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Countryside Survey 2000 Module 4

Increasing upland representation in Countryside Survey 2000

FINAL REPORT

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Executive Summary

Countryside Survey 2000 has generated estimates of the extent of Broad Habitats in the UK and at country level. The sampling units used in Countryside Survey 2000 (CS2000) are 1 km squares and the sample is stratified according to the ITE Land Classification. For reasons associated with policy requirements, particularly in Scotland, the land classification was developed for CS2000 so that there were separate classes in Scotland and in England with Wales. A result of this rearrangement of the sampling strategy was that those land classes which occurred within the uplands of England and Wales (Environmental Zone 3) were not particularly well sampled (54 squares at a sampling rate of 1: 283). Both to ensure adequate representation of each of the ITE Land Classes in Environmental Zone 3 (EZ3), and to improve the sampling rate in the uplands in particular, 38 new squares were added to those squares already sampled in CS1990, to form the sample for CS2000. Of these 'new' squares, 20 were funded by MAFF. Although it is not possible to tease out the effects of just the extra 20 squares, this report does address two key questions relating to the 38 new squares in EZ3:

1. by how much is the statistical robustness of estimates of Broad Habitats improved buy the addition of 38 new squares?
2. is the new sample of squares different from the old sample, in terms of Broad Habitat composition?,

Statistical robustness

The area of Broad Habitat in Environmental Zone in 1998 (the survey year for CS2000) was estimated using (a) CS1990 sample squares only (b) CS1990 squares plus the 'new' squares. The statistical error rates, as represented by the Coefficients of Variation of the estimate, were all reduced, most by at least 20%. Six of the Broad Habitats, representing about 64% of the area of EZ3, had CVs of less than 20% (as opposed to just two when the CS1990 sample was used alone).

Representativeness of the 'new' squares

A number of statistical tests were performed to compare the Broad Habitat characteristics of different samples of squares. The most appropriate test (Kolmogorov-Smirnov Test comparing the 54 old squares with the 38 new squares) showed no statistically significant differences between the two populations of squares. The least similar category, as judged from other tests, was Bog.

In summary, the 38 additional sample squares have improved the statistical robustness of the estimates of Broad Habitats in Environmental Zone 3 (by at least 20%) and, in terms of average Broad Habitat composition, have been shown to be no different from other squares in the zone.

INCREASING THE REPRESENTATION OF THE ENGLISH AND WELSH UPLANDS IN COUNTRYSIDE SURVEY 2000

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1. Background

1.1 Sampling strategy for the Countryside Surveys

The Countryside Surveys (CS1990 and CS2000), and their predecessor surveys (in 1978 and 1984), are sample-based field surveys of a wide range of rural features including land cover, habitats, landscape features and vegetation. The sampling units used in the surveys are 1 km squares and the sample is stratified according to the ITE Land Classification (Bunce et al. 1996). Up to and including CS1990, the classification comprised 32 different land types, determined by combinations of underlying environmental characteristics such as climate, geology and topography. The classification was applied to the whole of Great Britain and every one of the c. 240,000 1 km squares was allocated to one of the 32 classes. Thus, a land class might be characterised by a particular combination of environmental variables such that its geographical location straddled a country boundary.

Countryside Survey 1990 (CS1990) produced national estimates of the extent of, and change in, land cover types in GB. Many of the reported land cover categories were useful for policy purposes but some were comparatively rare and the estimates of their extent carried large statistical errors. Results were given for GB, for countries within GB, and for four 'landscape types' (aggregations of the 32 land classes) (Barr et al 1993) (Bunce and Howard, 1992). Country-based results were calculated using summations of individual land class means, weighted by their occurrence in individual countries. Thus, for example, estimates of the extent of any land cover category in Wales would be partially based on land class means which included samples in England.

