DEVELOPING HABITAT ACCOUNTS: AN APPLICATION OF THE UK COUNTRYSIDE SURVEYS

Dr Andrew Stott[1]

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[1] Department for Environment Food and Rural Affairs (DEFRA), Temple Quay House, Temple Quay, Bristol, BS1 6EB, United Kingdom.

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Dr Andrew Stott
Department for Environment Food and Rural Affairs (DEFRA)
Temple Quay House, Temple Quay, Bristol, BS1 6EB
United Kingdom

ABSTRACT

A prerequisite for sustainable development is sound information on the status and trends in environmental, social and economic capital. In the UK, as elsewhere, the amount of different types of habitats, the condition of these habitats, and the losses and gains of habitats form key objectives for biodiversity policy. Pilot habitat accounts have been produced using the results of the national Countryside Survey. The accounts take the form of a simple balance sheet presenting the opening stock of habitats, the major transfers of land between habitats, the closing stock and net change. Supplementary accounts provide information on the changing quality or condition of habitats. The accounting framework can offer a useful device for analysing and presenting the complex changes in farmland habitats. Unlike individual indicators, the accounts can offer a more integrated, cross-sectoral and transparent view of environmental capital.

POLICY CONTEXT

A prerequisite for sustainable development is sound information on the status and trends in environmental, social and economic capital (DETR, 1999). Such information can be used as a basis for setting objectives, measuring progress and shaping appropriate policy responses. Assessing land as an environmental resource poses particular problems. Most countries are faced with finite and fixed land resources. These land resources serve multiple functions. Traditionally viewed as a source of primary production, land has become valued in many different ways, for its aesthetics, its opportunities for leisure and recreation and as a habitat for wildlife. Land varies in quality in respect to all these functions but the monetary value of land is determined primarily by the opportunities it offers for agriculture or development. The market price does not normally measure the important non-market benefits of land (Bartelmus, 1998). As an alternative, we can look at the services that the land provides and measure these services in terms of biophysical parameters rather than monetary units.

In the UK as elsewhere, wildlife habitats form a major focus of nature conservation policies. Such policies take three broad approaches: i) the identification and protection of special habitats in designated sites; ii) the preparation and implementation of action plans for a select list of priority habitats within the UK Biodiversity Action Plan; and, iii) incentives and advice on management of habitats and controls on development in the wider countryside. The amount of different types of habitats, the condition of these habitats, and the losses and gains of habitats form key objectives for biodiversity policy (DETR, 2000; UKBG, 2001). Thus for example, for protected sites there is a target to achieve favourable condition on 95% of Sites of Special Scientific Interest in England by 2010 and for lowland chalk grassland there is a target to restore 1000 ha in the UK by 2010. The amount, condition and trends in habitats are one way of valuing land. Assessment of habitats is essential for appraisal of nature conservation policy. In the UK over 70% land, including many semi natural habitats, is in agricultural use. So any assessment of habitats must also, in large part, be an assessment of agricultural land.

The national indicators of sustainable development and sustainable agriculture include a number of indicators of the extent and condition of habitats (see Table 1). However, these indicators are necessarily selective in terms of the habitats and species considered and can only be regarded as a partial assessment of biodiversity. They also integrate a large number of driving forces and pressures that may be causing change. Thus, it is not straightforward to isolate the key underlying causes and thus determine the most

appropriate policy response. Many of the UK national indicators can be compared directly with the OECD habitat indicators and others relate to the same issues of concern.

Table 1 Summary of habitat indicators used in national indicator sets in the UK and comparison with OECD Environmental Indicators for Agriculture

UK indicator description	Reference [1,2]	OECD comparison [3]
Populations of wild birds/farmland birds	QOLC H13, TSA 35	Intensively farmed Species diversity
Trends in plant diversity	QOLC S3, TSA 34	Intensively farmed Species diversity
Delivery of UK Biodiversity Action Plan targets	QOLC S4	
Characteristic features of farmland (hedges)	QOLC S5, TSA 32	Landscape structure
Area of cereal field margins under environmental management	TSA 33	Intensively farmed
Area of semi-natural grasslands	TSA 34	Semi-natural
Area of woodland	QOLC S10	Uncultivated
Area of ancient semi-natural woodland	QOLC S11	Uncultivated
Biodiversity in coastal/marine areas	QOLC R3	
Extent and condition of Sites of Special Scientific Interest	QOLC S6	Semi-natural
Area of agricultural land in conservation schemes	QOLC D13, TSA 31	Landscape management
Area converted to organic production	QOLC D14	Intensively farmed
Area of agricultural land	TSA 28	Semi-natural
Net loss of soils to development	QOLC S1, TSA 29	Uncultivated
New homes built on previously developed land	QOLC H14	Uncultivated

Sources:

1. *QOLC Quality of Life Counts, DETR (1999)*
2. *TSA Towards Sustainable Agriculture, MAFF (2000)*
3. *OECD (2001)*

ACCOUNTING FRAMEWORK

A principal criterion of sustainable development is that economic growth should avoid compromising the stock of environmental or social capital. The conventional way of assessing a country's wealth is through monetary accounts providing a calculation of Gross Domestic Product (GDP). Environmental accounts attempt to provide a similar balance sheet of environmental assets, showing the stocks and flows over the accounting period. The accounts provide a means of assessing whether environmental capital has gone up or down. Land use and land cover accounts have been proposed as supplementary to national environmental accounts where the units of accounting are hectares of land. In the framework developed by the UNECE Task Force, economic activity, land use, land cover and measures of habitat condition are inter-related via a series of transition matrices (Radermacher, 1998). Thus, in principle, the framework provides a system for linking economic drivers to impacts on biodiversity. However, in practice there are few examples of sufficiently integrated data collection to enable the construction of such accounts, especially at a national level. Case studies illustrating parts of this accounting framework have been produced by the UK, Germany and France (Conference of European Statisticians, 1995).

