS is essentially a survey of rural areas (it excludes all areas with greater than 75% urbanisation) it may provide a means of identifying the characteristics of land surrounding towns in predominantly rural areas.

2. This question seeks to discover how much CS data can tell us about the land associated with towns and its distinctiveness ecologically from land in more rural areas.

3. It was decided that the approach to the question should initially involve a classification of squares into rural, urban and peri-urban squares, in order to be able to compare the ecological quality of land between the three categories. Currently, the government is seeking to define land within the UK into urban or rural. In 2001 a consortium was charged with reviewing definitions of urban and rural for policy purposes and statistical reporting in order to come up with a consistent approach to the definitions of 'urban' and 'rural'. Whilst it was concluded that no single definition of urban and rural areas could meet the needs of all users, the development of defined 'urban settlements' (previously called urban areas) was agreed upon. These 'urban settlements' are effectively land which has an irreversible urban use. The computer readable boundaries of 'urban settlements' are initially based on 2001 boundaries of urban land and population data from 2001 and are being constructed by the Office of the Deputy Prime Minister (ODPM), the Office of National Statistics (ONS) and Ordnance Survey (OS). For the government's purposes and to produce consistency in statistical reporting a cut off population of 10, 000 is recommended, so that all settlements over 10,000 are treated as urban areas, and all smaller settlements are treated as rural areas. The 'urban settlement' definition is simple in concept, fits well with people's perceptions of urban areas as land that has been built upon and is currently seen as the most effective way of obtaining a rural/urban split of the country. For consistency of approach, the computerised 'urban settlement' boundaries were used in the classification of CS squares into urban, rural and the

classification of surrounding squares.

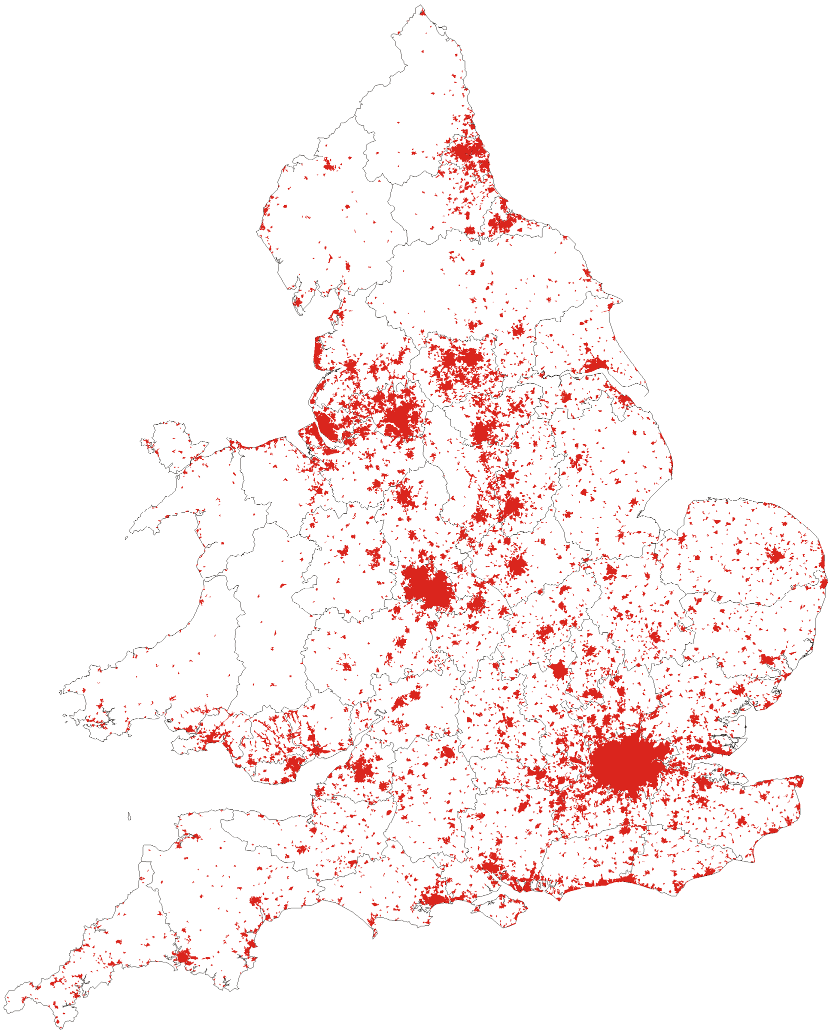
16.1 *Classification of data*

England and Wales

4. The 1 kilometre squares surveyed in the Countryside Surveys are predominantly rural squares as any squares containing over 75% built up area are rejected without visiting. However, the squares do contain up to 75% built up and can occur in the centre of dense urban settlements. As it is likely that both the actual urban content of a square and its proximity to other urban areas are likely to affect the habitat within that square it was decided that squares should be classified on two characteristics, i.e. their urban content and the urban nature of the surrounding area.

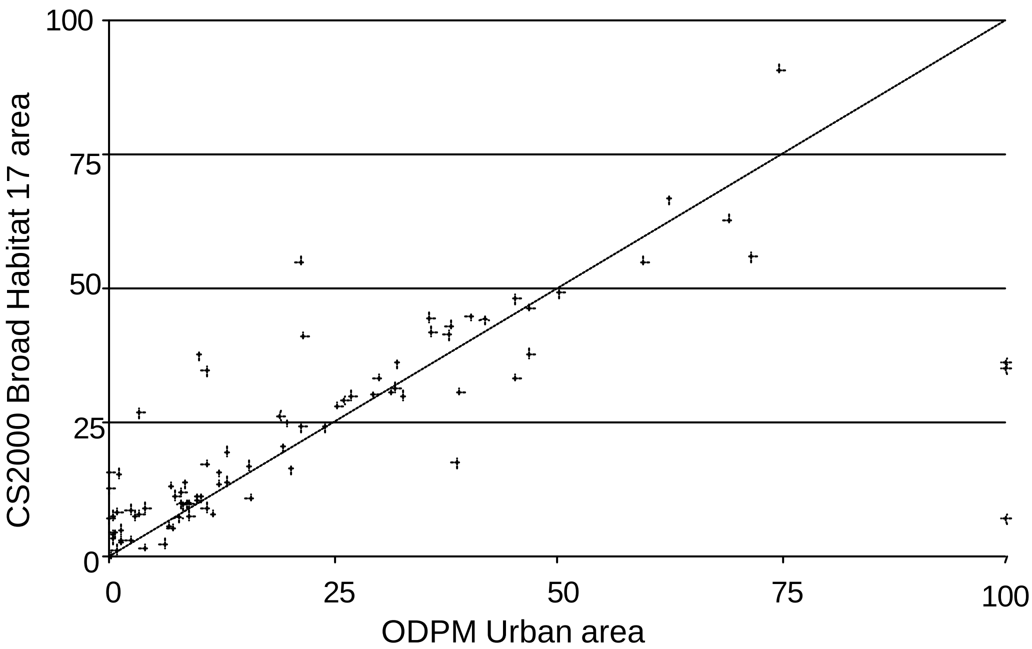
5. The Office of the Deputy Prime Minister (ODPM) has sponsored the creation of a map of England and Wales classifying land as urban or rural depending on the characteristics recorded on Ordnance Survey maps (see above). Whilst the dataset is awaiting its official release (summer 2003) we have been granted access to the latest version. Using the dataset (Figure 1), the urban extent of all the surveyed 1km squares in England and Wales and the urban/rural nature of surrounding squares were examined.

Figure 16.1a. The distribution of urban land in England and Wales in 2001 as defined by the Office of the Deputy Prime Minister



6. The relationship between the ODPM urban mask and the Broad Habitats mapped in CS2000 are shown in Figures 16.1b and 16.1c. Figure 16.1b shows the area of urban land within a survey square identified within the mask compared to the area mapped as Broad Habitat 17 (*Built up and gardens*). A strong correlation can be seen, with the exception of three squares which show 100% urban content from the mask and less than 50% BH 17. The three squares are all in London; the major cities are consistently defined as urban even if they contain parkland or open spaces.

Figure 16.1b. The relationship between urban land identified from the Office of the Deputy Prime Minister urban land map and CS2000 field survey *Built up and gardens* Broad Habitat (BH 17). Areas are in hectares, each point represents a single square, and the dashed line shows agreement between the datasets.



7. Almost 75% of land within the urban mask was from Broad Habitat 17 (*Built up and gardens*) with other Broad Habitats represented thus; *Improved grassland* (10%), *Broadleaved, mixed and yew woodland* (5%), *Boundaries and linear features* (4%), *Arable and horticultural* (4%) and *Neutral grassland* (1%) the only other habitats with over 1% inclusion (Fig 16.1c). There appears to be good spatial agreement between the mask and the field mapping.

Figure 16.1c. The proportion of the ODPM urban mask mapped as different Broad Habitats in CS2000.