1.2 Developments within CS2000

After publication of the CS1990 results, an assessment of the policy use of the results was carried out by DETR (Haines-Young and Swanwick, 1998). Among other conclusions, it was clear that some users required the sampling framework to be divided at country borders - this was particularly true for Scotland where concern was expressed about the use of 'English data' in deriving estimates for Scotland (Howard et al, 1998). Thus, in preparation for CS2000, the ITE Land Classification was re-developed so that land classes which crossed the England/Scotland border were sub-divided into two country-based classes. Where the resulting sub-divisions were too small to be practicable, they were combined with neighbouring land classes which had similar environmental affinities. The new classification resulted in a total of 40 classes, of which 16 were in Scotland (Barr et al, 1998).

In CS2000, the major reporting famework for land cover is by Broad Habitat, as given in the UK Biodiversity Action Plan (Ref). This contrasts to the 58 land cover categories that were reported in CS1990 (Barr et al 1993). During the planning of CS2000, it was estimated that this switch to fewer, broader categories would result in smaller statistical error terms; this improvement in accuracy would be partially offset

by the requirement to produce national estimates from only those squares that occur within the country concerned.

1.3 The need to increase the sample size in the uplands of England and Wales

The uplands and marginal uplands of England and Wales (as defined by ITE land classes) comprise some 2.6 million hectares, or just 17% of the two countries. As the need to produce sample estimates from country-based samples was identified (see above), so there was a consequent need to re-structure the aggregated land class system that had given rise to the four Landscape Types (since these comprised land classes and therefore also crossed national boundaries). The new Environmental Zones (Figure 1) gave three aggregations in England and Wales of which one, Environmental Zone 3 (EZ3), encompassed those sample squares that had previously been in both the Marginal Upland, and True Upland Landscape Types in England and Wales.

In 1990 a total of 54 1km sample squares were located in these upland areas (31 in England and 23 in Wales) representing an overall sampling rates of just under 1:500. Because of the small size of the sample in the new EZ3, and the heterogeneous mix of land cover, the sampling errors associated with estimates of Broad Habitats and other features were expected to be relatively high. Many of these Broad Habitat estimates were likely to be useful to MAFF in relation to policy development in the uplands and so the need to build confidence in the results by increasing the sample size was identified. From work carried out in the planning and preparation phase of CS2000, it was estimated that about 40 new squares in the uplands of England and Wales would go a long way to redressing the situation. In the event, MAFF contributed funding for 20 of these and the Welsh Executive and the Countryside Council for Wales provided funding for another 5 squares. A further 13 new squares in EZ3 were jointly funded by NERC and DETR (as part of a more general strategy of increasing representation in all Environmental Zones) bringing the total of new squares in EZ3 up to 38.