In the UK, pilot land cover or habitat accounts have been produced using the results of the national Countryside Survey (Stott and Haines-Young, 1998; Haines-Young et al., 2000). These accounts take the form of a simple balance sheet presenting the opening stock of habitats, the major transfers of land between habitats, the closing stock and net change. Supplementary accounts provide information on the changing quality or condition of habitats as well as changes in area.

HABITATS AND LAND COVER TYPES

Classifications of wildlife habitats and land cover are closely related. Land cover is a physical observation of the surface of the ground relating to soils, rock, water bodies, vegetation and various forms of human

development. These same features form the basis for the description of wildlife habitats, though often habitats have more specific definitions relating to key biological functions or species. Typically land cover classifications are devised for rapid assessment of large areas using remote sensing techniques whereas habitat classifications rely on more detailed field observations and tend to have a more restricted geographical scope. Numerous systems of land cover and habitat classifications have been devised for different purposes at national and international scales. In the UK, a classification of 'broad' habitats has been developed in an attempt to build a bridge between the two approaches (Jackson, 2000).

Within the UK Biodiversity Action Plan (UK Biodiversity Steering Group, 1995; UKBG, 2001; www.ukbap.org.uk). biological targets have been agreed for 41 selected 'priority' habitats covering a range of terrestrial, freshwater, coastal and marine habitats. The priority habitats are tightly defined in relation to their conservation status and have limited geographical extents. The UK BAP also has objectives relating to biodiversity in the wider countryside and maintaining the characteristics of local areas. The system of overarching 'broad' habitats was devised as a means of ensuring that all ecosystems present in the UK are included within the scope and objectives of the Biodiversity Action Plan. Given the intention that these broad habitats should be all inclusive and quantifiable it was necessary to develop definitions capable of rapid assessment using existing survey protocols as far as possible. For the terrestrial habitats this has provided an opportunity for convergence between land cover and habitat definitions.

Habitats may further be characterised by their constituent physical and biological components. For terrestrial habitats, vegetation types are crucial. In the UK, two main systems are currently in use: the National Vegetation Classification (NVC) (Rodwell, 1992) and the Countryside Vegetation Systems (CVS) (Bunce et al ,1999a). The NVC is a phyto-sociological classification especially focused on vegetation communities of restricted distribution and of conservation interest. The CVS is a statistical classification of randomly sampled vegetation plots into 100 widely occurring classes. The CVS classes can be characterised by the major ecological gradients of fertility, shade and moisture.

DATA COLLECTION AND ANALYSIS

Countryside Surveys have been undertaken in Great Britain in 1978, 1984, 1990 and 1998 and in Northern Ireland in 1986-1992 and 1998 (Haines-Young et al, 2000; www.cs2000.org.uk). The surveys involve a randomised sample of land cover, habitats and vegetation from a number of grid squares repeated in each survey year (see Table 2). The sample in Great Britain is stratified by 40 environmental land classes determined by a multi-variate statistical analysis using available mapped attributes such as topography and climate (Bunce et al., 1996). The 40 land classes are aggregated into six major 'environmental zones' for the purpose of summarising sub-national trends (Fig 1). In each sample square details of land cover and linear features are mapped for all land parcels and the botanical composition of around 50 vegetation plots is recorded. Soils, freshwater and bird populations have also been surveyed. The field recording codes can be used to allocate parcels to different classifications of land cover, land use or habitats. In the latest survey, parcels were allocated to the broad habitats as defined in the UK BAP. The sample-based field survey has been co-ordinated and inter-calibrated with synoptic mapping of land cover across the whole country in 1990 and 1998 using satellite imagery.

Table 2 Number of sample squares surveyed in the Countryside Surveys of Great Britain and Northern Ireland[1]. Figures in brackets refer to the number of sample squares repeated from the previous survey.

	1978	**1984**	**1990**[2]	**1998**
Great Britain	256	384	508 (381)	569 (501)
Northern Ireland	-	-	628	628 (628)

1. In Great Britain the sample squares had dimensions of 1 x 1 km (ie 100 ha); in Northern Ireland, 0.5 x 0.5km (ie 25ha.
2. The first NI Countryside Survey was undertaken as a rolling survey from 1986 to 1991.

The sample survey enables the calculation of national and regional estimates of the stock or extent of broad habitats (Table 3). The estimates of stock have associated sampling errors related to the size of the sample and the extent and geographical variability of the feature. The environmental stratification reduces the variability within the sampling strata increasing the efficiency of the survey. Accuracy has been improved by progressively increasing the sample size from 276 in 1976 to 569 in 1998, in Great Britain. The condition of habitats can be described by reference to the component vegetation types and botanical composition of the vegetation plots (Bunce et al, 1999b).

Table 3. Estimated stock ('000 ha) of broad habitat types in England and Wales, Scotland, Northern Ireland and United Kingdom, 1998.