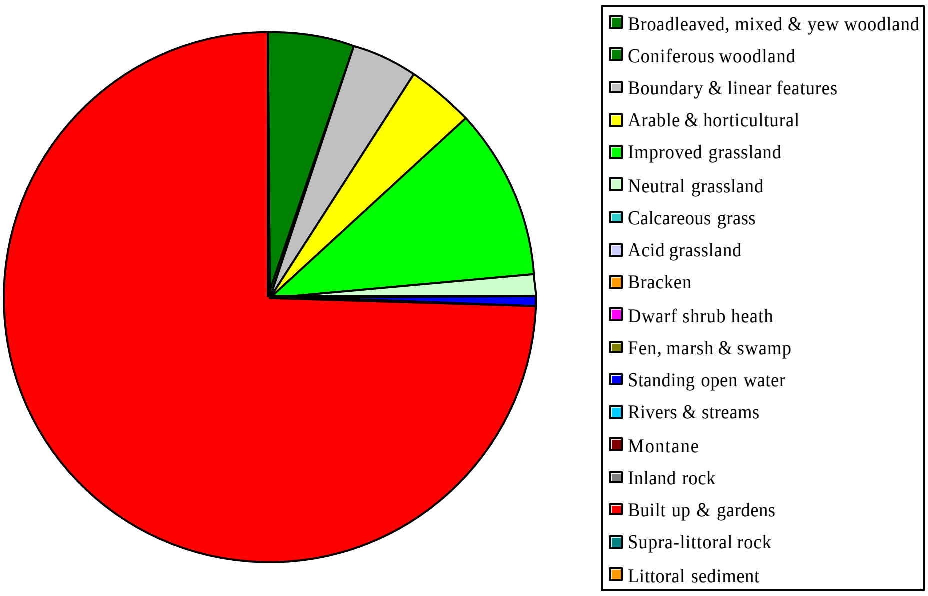
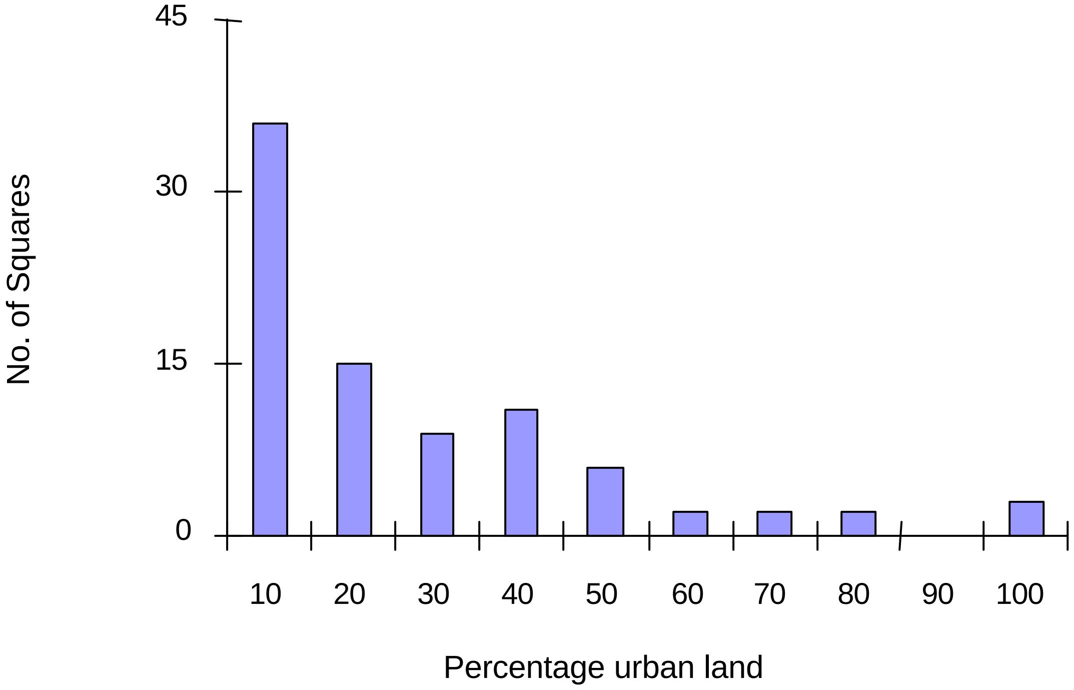


Figure 16.1d. The numbers of squares surveyed in England and Wales in CS2000 with different extents of urban land from the ODPM urban mask.



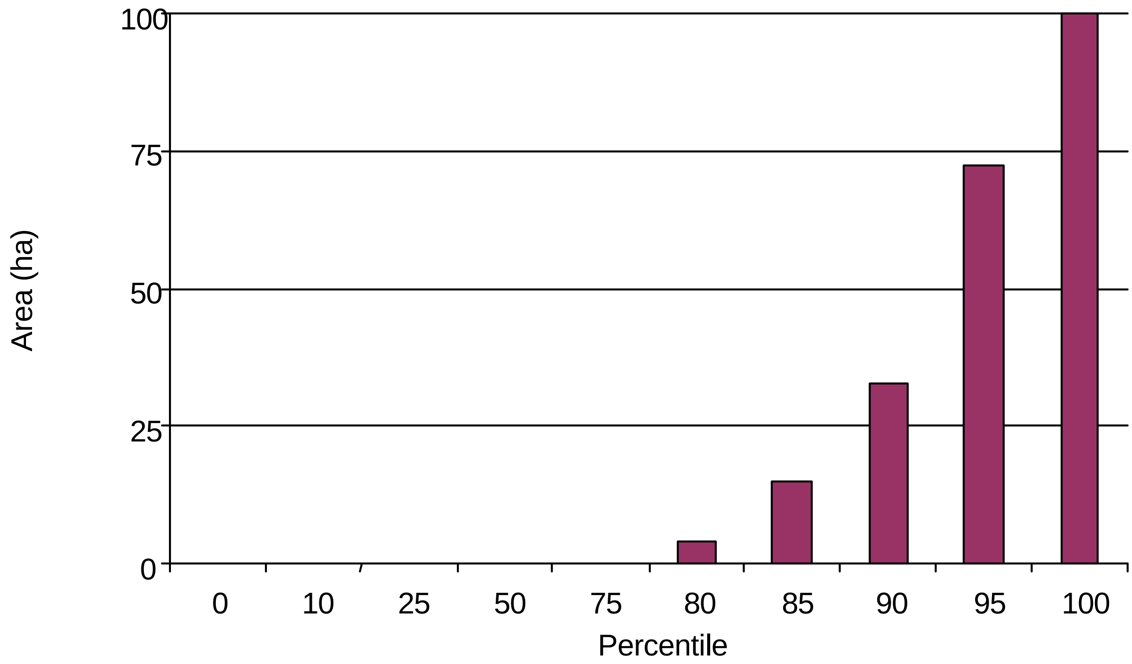
8. Figure 16.1d shows the proportion of surveyed squares in England and Wales with different levels of urban land. Omitted from the graph (for presentation reasons) are the 280 squares which contain no urban land.
9. To define the urban/rural nature of the area surrounding each of the survey squares, digital buffering was used to different extents (500 metres, 1 km, 2 km and 4 km) to select the areas outside of the square but inside the buffer.

The areas were used to clip the urban mask in order to identify the proportion of urban land within the buffer zone. It was decided that only the largest buffer would be used for analysis. Hence, squares were classified in two ways, by both the urban area within the square as well as the urban area within a 4 km radius of the square edge. Each set was divided into two groups, Urban (U) and Rural (R) dividing the survey squares into four groups:

- Rural squares in a rural setting (RR)
- Urban squares in a rural setting (UR)
- Rural squares in an urban setting (RU)
- Urban squares in an urban setting (UU)

10. To determine the cut off points separating Rural and Urban the distribution of extent of urban land in all CS squares in England and Wales was examined (Figure 16.1e). Approximately 75% (280) of the squares in England and Wales contain no urban land, initially it was considered that this upper quartile could be used as a classifier, but that would have meant that any squares with any urban land in were classified as urban. As the urban mask covers just under 12% of England and Wales it was decided that 10% would be an appropriate percentile to choose (expressed as a 90th percentile). The value for the 90th percentile was 32.8 ha which was rounded to 33 ha per square and used as a cut off for both the square and its setting. Squares with 33 ha or more were considered Urban, those with less Rural. Within the surrounding 4km radius greater than 33% Urban land was considered Urban.

Figure 16.1e. The distribution of the extent of urban land in all 1 km squares in England and Wales in 2001. Data from ODPM



11. The distribution of sample squares surveyed in CS2000 into the four classes is shown in Table 1. Only 30 squares are considered to be urban in either characteristic or context.

Table 16.1. Numbers of squares classified as rural (R) and urban (U) and in a rural (R) and urban (U) setting.