2 Project objectives

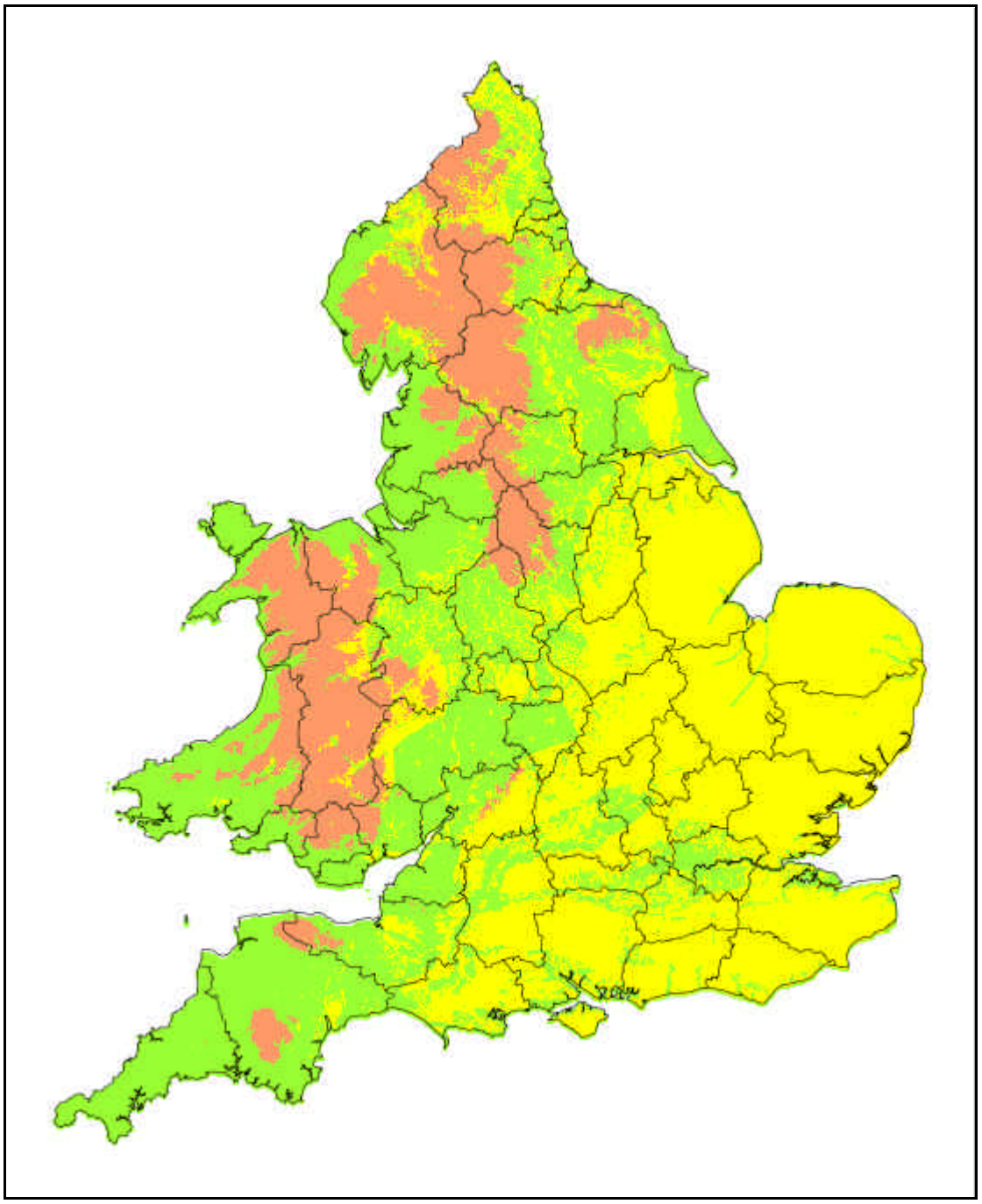
Overall objective: to ensure that CS2000 provides reliable information about upland Broad Habitats and landscape features in England and Wales and to establish a baseline for independent estimates of the stock of these features for England and Wales and, as part of this, to provide information about the ecological characteristics of the uplands as a whole in order to provide a context for site, habitat or scheme specific monitoring exercises and, specifically:

3 Methods

3.1 Adding additional squares

The principles of stratified sampling that have been used in the Countryside Surveys have developed over the lifetime of the surveys. At the outset, in 1978, an even number of sample squares (eight) was drawn at random from each of the 32 ITE Land Classes (giving an initial sample of 256 squares in GB). This random approach was restricted in that the squares were drawn from a grid of 1 km squares with intersections at 15 km. The same principle was adhered to in 1984 when a further four

Figure 1. Distribution of Environmental Zones in England and Wales, showing Environmental Zone 3 (uplands) in orange/brown



Key: Easterly lowlands - Westerly lowlands - Uplands

squares was drawn from each class (giving 384 squares in total). In CS1990, however, statistical analysis of the earlier surveys suggested that any additional squares should be allocated in proportion to the size (areal extent) of each class. Thus, the CS1990 sample of 508 squares was not evenly distributed throughout the classes.