Broad Habitat Type	England and Wales		Scotland		Northern Ireland[1]	UK[1]
	Stock ('000 ha)	*Standard Error ('000 ha)*	Stock ('000 ha)	*Standard Error ('000 ha)*	Stock ('000 ha)	Stock ('000 ha)
Broadleaved woodland	1177	*84*	300	*51*	51	1522
Coniferous woodland	380	*72*	993	*135*	61	1435
Arable and horticultural	4609	*205*	639	*98*	59	5307
Improved grassland	4431	*187*	1051	*104*	568	6050
Neutral grassland	444	*48*	168	*25*	254	867
Calcareous grassland	38	*17*	27	*23*	1	66
Acid grassland	547	*67*	748	*97*	28	1324
Bracken	273	*49*	166	*28*	4	443
Dwarf shrub heath	485	*78*	1002	*111*	13	1500
Fen, marsh and swamp	210	*37*	337	*55*	53	600
Bog	180	*45*	2038	*168*	148	2367
Montane	1	*1*	48	*31*	n/a	n/a
Coastal habitats	186	*n/a*	82	*n/a*	3	271
Standing open water	106	*46*	85	*32*	n/a	n/a
Rivers and streams	43	*6*	21	*4*	n/a	64
Inland rock	17	*4*	38	*11*	6	61
Built up areas/gardens	1180	*111*	151	*28*	n/a	n/a
Linear features	404	*20*	87	*7*	n/a	n/a
Unsurveyed urban land[2]	426	*n/a*	37	*n/a*	n/a	n/a
Unclassified	93	*37*	2	*1*	143	238

1. Separate data are not available (n/a) for some habitat types in Northern Ireland and UK. These are included under 'unclassified'. Standard error estimates are not available for Northern Ireland and UK totals.
2. The Countryside Survey excluded 1 km grid squares with over 75% developed land. This area is included in the table as 'unsurveyed urban land'.

Source: Countryside Survey 2000; Northern Ireland Countryside Survey 2000; see Haines-Young et al (2000).

Changes in stock and condition of habitats are recorded between one survey and the next. Estimated changes in national stock are calculated from the mean changes observed in each land class. The statistical significance and confidence intervals for the change estimates are determined using a boot strapping procedure (Efron and Tibishrani, 1993). Changes in stock include both estimates of net change in the area of habitats and the conversion of one habitat type to another. The results for changes in intensive agriculture habitats 1990 to 1998 are illustrated in Fig 2. In Great Britain, more semi-natural grassland was converted to intensive agriculture than was restored but creation or reversion of woodland and fen, marsh, swamp and bog exceeded intensification. Where habitat types have not changed between surveys, more subtle changes in condition can be assessed with reference to the changing botanical composition of the vegetation plots.

HABITAT ACCOUNTS

The pilot habitat account for 1990-98 is constructed from the matrix of change of broad habitats based only on the sample squares surveyed in both 1990 and 1998 in Great Britain. Similar accounts are not yet available for Northern Ireland. The flows between habitat types are summarised into ten main types of change (Table 4). Allocation to the flow categories is determined on the basis of the recorded change in habitats. The processes that are driving the change are inferred and not directly observed. The account includes the opening and closing stock of each habitat over the accounting period, the net change in stock, the amount of the opening stock carried over, the amount of the opening stock lost and the amount of new stock gained (Table 5, appears on Page 9 below).

Table 4. Definition of types of change categories used in the habitat account.

Type of Change	Description of flows from 1990 to 1998
Woodland creation	Change from any non-woodland habitat to either broadleaved or coniferous woodland.
Woodland rotation	Change between broadleaved and coniferous woodland.
Agricultural intensification	Change from any other habitat type to either arable and horticultural or improved grassland habitats.
Agricultural rotation	Change between arable and horticultural and improved grassland habitats.
Habitat creation	Change from any other habitat type any of the semi-natural habitat types (neutral grassland, calcareous grassland, acid grassland, bracken, dwarf shrub heath, fen marsh swamp, bog, montane, coastal).
Habitat rotation	Change between any semi-natural habitat types.
Water body creation	Change from any other habitat type to standing open water.
Development	Change from any other habitat type to either inland rock (includes mineral workings), built up areas and gardens or linear features (includes roads and road verges).
Developed land recycling	Change between inland rock, built up and gardens and linear features
Loss to unknown	Change to an unknown habitat type (usually as a result of access denied to surveyors).

There was relatively little net change in the stock of the intensive agriculture habitats in Great Britain as a whole, with a small shift in balance between improved grasslands and arable and horticultural habitats. However, there were high rates of exchange in both directions between these intensive agriculture habitats and semi-natural habitats, leading to a net loss of around 60,000 ha of semi-natural habitats, apparently due to agricultural intensification. But these gains in intensive agriculture were offset elsewhere by losses from agriculture to woodland and developed land habitats. The flows into and out of intensive agriculture are broken down by the six Environmental Zones in Table 6. This regional analysis shows that there were net gains in intensive agriculture habitats, mostly improved grassland, in the three marginal and upland Zones (EZ3, EZ5 and EZ6). Conversely there were net losses in the two lowland Zones in England and Wales (EZ1 and EZ2) as a result of woodland planting and development. There was little net change in intensive agriculture habitats in the lowlands of Scotland (EZ4). Thus a general patterns emerges for the period 1990-1998 in which the national 'capital' of intensive agriculture habitats was maintained by 'acquisition' of semi-natural habitats in the marginal uplands and 'disposal' to woodland and developed land in the lowlands. Such trading is not apparent from simple national estimates of net change.

Some of the semi-natural habitats experienced proportionately large changes in stock at the national level, with net losses of semi-natural grasslands and net gains in fen, marsh and swamp habitats. The reasons for these changes require further investigation but may include changes in land management and grazing regimes.