		Square	
		R	U
4km radius	R	336	15
	U	9	6

Scotland

12. The ODPM dataset only described England and Wales, therefore an equivalent classification was required for Scotland. This was obtained from the Scottish Executive in the form of a spatial dataset of urban areas similar to that provided by the ODPM. However, due to the fact that Scotland is a less densely populated country than England, there are differences between the cut-off points at which areas are described as urban rather than rural. For Scotland a population of 3000 or greater results in a parcel of land being described as urban whereas for England and Wales the cut-off point is 5000.

13. The Scottish dataset was used in the same way as that for England and Wales to classify CS squares in Scotland into Rural and Urban. Initially the classification of Urban and Rural squares was carried out using exactly the same methodology to classify both squares themselves as well as the area around them up to a buffer area of 4km from the square edge. Therefore squares with 33 ha or more were considered Urban, those with less Rural. Within the surrounding 4km radius greater than 33% Urban land was considered Urban. This resulted in a total of 4 of the 203 squares in Scotland being classified as Urban, 3 of these with a Rural buffer area. Of the Rural squares only one was set in an Urban context.

14. As these numbers were very low and would make it very difficult to carry out analysis to investigate the extent and condition of Broad Habitats between the two different square types, squares were re-classified on the basis of whether they contained 10% or more Urban land or whether 10% or more of the surrounding 4km radius was Urban land. Following this re-classification 8 squares were classified as Urban, 5 of which were also in an Urban context. Only 2 Rural squares were classified as being within an Urban context. Because of the very small numbers in each of the categories and the difficulties with validity of statistical analysis it was decided (after consultation with SNH) that all squares should fall within just 2 categories, rather than the 4 used for England and Wales. These categories were defined as Rural or Urban, any square either containing or being surrounded by land with 10% or greater Urban content was defined as an Urban square (total number = 10). All other squares were defined as Rural (total number = 193).

16.2 *Comparison of extent of Broad Habitats in different square types.*

Approach

England and Wales

15. In order to test the variation in the extent of different Broad Habitats between the four classes a General Linear Model (SAS institute 1999-2001) was used. This test calculates an F statistic to determine whether there is a significant difference between classes. The model incorporated squares classified as Rural or Urban because of the content of the square and squares classified as Rural or Urban because of the character of the land surrounding the square. Due to the differences in sample size (Rural-Rural (RR) =336, Rural-Urban (RU) = 9, Urban-Rural (UR) =15, Urban-Urban (UU) =6) between the classes used a GLM was used as it is more resilient than comparative methods such as ANOVA. Variation in the extents of all Broad Habitats with the exception of the *Boundary and Linear Features* Broad Habitat (due to its under-representation in urban areas as a result of survey definitions), were investigated. Tests were carried out on both the 1998 dataset as well as on the changes between 1990 and 1998.

Scotland

16. The same type of model as described above was used to look at differences in the extent and condition of Broad Habitats in the Rural (193) and Urban (10) squares in Scotland.

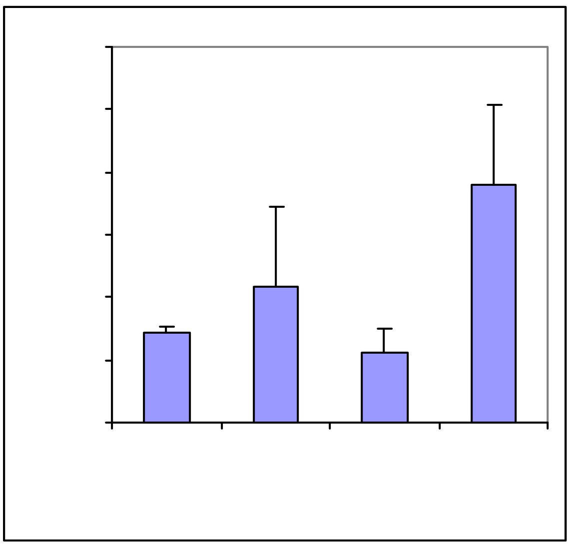
Results

England and Wales

1998

17. Tests showed no differences between the extents of all Broad Habitats with the exception of *Broadleaf, Mixed and Yew woodland* where the extent of *Broadleaf, Mixed and Yew woodland* in the surrounding 4km differed significantly between square types, with those surrounded by urban squares having significantly higher amounts of woodland than those surrounded by rural squares (p = 0.01) (Fig 16.2a).

Figure 16.2a. The mean and S.E. of the extent of *Broadleaf, Mixed and Yew woodland* in different square types in England and Wales.

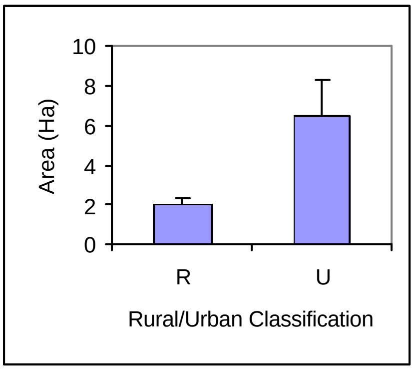


Scotland

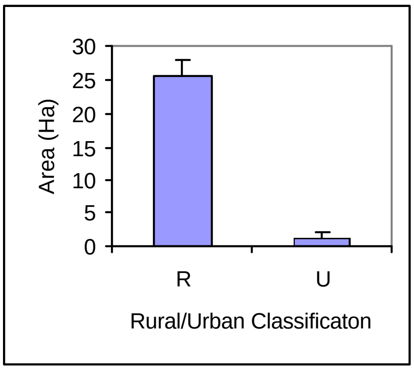
18. Tests showed differences between the extents of two Broad Habitats in Rural and Urban squares. The amount of *Neutral grassland* was significantly higher in Urban than in Rural squares (p = 0.01) and the amount of Bog was significantly lower in Urban than in Rural squares (p = 0.02).

Figure 16.2b. The mean and S.E. of the extent of b) Neutral grassland, c) Bog and d) Maximum patch size in Urban and Rural squares in Scotland.

b)



c)



1990-1998

England and Wales

19. Tests showed no differences between the changes in the extent of all Broad Habitats between different square types.

Scotland

20. Tests showed no differences between the changes in the extent of all Broad Habitats in Urban and Rural squares in Scotland.

16.3 *Comparison of condition of Broad Habitats in different square type.*

Approach

England and Wales

21. A General Linear Model (SAS institute 1999-2001), similar to that used to test differences in extent of Broad Habitats, but which included a random factor for square to account for the effect of plots being located within the same square, was used to test the variation in condition measures between the four classes as well as variation between classes within a plot type. This test calculates an F statistic to determine whether there is a significant difference between classes. The model incorporated squares classified as Rural or Urban because of the content of the square and squares classified as Rural or Urban because of the character of the land surrounding the square. There were great differences in sample size in terms of numbers of plots (Rural-Rural (RR) =5805, Rural-Urban (RU) = 173, Urban-Rural (UR) =210, Urban-Urban (UU) =187) between the classes which is why a GLM was used as it is relatively resilient to unequal sample sizes. The condition measures used were cover

weighted (the score for each species present was weighted by the amount of it that was present) Ellenberg Scores for N (Nitrogen),R (pH), L (Light), W (Moisture), Grime's C (Competitive), S (Stress-tolerant), R (Ruderal) and species richness. The test was repeated between classes within plot types in order that the same type of plot could be compared. Tests were carried out on both the 1998 dataset as well as on the changes between 1990 and 1998. The difference between scores rather than the scores themselves was used to test the changes between 1990 and 1998.

Scotland

22. A General Linear Model (SAS institute 1999-2001), similar to the one mentioned above which included a random factor for square to account for the effect of plots being located within the same square, was used to test the variation in condition measures between the two classes Rural or Urban as well as variation between classes within a plot type. This test calculates an F statistic to determine whether there is a significant difference between classes. Unlike England the model only incorporated squares classified as Rural or Urban . There were great differences in sample size in terms of numbers of plots (Rural =2994, Urban = 192) between the classes which is why a GLM was used as it is relatively resilient to unequal sample sizes. The condition measures used were cover weighted (the score for each species present was weighted by the amount of it that was present) Ellenberg Scores for N (Nitrogen),R (pH), L (Light), W (Moisture), Grime's C (Competitive), S (Stress-tolerant), R (Ruderal) and species richness. The test was repeated between classes within plot types in order that the same type of plot could be compared. Tests were carried out on both the 1998 dataset as well as on the changes between 1990 and 1998. The difference between scores rather than the scores themselves was used to test the changes between 1990 and 1998.

Results

1998

England and Wales

- Rural squares had a significantly higher Ellenberg moisture value (p=0.05) than Urban squares, although there was no effect as a result of whether the surrounding squares were classified as Rural or Urban (Fig. 16.3a).
- There was a slight trend for species richness to be higher in squares surrounded by Rural squares compared to squares surrounded by Urban squares (p = 0.06) although there was no effect from whether squares themselves were Rural or Urban.