In CS2000, as stated above, the allocation of additional squares in the uplands of England and Wales was made possible by funding from MAFF (20 squares) and other funders (18 squares). In allocating all of the 38 new squares, the aim was to create a more or less uniform sampling rate (sample squares per area) across all classes, once a minimum sample size (6 squares) had been achieved.

(**Note**: It is not possible to say which individual squares was funded by MAFF, nor to separate out the consequences of introducing an additional 20 squares. This report can only comment on the effects of introducing 38 new squares, of which 20 were funded by MAFF.)

The result of the allocation procedure is shown in Table 1.

Table 1 Allocation of new squares to ITE land Classes in EZ3

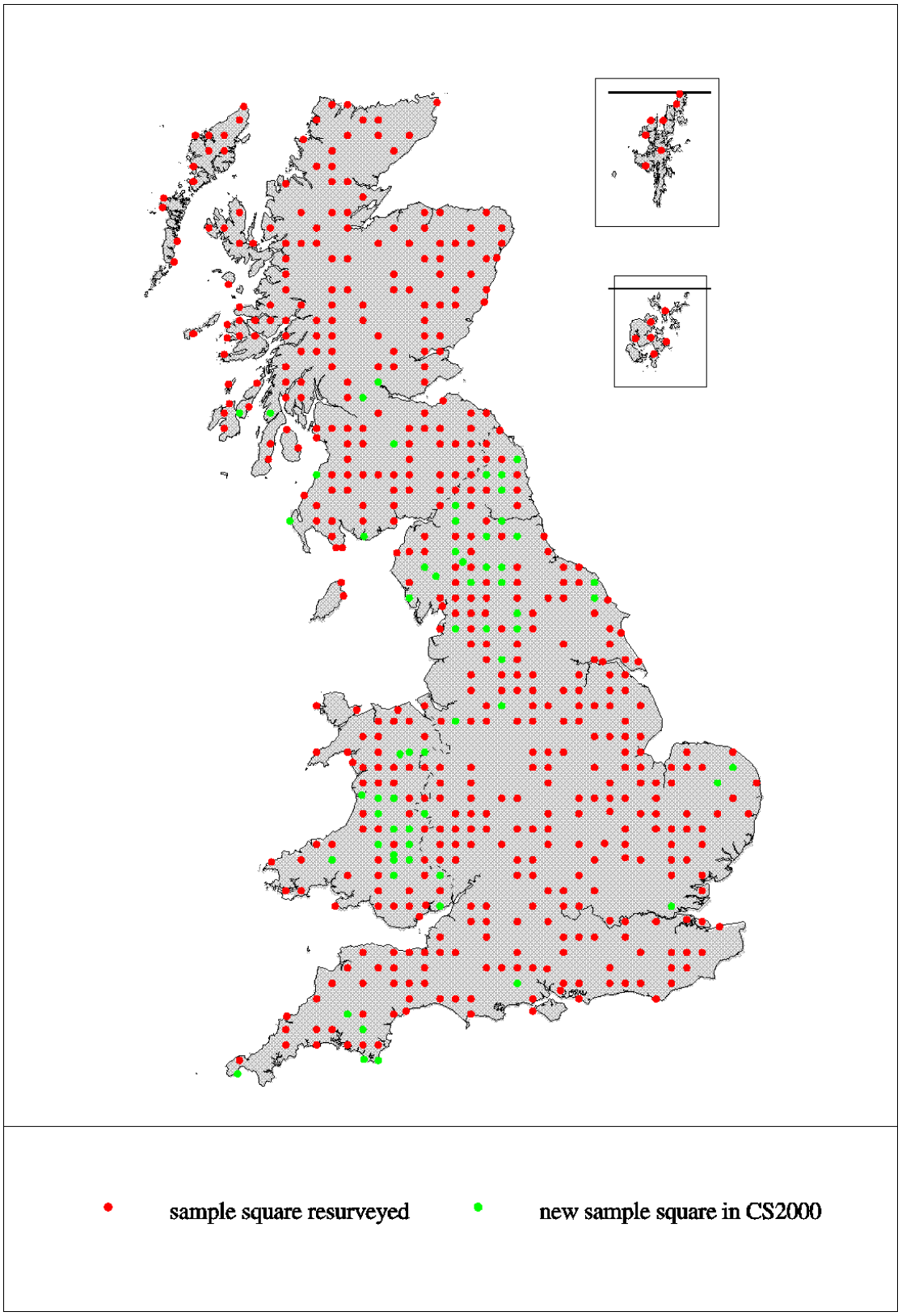
Land Class	**Area (km^2)**	**No. squares from CS1990 sample**	**No. new squares in 1998**	**No. squares in CS2000 sample**	**Sampling rate (1 : x km^2)**
17e	3,934	9	4	13	303
17w1	1,941	3	3	6	324
17w2	4,978	6	11	17	293
17w3	2,082	8	0	8	260
18e	3,009	8	4	12	251
19e	5,677	9	10	19	299
22e	3,308	6	5	11	276
23e	1,082	5	1	6	180
Total	**26,011**	**54**	**38**	**92**	**283**