Table 5. Pilot habitat account for Great Britain, 1990-1998. *Source: Countryside Survey 2000.*

Broad Habitat Type '000s ha	**1990 Stock**	**Changes in stock 1990 –1998**										**1998 Stock**	Reductions	Additions	**Net Change**	Net Change (% of 1990 stock)	Stock carried over (% 1998 stock)
		Woodland creation	Woodland rotation	Agricultural intensification	Agricultural rotation	Semi-natural creation	Semi-natural rotation	Water body creation	Development	Developed land recycling	Loss to unknown						
Broadleaved and mixed woodland	**1371**	132	14	-22		-42		-1	-13		-0	**1439**	78	146	**68**	4.9	90
Coniferous woodland	**1369**	67	-14	-9		-48		-1	-5		0	**1360**	76	67	**-9**	-0.7	95
Woodland sub-total	***2741***	***212***	***0***	***-31***		***-90***		***-1***	***-18***		***-0***	***2799***	***141***	***212***	***70***	***2.1***	***93***
Arable and horticultural	**5246**	-29		59	118	-41		-1	-19		-0	**5333**	91	178	**87**	1.7	98
Improved grassland	**5539**	-34		341	-118	-232		-1	-54		-5	**5436**	444	341	**-103**	-1.9	94
Intensive agriculture sub-total	***10785***	***-63***		***400***	***0***	***-273***		***-2***	***-73***		***-6***	***10768***	***416***	***400***	***-16***	***-0.2***	***96***
Neutral grassland	**570**	-24		-154		239	-18	-1	-33		-0	**578**	230	239	**9**	1.5	59
Calcareous grassland	**81**	-1		-13		4	-4	0	-0		0	**67**	18	4	**-15**	-18.0	95
Acid grassland	**1471**	-24		-134		43	-35	0	-5		-1	**1317**	198	43	**-154**	-10.5	97
Bracken	**457**	-22		-9		20	39	0	-1		0	**485**	31	59	**28**	6.1	88
Dwarf shrub heath and montane	**1539**	-25		-1		13	-41	0	-3		0	**1480**	70	13	**-57**	-3.7	99
Fen, marsh, and swamp	**456**	-6		-25		61	71	-1	-1		-1	**555**	34	132	**99**	21.8	76
Bog	**2297**	-18		-1		11	-10	-0	-0		-0	**2279**	29	11	**-19**	-0.9	100
Coastal habitats	**274**	-0		-1		3	-2	-0	0		0	**273**	3	3	**-1**	-0.3	98
Semi-natural sub-total	***7143***	***-120***		***-337***		***394***	***0***	***-2***	***-43***		***-2***	***7033***	***504***	***393***	***-110***	***-1.5***	***94***
Standing open water and canals	**208**	-0		-1		-1		5	-1		0	**210**	3	5	**2**	0.9	98
Rivers and streams	**67**	-0		-0		-1		0	-0		0	**65**	2	0	**-2**	-2.3	100
Water bodies sub-total	***275***	*-0*		*-1*		*-2*		*6*	*-1*		*-0*	***276***	*5*	*6*	***0.***	*0.1*	*98*
Inland rock	**54**	-1		-2		-8		0	13	4	0	**60**	10	17	**7**	12.3	72
Built up areas and gardens	**1231**	-14		-12		-9		-1	100	-2	-1	**1291**	40	100	**61**	4.9	92
Boundary and linear features	**495**	-1		-15		-8		-0	22	-2	-0	**492**	25	22	**-3**	-0.7	96
Developed sub-total	***1779***	***-16***		***-29***		***-25***		***-1***	***136***	***0***	***-1***	***1843***	***72***	***136***	***64***	***3.6***	***93***
Sea	**299**	0		0		-1		0	0		0	**298**	1	0	**-1**	-0.2	100
Unknown	**74**	-0		-2		-2		0	0		9	**79**	4	9	**5**	6.3	89
Unsurveyed urban land	**463**											**463**	0	0	**0**	0.0	100
Total	***23558***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***23558***	***0***	***0***	***0***	***0.0***	***100***

Notes: The stock estimates for 1998 in Table 5 differ slightly from those presented in Table 3 because the stock estimates are derived from just the 501 squares surveyed in both 1990 and 1998. '-0' indicates a loss between –0.5 and –0.1.

Table 6. Breakdown of changes in stock 1990-1998 by Environmental Zone for the intensive agriculture habitat types (arable and horticultural and improved grassland). See Fig.1 for map of Environmental Zones.

'000 ha	Agricultural Intensification	Woodland Creation	Habitat Creation	Development	*Net Change*
EZ1	69	-27	-73	-29	*-60*
EZ2	132	-20	-105	-36	*-34*
EZ3	87	-6	-36	-4	*41*
EZ4	43	-9	-35	-4	*-5*
EZ5	46	-1	-20	0	*24*
EZ6	22	0	-4	0	*17*
GB Total	***400***	***-63***	***-273***	***-73***	***-16***

CHANGES IN HABITAT CONDITION

Habitat accounts, presenting stocks and flows, provide a greatly simplified view of the gradual changes in habitats occurring in Britain. The broad habitat classes, by definition include a wide range of habitat types and conditions within each class. For example, the neutral grassland broad habitat includes both unimproved and semi-improved hay meadows and grazing pastures and unmanaged tall grassland herb vegetation. The flow accounts can only show major changes between habitat classes (those generally associated with changes in land use but also including the cumulative affects of more progressive changes, such as the natural regeneration of woodland). Information on habitat condition is needed to assess the more subtle changes taking place within broad habitat classes and to assess the degree to which gains in habitat in one place can compensate for losses elsewhere. It is likely that newly created parcels of semi-natural habitat will, at least initially, lack the full complement of biodiversity associated with long established parcels. Thus even though the extent of some semi-natural habitats may have been maintained or increased, the condition may have fallen as the newly created habitats fail to match the condition of the habitats lost.