23. There were few significant results between condition measures by plot type.
24. In X plots there were significantly higher competitor scores (p = 0.05) in squares surrounded by Urban squares, although there was no effect from whether squares themselves were Rural or Urban (Fig. 16.3b).
25. There was a significantly higher Grime ruderal score in roadside plots in squares surrounded by Urban squares but not in Urban squares (p = 0.01)(Fig 16.3b).
26. There was a slight non-significant trend towards a higher stress tolerator score in Rural squares for A plots and SW plots.

Figure 16.3a. Mean and S.E. of the Ellenberg moisture score between squares classified as RR, RU, UR and UU over all plot types in 1998.

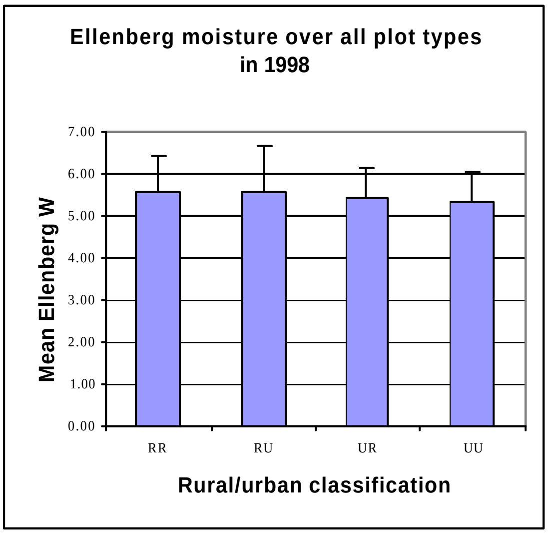
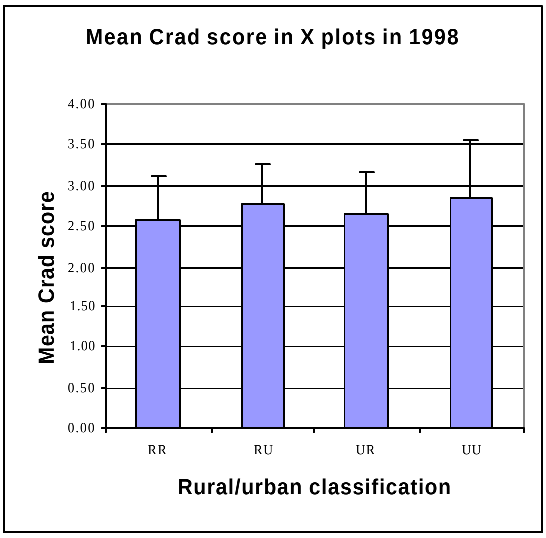
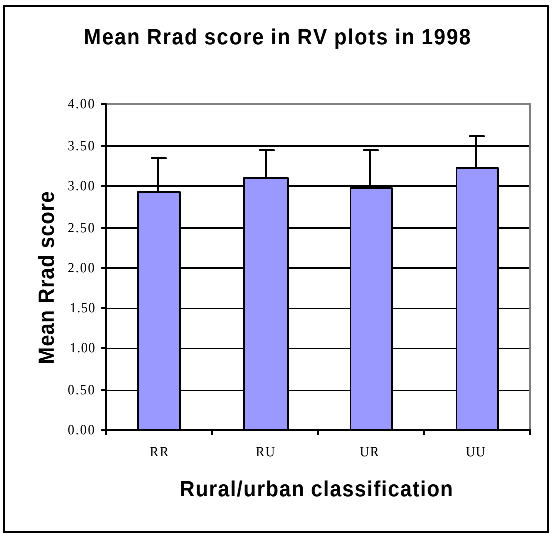


Figure 16.3b. i) Mean and S.E. of the Grime Competitor score for squares classified as RR, RU, UR and UU in X plots in 1998. ii.) Mean and S.E. of the Grime Ruderal score for squares classified as RR, RU, UR and UU in Roadside plots in 1998.

i)



ii)

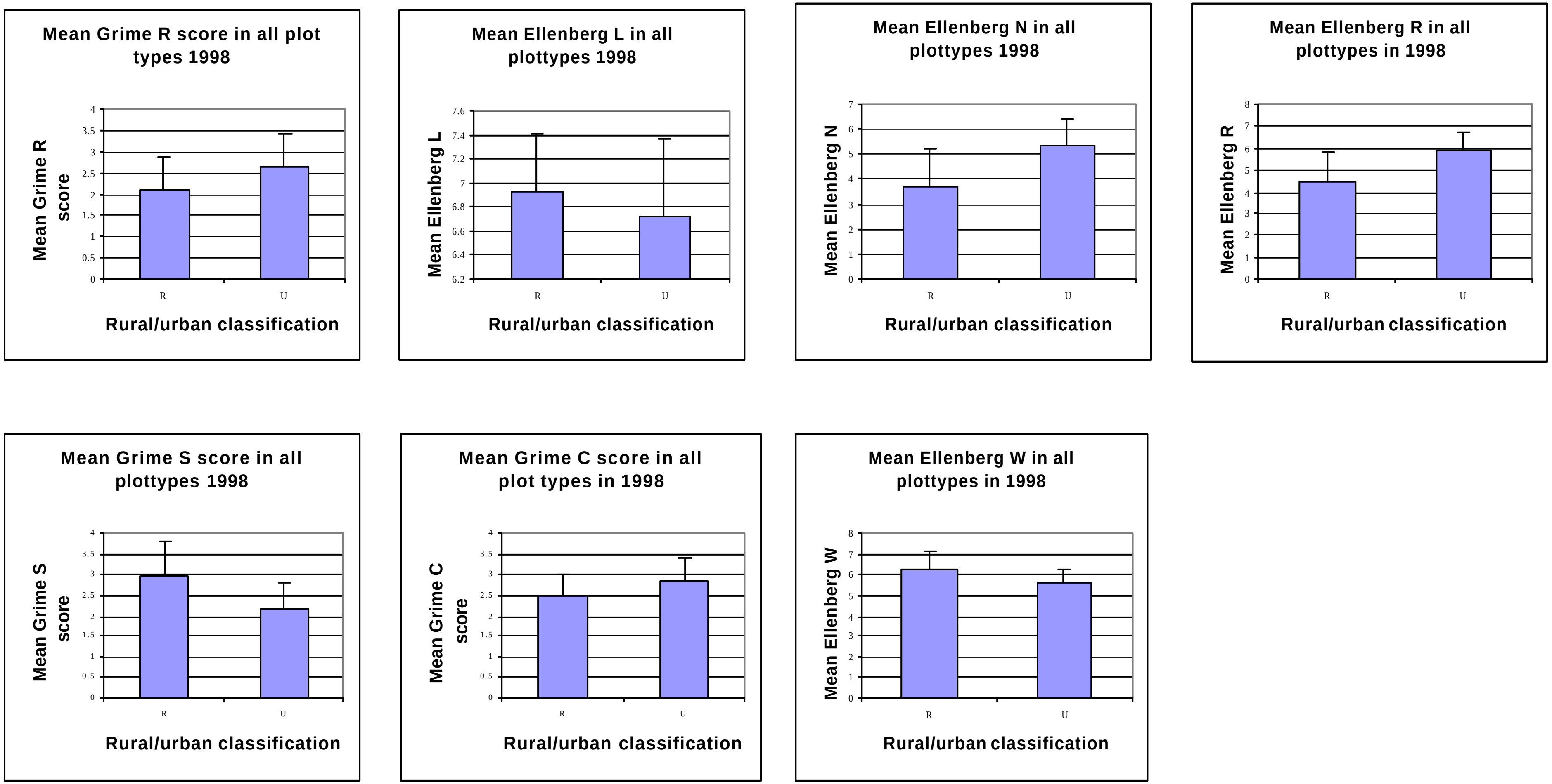


Scotland

27. There were more significant results for Scotland than there were for England and Wales in in 1998, both overall and by plot type.

- Rural squares had significantly lower Ellenberg pH, Nitrogen values and Grime competitor and ruderal scores than Urban squares ($p < 0.001$) (Fig 16.3c).
- Rural squares had significantly higher Ellenberg Light ($p < 0.05$), Moisture ($p < 0.001$) and Grime stress tolerator scores ($p < 0.001$) than Urban squares (Fig 16.3c).

Figure 16.3c. Mean and S.E. of the Ellenberg and Grime's scores for all plot types in Urban and Rural squares in Scotland in 1998.



28. Significant differences between Rural and Urban squares by plot type for Scotland are summarised below and in Table 16.3.