Having determined the number required for each class, additional sample squares were then drawn at random from each of the eight ITE Land Class in EZ3. Figure 2 shows the approximate locations of all CS2000 squares, with 'new' squares differentiated. For reasons stated above, it is not possible to identify which squares were part of the increased EZ3 sample, and which were part of the general procedure for ensuring adequate representation in all land classes.

3.2 Field survey

The field survey of the additional squares was carried out as an integral part of the survey of all 569 squares. The approach is described in (Ref).

Figure 2 - Map of the CS2000 sample squares in England with Wales, and in Scotland



4 Results

4.1 Estimates of Broad Habitats in Environmental Zone 3

The estimates of Broad Habitats and their Standard Errors are shown in Table 2. and the differences between the estimates are shown in Figure 3.

4.2 Effects of additional squares on sampling error terms

The primary purpose of the increased sample was in order to reduce the size of the Standard Errors associated with the estimates of the extent of Broad Habitats. As can be seen from Table 2, most of the error terms were reduced by at least 20%. To put this another way, using the 1990 sample, only 2 of the Broad Habitats would have been estimated with a Coefficient of Variation (the SE as a percent of the estimate) of 20% or less (the target set by the CS2000 Advisory Group), whereas with the increased sample, 6 came into this category (the additional categories being the important upland habitats, Acid grass, Dwarf shrub heath, Bracken and Broadleaved woodland).

The results given in Table 2 show that there has been a worthwhile improvement in the estimates of Broad Habitats in EZ3 as a result of the increased number of sample funded by MAFF, WA and CCW.

4.3 'Representativeness' of additional squares of Environmental Zone 3

The sampling rate of CS2000 is relatively low (1:283 in EZ3) and so it was important to establish that the relatively few new squares were reasonably representative of the sample as a whole. A number of tests were carried out:

a) t-test – '1990 sample' versus '2000 sample'
To compare the situation that would have existed had there been no additional squares, versus the situation with the additional squares, a standard t-test was carried out on land cover estimates generated by the '1990 sample' (ie the 54 squares used in CS1990) versus those from the '2000 sample' (ie CS1990 sample plus the 'new squares', giving 92 squares).

b) t-test – '1990 sample' versus '2000 sample'
To compare the situation that would have existed had there been no additional squares, versus the situation with the additional squares, a standard t-test was carried out on land cover estimates generated by the '1990 sample' (ie the 54 squares used in CS1990) versus those from the '2000 sample' (ie CS1990 sample plus the 'new squares', giving 92 squares).