To assist the interpretation of changes in habitat condition the Countryside Survey vegetation plots have been classified using the Countryside Vegetation System. This allocates each plot to one of 100 vegetation classes based solely on their floristic composition. These classes are aggregated into eight major vegetation types for the purpose of reporting (Bunce et al, 1999a & 1999b).

A number of habitat condition measures have been developed based on the plants observed in vegetation plots. The condition measures include both direct measures of biodiversity, such as mean species richness, and measures of ecological status, such as nutrient levels or acidity (Bunce et al 1999b, Haines-Young et al., 2000). Species richness is a simple indicator of conservation significance, especially useful in intensive agricultural habitats and semi-natural grasslands. However its interpretation is not straightforward because not all species may be regarded as equivalent in terms of value for conservation. The other measures of ecological status help to assess changes in habitat condition and identify the processes of change. Thus, increases in nutrient status, for example, are an indication of eutrophication, probably as a result of increased levels of nutrient inputs in agricultural habitats leading to losses of plants restricted to low nutrient situations and increases in more widespread plants associated with artificially raised nutrient levels.

The changes in habitat condition measures over the period 1990-98 can be summarised for the eight major vegetation types. The condition measure of botanical species richness is included as one the Government's Quality of Life Counts indicators. The results show significant losses in species richness in grassland vegetation types over the period 1990-98 (Fig 3A). Increased diversity in crops and weeds vegetation is observed especially in field boundaries. The condition measure for fertility (Fig 3B) shows significant increases in fertility in semi-natural grassland, moorland and bog vegetation. Increased fertility is an

indication of artificial nutrient inputs either as a result of intensive agriculture or atmospheric pollution, or both. Fertility decreased in crops and weed vegetation.

The condition measures can also be broken down by broad habitats and environmental zones. Fig 4A provides an update to the sustainable agriculture indicator (MAFF, 2000) for extent of semi-natural grassland in England and Wales. The indicator shows no significant change in stock of neutral grassland but statistically significant losses of calcareous and acid grassland broad habitats. Fig 3B presents information on changes in condition measures for less intensively managed agricultural grasslands. The condition measures show losses in species richness in semi-improved and neutral grasslands and no change in diversity in acid grasslands. Fertility increased in all three grassland types. Thus, in general terms, whilst the extent of neutral grassland was maintained it became less diverse and more eutrophic, and as acid grassland declined in extent it also became more eutrophic. The results show that it is important to avoid a high level aggregation into a single semi-natural grassland category.

An overall assessment of broad habitats can then be made by considering changes in both stock and condition of the broad habitat. These results are illustrated in Fig 5.

DISCUSSION AND CONCLUSIONS

The accounting framework can offer a useful device for analysing and presenting the complex changes in farmland habitats. The pilot accounts produced in the UK:

- include intensively farmed, semi-natural and uncultivated habitats and the flows between them and to other 'off-farm' habitats;
- suggest the underlying driving forces of change and their relative balance in maintaining environmental capital;
- provide an initial view of the turnover of habitats and the extent of compensation or substitution taking place;
- offer an integrated view across major land use sectors of agriculture, forestry and development and a framework for analysing interactions between competing land use objectives; and,
- inform the choice of biodiversity indicators and show they relate to one another.

The results also demonstrate the importance of disaggregation in both ecological and geographical dimensions. There is a clear dilemma between the detailed disaggregation necessary for interpretation and policy development, the production of summary indicators for national and international reporting and the costs of acquiring suitable data. Geographical disaggregation needs to take account of both administrative requirements and underlying environmental variability. The approach adopted in Countryside Survey 2000 to disaggregate between two administrative units, England & Wales and Scotland, and six Environmental Zones was a pragmatic compromise in this instance. Ecological discrimination of habitat types is also necessary to take account of nature conservation objectives and land management options but without becoming over-complicated or too data demanding. Again the broad habitats used in the Countryside Survey were intended to provide this compromise.

However, the accounts which present stocks and flows in terms of area, need to be supplemented by additional information on changes in habitat condition. In the results from Countryside Survey 2000 reported above, condition assessment was based on changes in botanical composition. The space available in this paper only permits presentation of two condition measures – species richness and fertility – but several others relating to plant strategies and benefits for other organisms are available (Haines-Young et al 2000). The results show that although the stock of habitats may be maintained the condition may deteriorate (or improve) either because of effects of habitat turnover or of more subtle and gradual effects such as land management or climate change. Assessment of habitat condition inevitably links to other biodiversity indicators.

The sampling approach adopted in Countryside Survey is not without its shortcomings and limitations. Whilst its strength lies in the ability to collect data for a national overview of the typical countryside, the downside includes:

- less robust analyses at sub-national resolution;
- national assessment of significance may not reflect local importance – habitat values vary with place;
- limited coverage of rare or localised habitats which make a disproportionate contribution to biodiversity in terms of both biology and human value systems;
- infrequent sampling intervals of 6-8 years;
- complex statistical analyses;
- processes and drivers of change inferred from biological outcomes; and
- inadequate understanding of the ecological processes occurring and the complex interaction of factors causing change.