- There were significantly higher Ellenberg pH scores in Roadside, streamside, U, X and Y plots in Urban squares.
- There were significantly higher Ellenberg N scores in Roadside, streamside, U, X and Y plots in Urban squares.
- There were significantly lower Ellenberg moisture scores in Streamside, U, X and Y plots in Urban squares.
- There were significantly lower Ellenberg light scores in D plots only.
- There were significantly higher Grime competitor scores in streamsides, U and Y plots in Urban squares.
- There were significantly lower Grime stress tolerator scores in Roadside, streamside, U, X and Y plots in Urban squares.
- There were significantly higher Grime ruderal scores in streamsides, U and Y plots in Urban squares

Table 16.3 The mean values of condition measures in Rural and Urban squares in Scotland and the significance level for the difference between them.

Condition measure	Plot type	R	U	Significance
Eberg R	RV	4.91	5.73	*
	SW	3.78	5.46	***
	U	2.43	3.54	***
	X	3.39	5.21	***
	Y	3.44	4.92	***
EbergN	RV	5.51	6.21	*
	SW	4.62	5.95	***
	U	3.36	4.17	***
	X	4.13	5.74	***
	Y	4.30	5.76	***
EbergW	SW	6.55	6.15	*
	U	6.71	6.02	*
	X	6.31	5.49	***
	Y	6.42	5.76	***
EbergL	D	5.62	4.99	*
Crad	SW	2.53	3.13	***
	U	2.27	2.51	*
	Y	2.47	2.83	**
Srad	RV	2.37	1.91	**
	SW	2.98	2.06	***
	U	3.53	3.16	**
	X	3.11	2.18	***
	Y	3.11	2.44	***
Rrad	SW	2.13	2.58	***
	U	1.57	1.95	*
	X	2.06	3.19	***
	Y	2.03	2.53	**

1990-1998

England and Wales

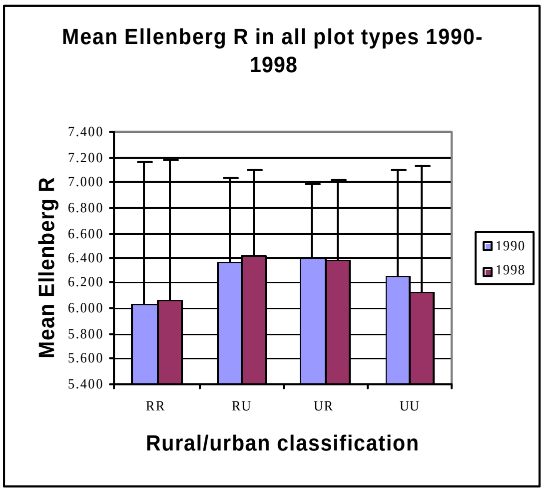
- There was a significant difference in the change in Ellenberg R (pH), Ellenberg N and Grime R score between Rural and Urban squares ($p = 0.02$, $p = 0.01$, $p = 0.01$ respectively). Plots within Urban squares decreased in fertility and pH between 1990 and 1998 whereas plots in Rural squares increased in fertility and pH. The number of ruderal plants (Grime R score) decreased in Rural and Urban squares but decreased slightly more in Rural squares (Fig. 16.3c).
- There was a significant difference in changes in Ellenberg L values ($p = 0.03$) between squares surrounded by Rural squares and squares surrounded by Urban squares. Rural squares surrounded by Urban squares had lower light levels than Rural-Rural squares (Fig. 16.3d).

29. The changes in condition measures between classes within plot types were marginally significant.

- Change in fertility levels was different in H plots between Rural and Urban squares ($p = 0.05$) with values higher for Rural squares than for Urban squares (Fig. 16.3e).
- Y plots showed greater changes in Ellenberg R (pH) in plots in Rural squares than those in Urban squares ($p = 0.03$) (Fig 16.3e).
- Y plots ($p = 0.03$) which showed greater decreases in ruderal species in Rural than in Urban squares (although both types of square showed decreases) (Fig. 16.3e).

Figure 16.3d. i) Mean and S.E. of the Ellenberg pH score for squares classified as RR, RU, UR and UU in all plot types from 1990-1998. ii) Mean and S.E of the Ellenberg Fertility score for squares classified as RR, RU, UR and UU in all plot types from 1990-1998.

i)



ii)

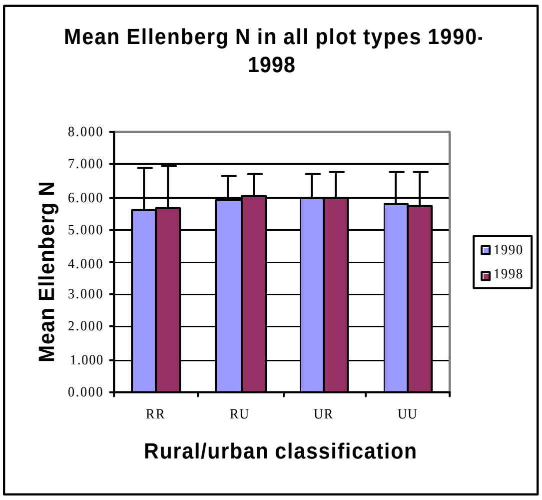
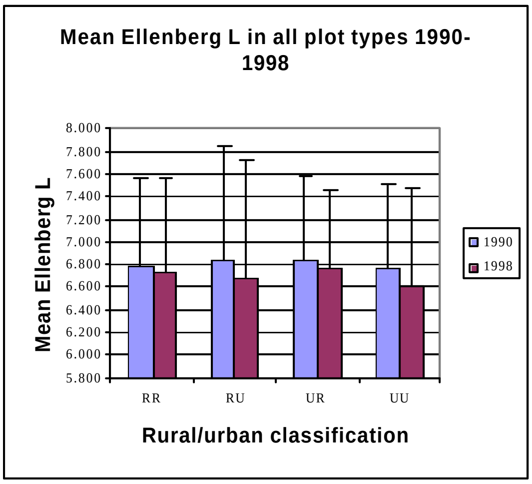


Figure 16.d iii.) Mean and S.E. of the Ellenberg Light score for squares classified as RR, RU, UR and UU in all plot types from 1990-1998. iv.) Mean and S.E. of the Grime Ruderal score for squares classified as RR, RU, UR and UU in all plot types from 1990-1998.

iii)



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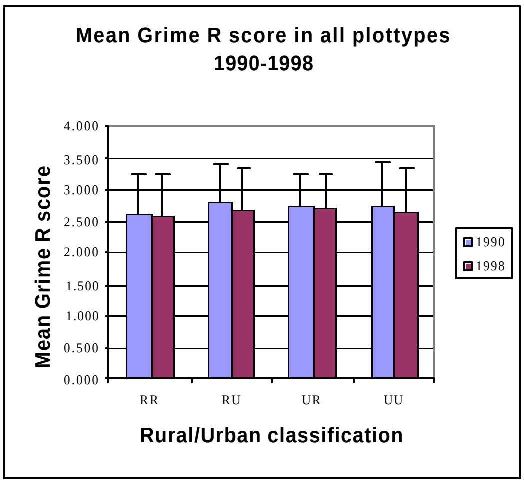
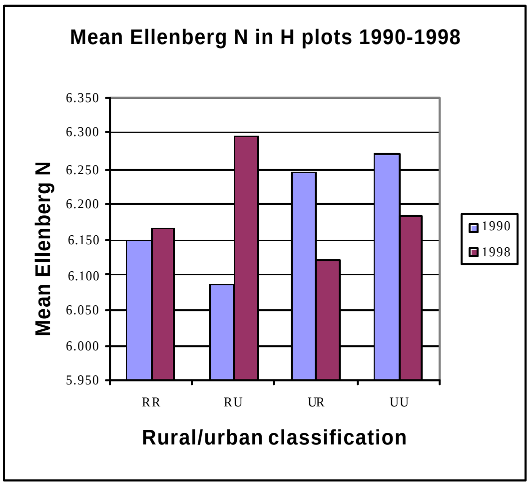
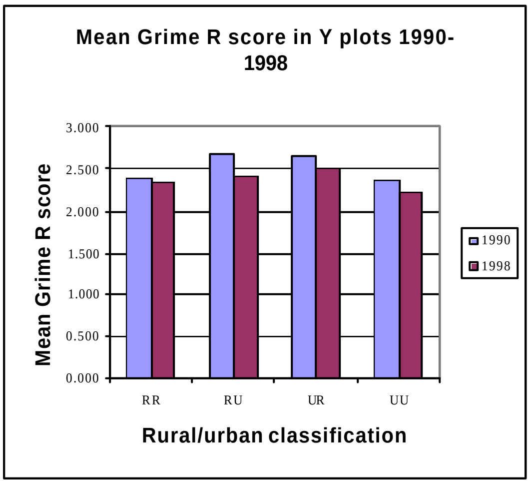


Figure 16.3e. i) Mean and S.E. of the Grime Ruderal score for squares classified as RR, RU, UR and UU in Y plots from 1990-1998. ii) Mean and S.E. of the Ellenberg Fertility score for squares classified as RR, RU, UR and UU in H plots from 1990-1998. iii) Mean and S.E. of the Ellenberg R (pH) score for squares classified as RR, RU, UR and UU in Y plots from 1990-1998.