c) t-test – '1990 sample' versus 'new squares only'
Although (a) tests the data sets used in producing estimates of Broad Habitats for EZ3, these data are not independent in that they 'share' 54 squares from the CS1990 sample. A more rigorous test was carried out to test the two independent samples, the 54 1990 sample squares and the 38 new squares.

d) non-parametric test – '1990 sample' versus '2000 sample'
There is an argument that the t-test is not appropriate for testing the difference between these samples because the estimates are not normally distributed (ie do not show a normal, or Gaussian, bell-shaped curve). In this circumstance, it is suggested

Figure 3 Estimates of Broad Habitats in EZ3 calculated from (a) '1990 squares' only and (b) '1990 squares' + 'new squares'.

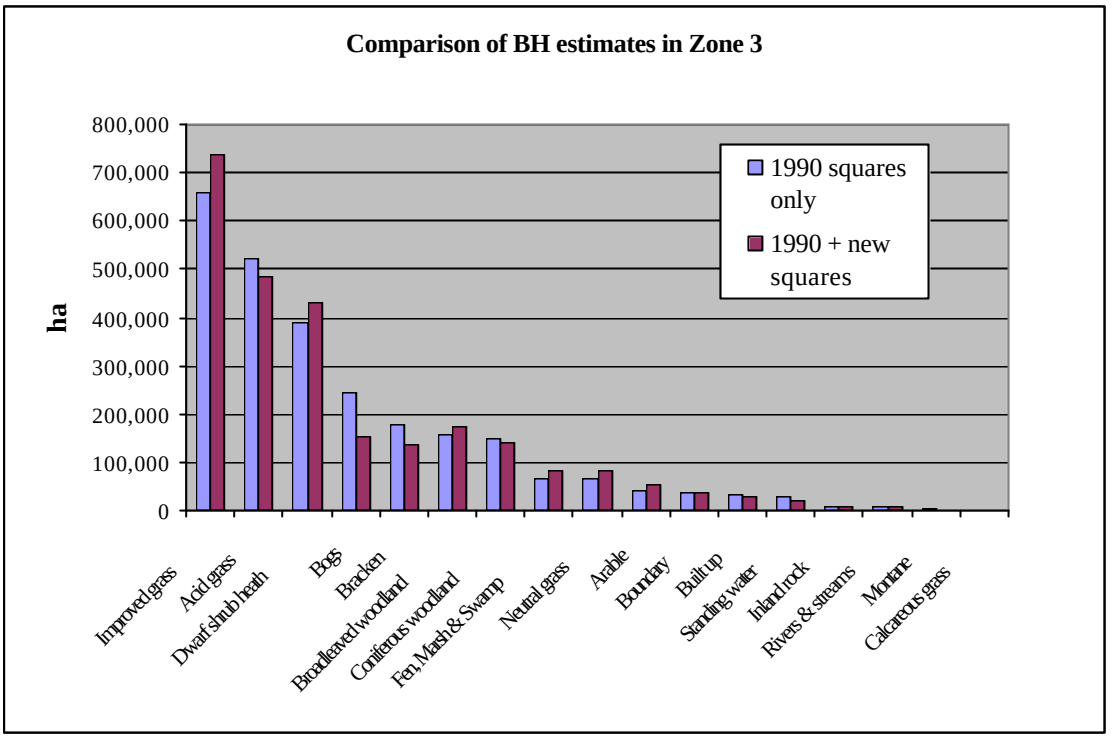


Table 2. Comparison of the estimates of the area ('000 ha) and Standard Error ('000 ha) of each Broad Habitat in EZ3, based on CS1990 and CS2000 samples. The Broad Habitats are ranked according to their extent