Further work is required to extend and develop the pilot accounts derived from Countryside Survey 2000. Work in progress and planned includes:

- investigation of the processes of change in the soil-vegetation system and the significance of botanical changes for other elements of biodiversity and biodiversity indicators;
- survey of land managers and advisers to better understand the drivers, individual motivations and policy impacts;
- developing the linkages between national datasets on countryside change and creating an integrated indicator of countryside quality which takes into account local character and priorities; and,
- using the habitat accounts to inform a review of the pilot set of sustainable agriculture indicators.

The above discussion has considered some of the methodological implications of the pilot habitat accounts. From a broader, policy perspective the accounting framework starts to provide an insight into what we actually mean by the environmental dimension of sustainable development or sustainable agriculture. We can ask ourselves what type of changes in the account would be regarded as sustainable and then how those types of change might be achieved. Unlike individual indicators, the accounts can offer a more integrated, cross-sectoral and transparent view of environmental capital.

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Fig. 1. Distribution of Environmental Zones in (a) England and Wales (EZ1 Westerly Lowlands; EZ2 Easterly Lowlands; EZ3 Uplands) and (b) Scotland (EZ4 Lowlands; EZ5 Marginal uplands and islands; EZ6 Uplands).

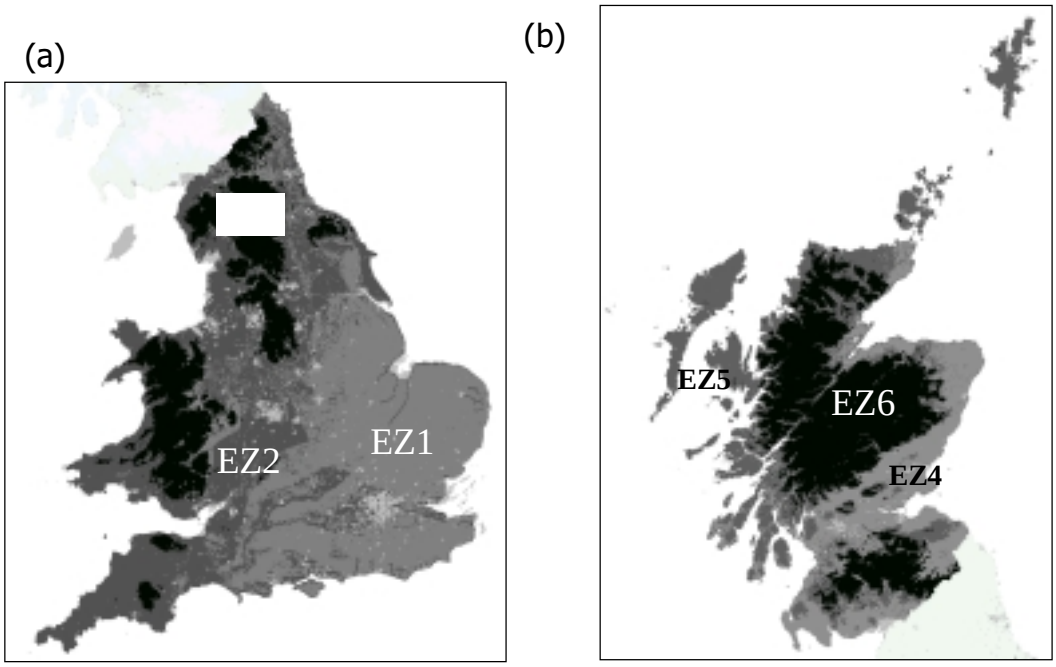

Fig. 2. Gains and losses of intensive agricultural habitats (arable and horticultural and improved grassland) from and to other habitat types in Great Britain, 1990 –1998. *Source: Countryside Survey 2000.*

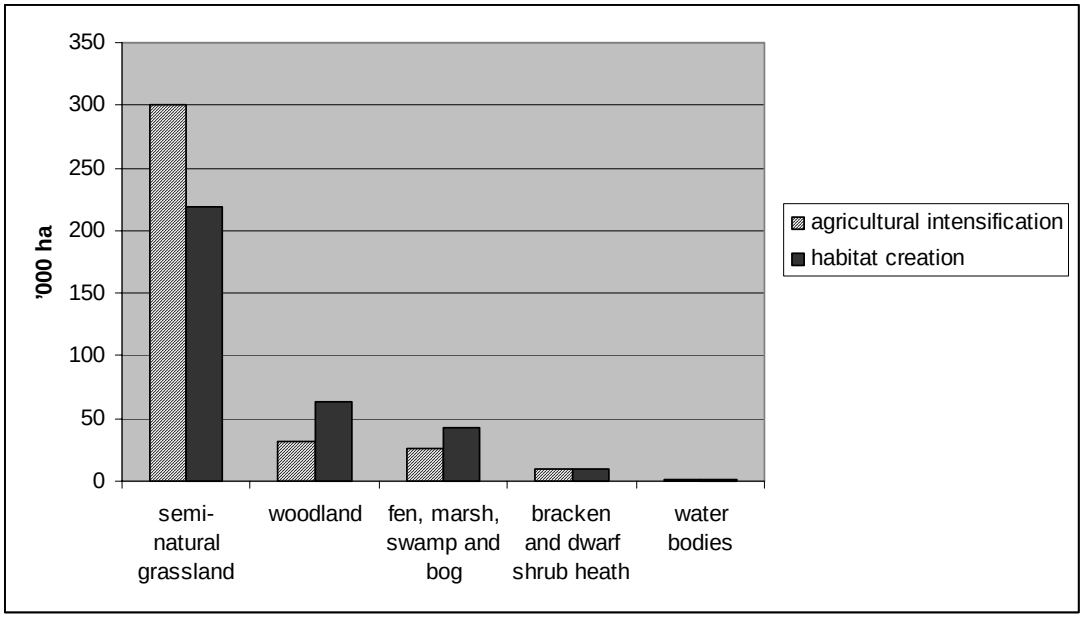

Fig 3A Plant diversity in major vegetation types. The figure shows mean species richness for eight vegetation types in Great Britain in 1990 and 1998. Significant changes are marked '*'. All vegetation plots sampled in both1990 and 1998 are included in the analysis and they are allocated according to the vegetation type present in 1990. *Source: Countryside*