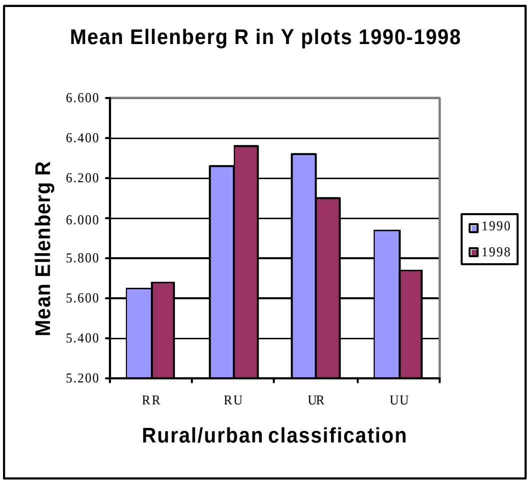
i)



ii)



iii)



Scotland

- There was a significant difference in the change in Ellenberg L (Light) and Grime Ruderal score between Rural and Urban squares ($p < 0.05$). Plots within Urban squares decreased in Light score between 1990 and 1998 whereas plots in Rural squares remained the same. The number of ruderal plants (Grime R score) decreased in Rural and Urban squares but decreased slightly more in Urban squares (Fig. 16.3f).

30. Changes in condition measures between classes within plot types were marginally significant.

- Changes in light scores were significantly different in X plots between Rural and Urban squares ($p < 0.05$) with values higher for Urban squares than for Rural squares (Fig.16.3g).

- There were greater decreases in stress tolerator species in Y plots in Rural than in Urban squares (although both types of square showed decreases) (Fig. 16.g).

Figure 16.3 f. i) Mean and S.E. of the Ellenberg Light score in all plot types 1990-1998. ii.) Mean and S.E. for Grime ruderal scores in all plot types I 1990-1998

i) ii)

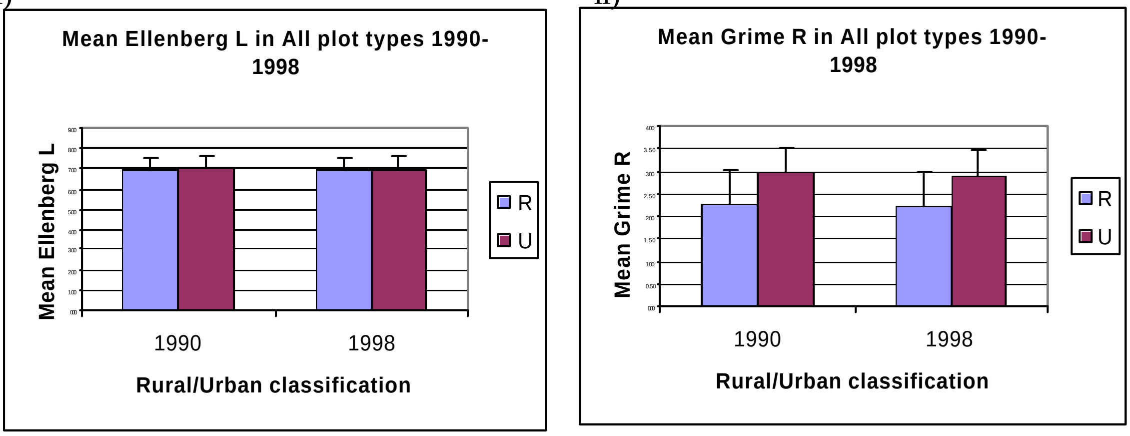
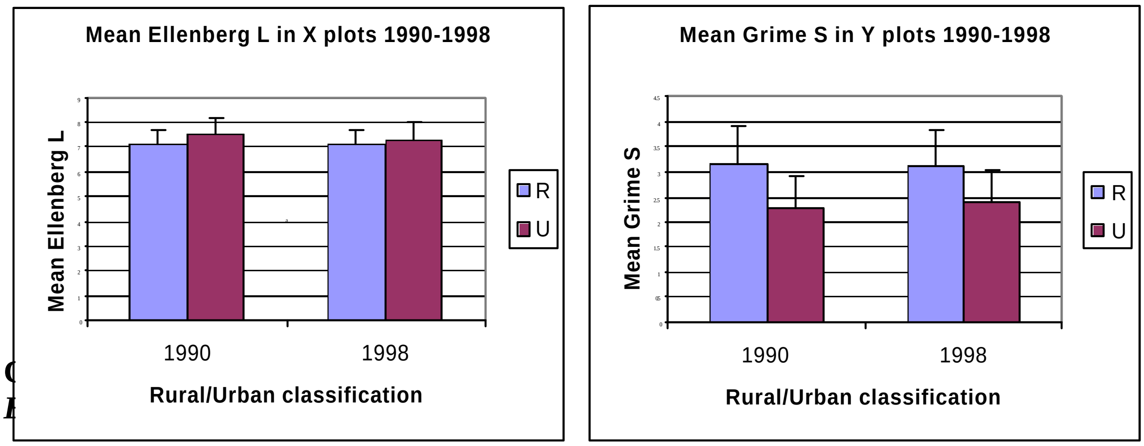


Figure 16.3 g. i) Mean and S.E. of the Ellenberg Light score in X plots 1990-1998. ii.) Mean Grime Stress tolerator score in Y plots 1990-1998.

i) ii)



31. It might be expected that urban areas would be characterised by high levels of disturbance and environmental modification (Gilbert 1989) and that species in urban areas would therefore be more tolerant of high fertility (Roy 1999) and higher light levels than their equivalents in rural areas. However, the results here suggest that the opposite is true and that urban areas are actually showing lower increases in fertility than rural areas. Eutrophication across the wider countryside was a very strong signal identified in CS2000 and it is perhaps surprising to find that the signal was higher in squares classified as Rural rather than Urban.

32. In 1998 species richness was slightly higher in Urban squares surrounded by urban land, this is not surprising as habitats in urban areas are generally more disturbed and so are prone to invasion by a variety of ruderal, opportunist species including non-natives. There is usually a greater availability of

propagules from increased transport links, seeds transported on cars, by river, and gardens. Studies in central Europe have shown that cities are more species rich than the surrounding countryside partly because habitat heterogeneity in urban areas is usually greater than the surrounding countryside (Pysek 1993). Recent work by Thompson *et al.* (2003) has shown that urban gardens provide habitats for a vast range of species both native and alien.

33. In terms of Grime's CSR strategies almost the full spectrum (highly stressed, competitive and ruderal habitats) may be present in a conurbation. The results showed that although the number of ruderal species in Rural and Urban squares had decreased between 1990 and 1998 they had decreased less in Urban squares i.e. Urban areas had more ruderal species. In 1998 there did not appear to be an effect of square type on species strategy, however, when the land surrounding a square was urban both competitor and ruderal scores were higher.

Scotland

34. Scotland showed different trends to those shown in England and Wales. This is to be expected for two main reasons; 1) Squares were classified differently in Scotland, with those containing just 10% of urban land either actually in the square or within a 4km radius of the square categorised as Urban and 2) The spatial pattern of urban areas in Scotland is very different to that within England. Although there are some large urban areas such as Glasgow in Scotland, there are also vast areas which are largely uninhabited, this contrasts with the gradient of urbanisation found in England.
35. The expectation that species in urban areas are more tolerant of high fertility (Roy 1999) and pH than their equivalents in rural areas appears to be fulfilled here. Ellenberg fertility scores were higher in Urban squares, suggesting either that the Urban squares are undergoing more eutrophication than in England and Wales or that the surrounding rural land does not have as high a fertility as England. There was no significant change in the fertility of grasslands in Scotland between 1990 and 1998.

36. Moisture scores were found to be lower in Urban squares. Despite no significant difference between Urban and Rural squares in Ellenberg light scores in 1998, there was an indication that light scores had decreased between 1990 and 1998 in Urban squares but remained unchanged in Rural squares. This suggests that there has been an increase in rankness in Urban squares. Changes were detected both across and within plot types with no apparent differentiation by plot type as significant effects were noted in most plot types.

37. Grime Competitor and Ruderal scores were higher in Urban squares and stress tolerator scores were higher in Rural squares despite a higher rate of decrease in Rural squares between 1990 and 1998. This is perhaps as would be expected as species which are more successful competitors are more likely to respond to the higher disturbance levels and opportunities for colonisation.