	Estimates using 1990 sample			Estimates using 2000 sample			% reduction
Broad Habitat	**Area**	**SE**	**CV**	**Area**	**SE**	**CV**	**in CV**
Improved grass	659	113	17.2	739	81	11.0	36.2
Acid grass	524	109	20.8	486	63	13.0	37.7
Dwarf shrub heath	388	105	27.0	431	75	17.3	35.8
Bogs	244	87	35.8	154	41	26.7	25.5
Bracken	180	43	24.1	137	25	18.4	23.5
Broadl'd woodland	156	35	22.2	174	30	17.5	21.2
Coniferous woodland	149	56	37.9	141	47	33.0	13.1
Fen, Marsh & Swamp	66	15	22.9	82	18	21.7	5.3
Neutral grass	65	16	24.6	85	19	22.1	10.2
Arable	43	18	41.3	53	18	32.9	20.5
Boundary	36	6	17.4	39	5	14.1	18.6
Built up	33	11	32.5	28	6	22.2	31.6
Standing water	27	20	72.7	23	13	59.3	18.4
Inland rock	10	5	45.1	7	2	34.6	23.2
Rivers & streams	7	3	39.4	7	2	33.6	14.7
Montane	3	1	53.5	2	1	42.1	21.3
Calcareous grass	+	+	100.0	+	+	70.9	29.1

in classic statistical texts (eg Steel & Torrie, 1980) that non-parametric test may be more appropriate. In this case, we used the Kolmogorov-Smirnov Test, which is not

only sensitive to differences in the location of distributions (eg differences in means) but is also greatly affected by differences in their distribution shapes.

e) non-parametric test – '1990 sample' versus 'new squares only'
For the reasons cited above, the non –parametric test was also carried out on the comparison between the 1990 sample and the new squares only.

The results of the tests are given in Table 3. It is clear that in only one case is a significant difference found: this is for *Bog* when a t-test (which is arguably not an appropriate test anyway) is performed.

It may be concluded that overall, there is no significant difference in the Broad Habitat characteristics between the new squares and the old ones.

Conclusions and Relevance to Policy

The 38 additional sample squares have been shown to have no significant differences in the land cover characteristics from the earlier sample of 54 squares, suggesting that the random, stratified Countryside Survey samples continue to provide an unbiased and representative sample of the major geographical regions of Britain.

The addition of the new sample squares into CS2000 has allowed estimates of the land cover (Broad Habitats) characteristics of the uplands of England and Wales (EZ3) to be made with more confidence. Although there is no absolute rule about what constitutes an acceptable statistical error, the fact that the additional samples allow six Broad Habitats to be measured with Coefficients of Variation of 20% or less, and that these six habitats comprise 64% of the area of EZ3, means that the results from CS2000 can be used as a basis for underpinning rural policy in the uplands with more authority than previously.

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Table 3 Significance tests between different sample sizes.

	t-test results*		non-parametric test results*	
Broad Habitat	**1990 vs 2000**	**1990 vs new**	**1990 vs 2000**	**1990 vs new**
Improved grass	0.810	0.640	p > 0.10	p > .10
Acid grass	0.972	0.945	p > .10	p > .10
Dwarf shrub heath	0.781	0.589	p > .10	p > .10
Bogs	0.309	**0.027**	p > .10	p > .10
Bracken	0.518	0.182	p > .10	p > .10
Broadleaved woodland	0.739	0.544	p > .10	p > .10
Coniferous woodland	0.935	0.874	p > .10	p > .10
Fen, Marsh & Swamp	0.566	0.294	p > .10	p > .10
Neutral grass	0.537	0.281	p > .10	p > .10
Arable	0.918	0.841	p > .10	p > .10
Boundary	0.726	0.530	p > .10	p > .10
Built up	0.687	0.397	p > .10	p > .10
Standing water	0.734	0.460	p > .10	p > .10
Inland rock	0.981	0.964	p > .10	p > .10
Rivers & streams	0.825	0.693	p > .10	p > .10
Montane	0.699	0.416	p > .10	p > .10
Calcareous grass	0.993	0.986	p > .10	p > .10

* – for the two samples to be significantly different, the p value must be less than 0.01 (at the 1% level)