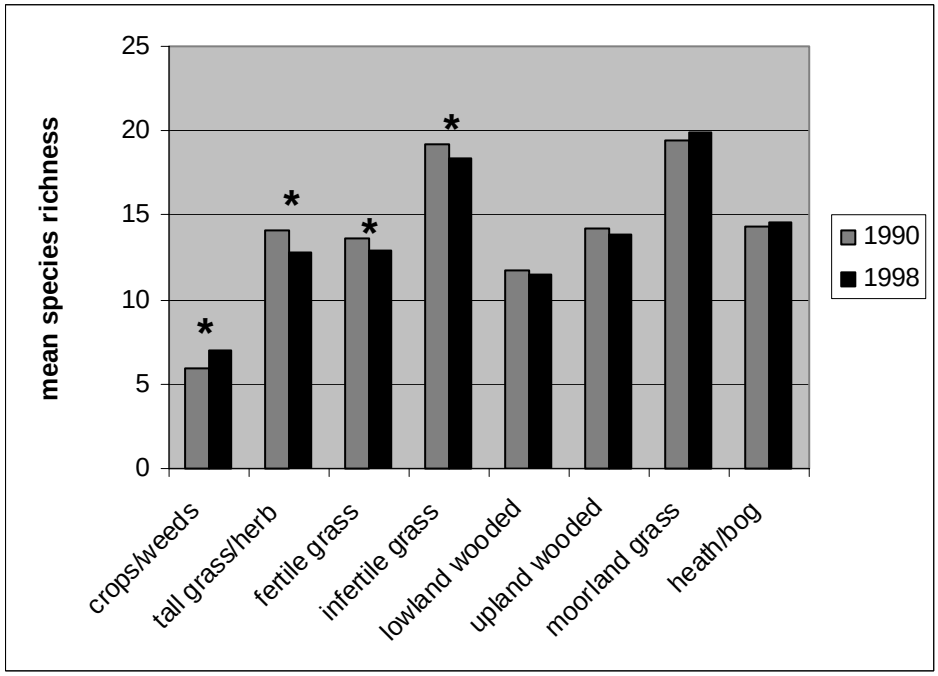

Fig 3B Fertility in major vegetation types. The figure shows mean Ellenberg fertility score for eight vegetation types in Great Britain, 1990 – 1998. Significant changes are marked '*'. All vegetation plots sampled in both1990 and 1998 are included in the analysis and they are allocated according to the vegetation type present in 1990. *Source: Countryside Survey 2000*

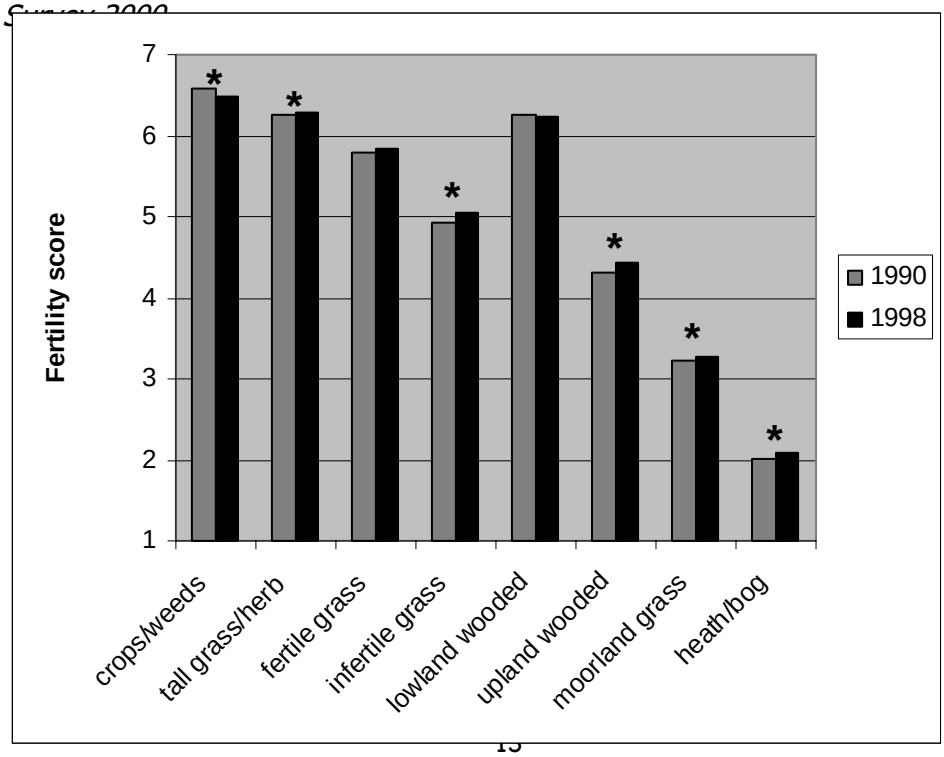

Fig 4A Update to sustainable agriculture indicator (34) showing changes in estimated stock of semi-natural grassland in England and Wales in 1984, 1990 and 1998. Statistically significant changes are marked '*'. *Source: Countryside Survey 2000*