16.4 *Comparison of extent of spatial characteristics in different square types.*

Approach

England and Wales

38. In order to test the variation in the extent of spatial characteristics between the four classes a General Linear Model (SAS institute 1999-2001) was used. This test calculates an F statistic to determine whether there is a significant difference between classes. The model incorporated squares classified as Rural or Urban because of the content of the square and squares classified as Rural or Urban because of the character of the land surrounding the square. Due to the differences in sample size (Rural-Rural (RR) =336, Rural-Urban (RU) = 9, Urban-Rural (UR) =15, Urban-Urban (UU) =6) between the classes used a GLM was used as it is more resilient than comparative methods such as ANOVA. The spatial characteristics tested included 1) the extent of various linear features measured in km/km^2; hedges, remnant hedges, walls, fences, total boundary length, streams, all ditches (roadside and other), 2) the numbers of inland water bodies, 3) pattern measures in ha/ km^2; mean parcel size, minimum parcel size, maximum parcel size, 4) the Shannon Weiner diversity index for variation in size of parcels and 5) the number of parcels per square.
39. Tests were carried out on both the 1998 dataset as well as on the changes between 1990 and 1998.

Scotland

40. The same type of model as described above was used to look at differences in the same spatial characteristics of Rural (193) and Urban (10) squares in Scotland.

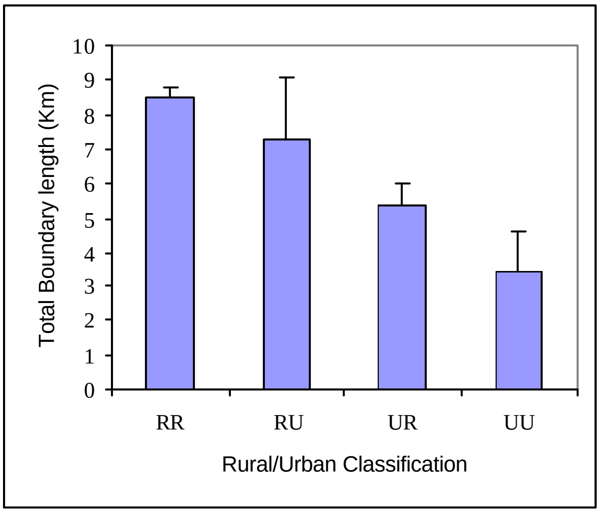
Results

1998

England and Wales

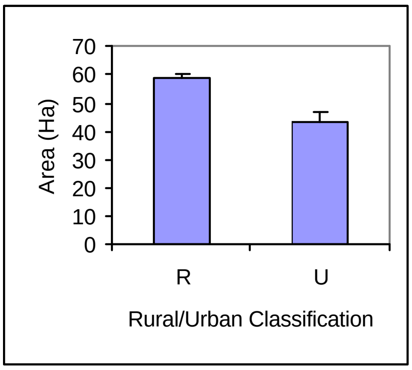
41. There was one significant result, which indicated that the total boundary length was lower in Urban squares than it was in Rural squares ($p = 0.003$) (Fig 16.4a).
42. Since boundaries are not surveyed in urban areas in Countryside Survey, this result is not very surprising.

Figure 16.4 a). The mean and S.E. of the extent of boundary features in different square types.



Scotland
There was a significant difference in the maximum patch size between square types with a greater maximum in Rural than in Urban squares (p = 0.02).

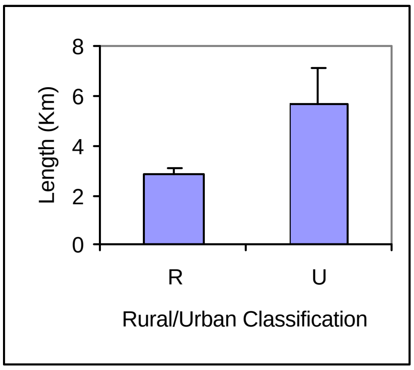
Fig 16.4 b) The mean and S.E. of Maximum patch size in Urban and Rural squares in Scotland.



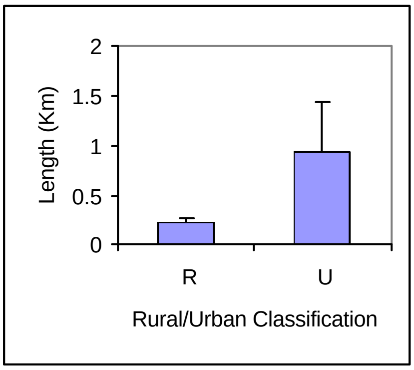
There were also significant differences between the lengths of boundary features in Rural and Urban squares with differences between hedge, fence and total boundary length all significant at p = 0.01 (Fig 16.4 c).

Fig. 16.4c) The mean and S.E. of i) Hedge length, ii) Fence length and iii) Total boundary length in Urban and Rural squares in Scotland.

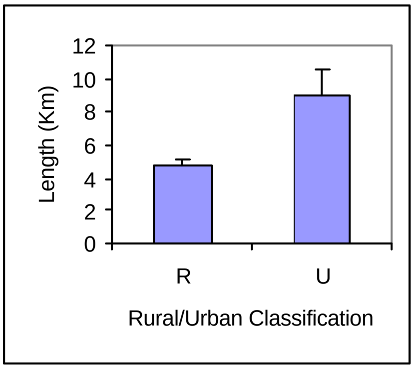
i)



ii)



iii)



1990-1998
England and Wales

43. There was also only one significant result from the analysis of changes in spatial characteristics between 1990 and 1998. This showed that the number of inland water bodies in squares surrounded by Rural areas decreased less than those in squares surrounded by Urban areas (p = 0.04) (Fig 16.4d).

Scotland

44. There was a marginally significant difference between Urban and Rural squares in terms of changes in the extent of streams between 1990 and 1998, with Urban squares showing more change than Rural (p = 0.02) (Fig 16.4e) . There were also significant differences in the extent of change in boundary features with higher levels of change in the lengths of hedges (p < 0.05) and fences (p = 0.01) as well as overall boundary length (p=0.001) in Urban squares (Fig 16.4e).

Figure 16.4 d). The mean and S.E. of the change in the numbers of inland water bodies (IWB's) in different square types.

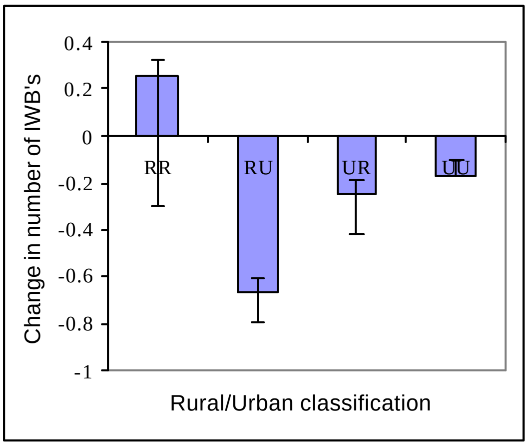
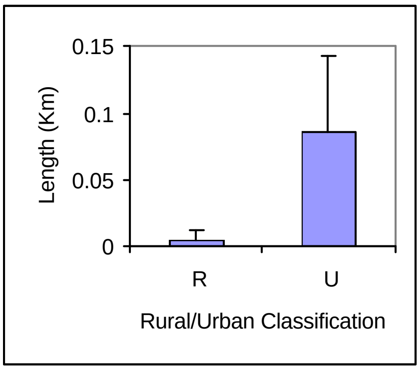
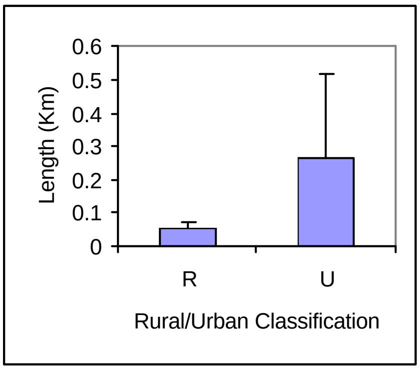


Fig 16.4 e) The mean and S.E. of the change in i) stream length, ii) hedge length, iii) fence length and iv) total boundary length in Urban and Rural squares in Scotland.

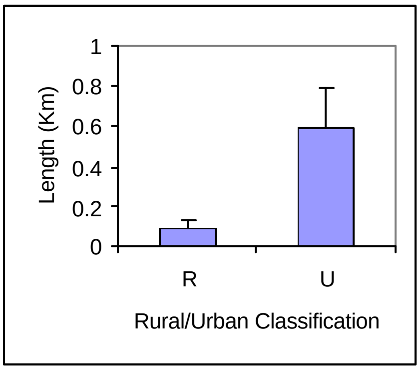
i)



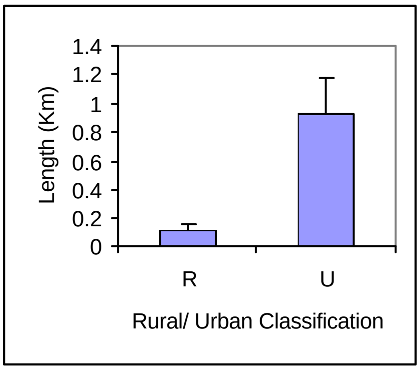
ii)



iii)



iv)



45. The differences between both extent and change in boundary features in Rural and Urban squares is complicated by a number of factors. The first, already referred to in relation to Fig. 16.4a), concerns the fact that once an area is defined as Urban by field surveyors boundary features within those areas are not recorded. For England and Wales this may well bias the figures to show greater extent of boundary features in Rural compared to Urban squares. However, for Scotland the situation is rather different (Figs. 16.4 c) and e)), not least as a result of the fact that squares are classified as Rural or Urban on the basis of a much smaller percentage of Urban coverage. In addition Urban squares within Scotland are predominantly based in lowland areas (8 in EZ 4 and 2 in EZ 5) where there are more likely to be boundary features, than in upland Rural squares. The contrast between landscape types is not as great within England.