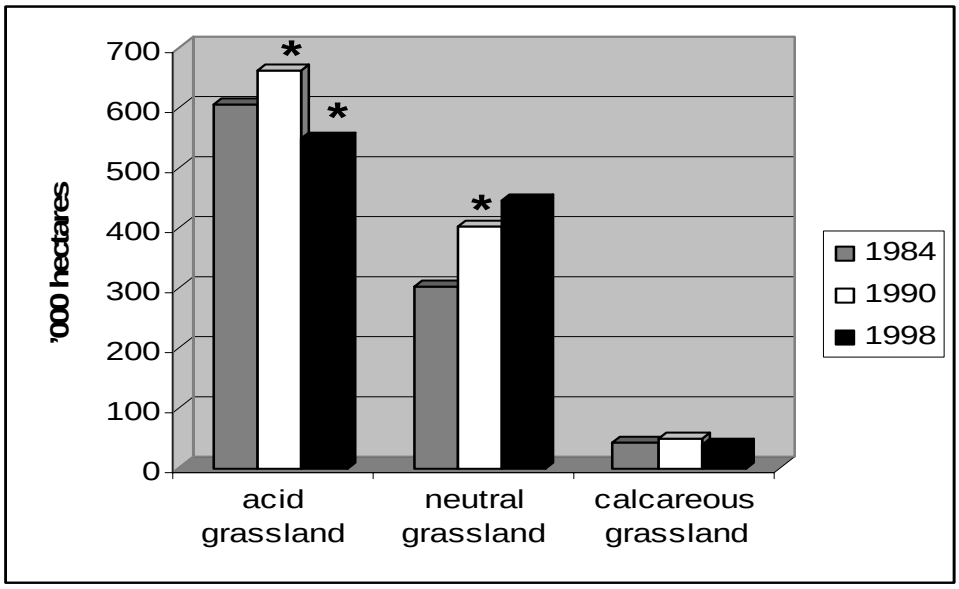

Fig 4B. Changes in condition measures for three agricultural grassland habitats in England and Wales, 1990-1998. The index of species richness (Spp rich) is mean species number per plot (divided by 10 for scaling purposes). The index of fertility is the mean Ellenberg Fertility Score. Data are presented for CVS 'infertile grassland' X plots in improved grassland, all Y plots in neutral grassland, and 'moorland grass mosaic' X plots in the acid grassland broad habitat. Analysis included only plots in the same broad habitat type in 1990 and 1998. Statistically significant changes marked '*'. *Source: Countryside Survey 2000.*

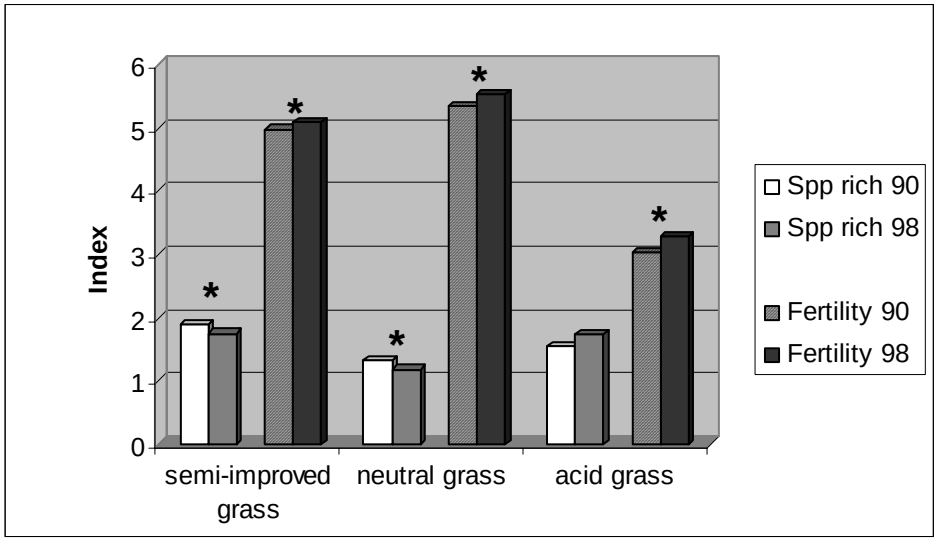

Figure 5 Summary of changes in stock and condition of broad habitats as reported in the recent Countryside Surveys of Great Britain and Northern Ireland. Assessment of stock refers to net changes in the extent of habitats in the UK, 1990-98. Assessment of condition refers to changes in vegetation composition and biological quality of rivers and streams, in GB, 1990-98. Assessment is made against general UK BAP objectives. (☺ = some favourable trends; 😐 = no significant or consistent change; ☹ = unfavourable trends; **?** = insufficient data).

BROAD HABITAT	***STOCK***	***CONDITION***
Broadleaved, mixed and yew woodland	☺	☹
Coniferous woodland	😐	😐
Arable and horticultural	😐	☺
Improved grassland	😐	☹
Neutral grassland	☹	☹
Calcareous grassland	☹	?
Acid grassland	☹	☹
Bracken	😐	?
Dwarf shrub heath	😐	☹
Fen marsh swamp	☺	😐
Bog	😐	☹
Montane	😐	?
Standing water and canals	☺	?
Rivers and streams	😐	☺
Boundary and linear features	☺	☹