16.5. *Additional information*

Approach

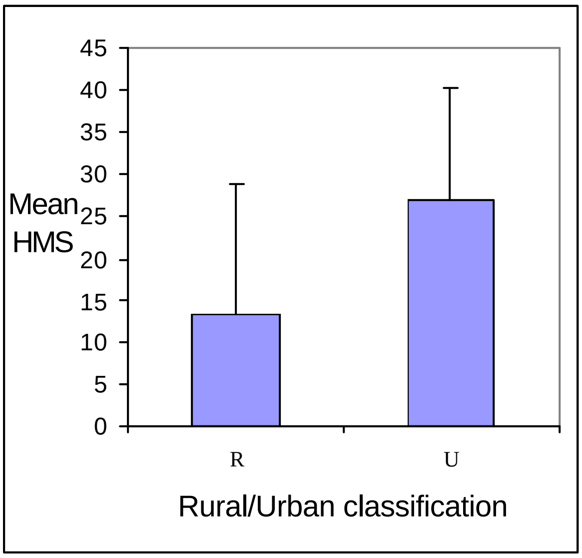
46. The classification was looked at in relation to the squares in which freshwater data was collected in 1998. A total of 172 squares in England and Wales were surveyed as part of the freshwater survey in 1998. Of these, the vast majority of squares were classified as Rural/Rural (164), 6 squares were classified as Urban/Rural and just 2 squares were classified as Rural/Urban. For Scotland a total of 136 were surveyed with 9 of these classified as Urban squares and the other 127 Rural. Analysis was carried out on both the HMS (Habitat modifications score) and HQA (Habitat quality assessment) scores and on measures of species diversity (Biological Monitoring Working Party scores) to see whether there was any difference between square types in terms of the

quality of the river habitat or the extent to which it has been modified. A General Linear Model (SAS institute 1999-2001), similar to that used to test differences in the extent and condition of Broad Habitats was used. This test calculates an F statistic to determine whether there is a significant difference between classes.

England and Wales

47. The results showed that HMS was significantly different between Urban and Rural squares, with Urban squares having a significantly higher HMS ($p = 0.03$) (Fig 16.5a)). There were no significant differences between Urban and Rural squares for Habitat Quality Assessment in England and Wales.

Figure 16.5a). Comparison between Mean and S.E. of Habitat Modification Scores (HMS) in Rural and Urban squares.

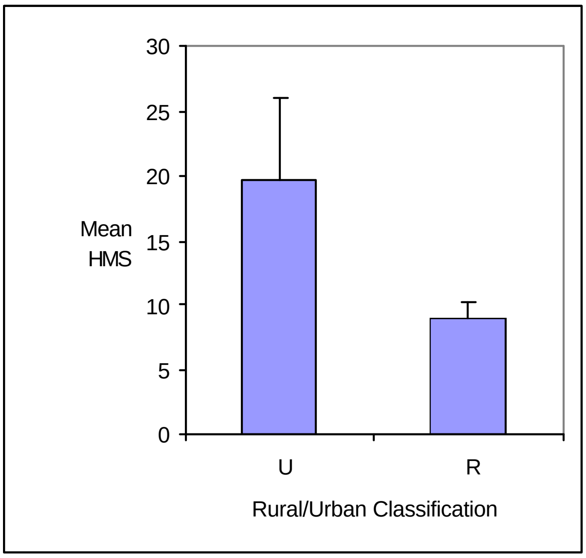


48. It was also hoped that it may be possible to look at bird data for the relevant squares. However, due to the way in which the bird data is recorded and the lack of simple indices with which to summarise bird data at the square level it has not been possible to carry out such an analysis. The bird squares in England and Wales are also predominantly Rural/Rural, with 10 of the 206 squares Rural/Urban, 3 Urban/Rural and 2 Urban/Urban.

Scotland

49. The results showed that HMS was significantly different between Urban and Rural squares, with Urban squares having a significantly higher HMS ($p = 0.03$) (Fig 16.5 b)).There were no significant differences between Urban and Rural squares for Habitat Quality Assessment in England and Wales.

Figure 16.5b). Comparison between Mean and S.E. of Habitat Modification Scores (HMS) in Rural and Urban squares.



50. Another aim of this question was to explore synergies between the CS database and other databases and to review the potential for exploitation of those databases to improve future surveys in urban areas. To this end, the use of the ODPM database has proved a very useful basis in terms of defining squares as Rural or Urban as well as defining the areas around survey squares on the same basis. The ODPM database is, like other similar spatial databases still in the process of development, but it is likely that it and other similar databases may be used alongside CS in the future. The current set of CS squares is very much a rural based set of squares which limits the use to which urban datasets can be exploited, although datasets such as LCM2000 that incorporate surveys of urban land (where CS does not) may in the future provide better opportunities alongside CS for comparison between the extent and ecological character of 'countryside' within and outside of urban areas.

SUMMARY STATEMENT

- CS squares in England, Wales and Scotland were classified into Urban and Rural on the basis of the amount of urban land found within them. For England and Wales if the amount of urban land within the square exceeded 33 ha they were classified as Urban squares and squares with less than 33ha of urban land were classified as Rural. For Scotland, the threshold level of urban land was just 10 ha in order for a square to be classified as Urban.
- A buffer of a 4km radius was produced for each CS square to indicate whether the surrounding area was urban or rural in character. For England and Wales, if land within that radius contained greater than 33% urban land then it was classified as Urban and if less than 33% it was classified as rural. For Scotland the threshold percentage was 10%.
- The vast majority of squares in England and Wales were classified as Rural in

a Rural setting with less than 20 Rural squares set in urban surrounding and less than 20 squares being either classified as Urban or as being within an Urban setting. Due to the low numbers of squares in Scotland that were classified as Urban or as being set within an Urban context,all squares were amalgamated into just two categories (Rural – less than 10 ha of urban land within the square itself, or less that 10% of the surrounding 4km radius urban land and Urban –with greater than 10 ha or 10%)

- There were very few differences in the extent (1998) or changes in the extent of Broad Habitats between Urban and Rural squares and their surroundings. For England and Wales only the amount of woodland differed between squares surrounded by Urban and Rural land, with those in Urban surroundings containing higher amounts of *Broadleaf, Mixed and Yew woodland*. For Scotland, the amount of Bog was lower in Urban squares and the amount of Neutral grass higher in Urban squares, possibly reflecting the fact that most Urban squares in Scotland are in EZ 4.
- Condition measures between square types did show some differences, particularly in Scotland. For England and Wales the differences in the 1998 data set tended to show that in general the condition of Broad Habitats in Rural squares was not greatly different from that of Urban squares whilst the change data showed that the eutrophication signal was in fact stronger in Rural than in Urban squares. For Scotland, Urban squares tended to be more fertile and contain more competitive and colonising species than Rural squares and the contrast between Rural and Urban squares was greater than in England and Wales.
- Measures of spatial characteristics in England and Wales showed very little difference between Urban and Rural squares with the exception of boundary features which are not recorded within urban areas of squares under current CS methodology. Apart from differences in maximum patch size (larger in Rural squares) and changes in the extent of stream length (greater in Urban) the majority of differences between spatial characteristics in Scottish squares were due to boundary features being more prevalent in Urban squares (again reflecting the EZ in which Urban squares were located)
- The extent to which river habitats have been modified was significantly higher for Urban squares than for Rural squares in both England, Wales and Scotland, as may be expected.
- England and Wales and Scotland are very different countries in terms of the way in which their populations are distributed across the landscape. This impacts on the way in which squares can be classified into Rural or Urban and on attempts to make comparisons between countries.
- Countryside Survey is, as entitled, a survey of the countryside. The fact that the vast majority of squares fall within the Rural/Rural classification confirms this. Whilst it is possible to carry out appropriate tests on the effects of class types on various measures, the inequality of distribution of squares between the different class types means that we have very small sample sizes in Urban categories.

Further work and recommended changes to methodology

51. These depend largely on the extent to which CS is likely to be used as a measure of urban environments. It is possible to modify certain aspects of the survey and place a different emphasis on the importance of urban areas, but at what point does that change the fact that it is, after all, a Countryside Survey.

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