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Towards sustainable grazing for biodiversity

An analysis of conservation grazing projects and their constraints
Part 1

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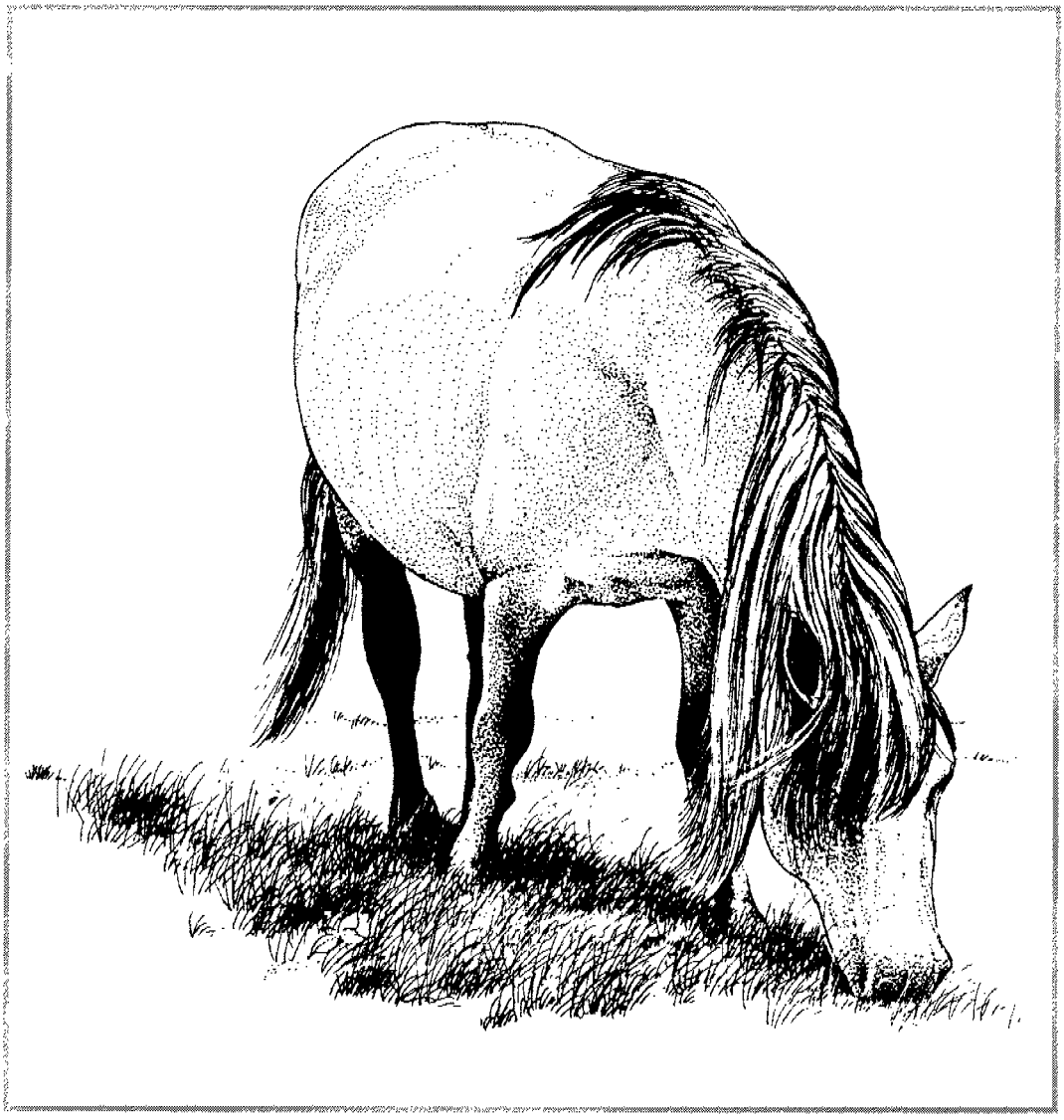

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English Nature Research Reports

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Towards sustainable grazing for biodiversity: an analysis of conservation grazing projects and their constraints

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Summary

This report aims to provide English Nature and its partner organisations within, and beyond, the Grazing Animals Project with a greater understanding of the use of domestic livestock for grazing in the management of habitats for conservation. An analysis of existing or proposed grazing schemes is documented which will serve as a guide to the successful and sustainable use of grazing animals in conservation for site managers, graziers, farmers and statutory and advisory bodies.

Two detailed questionnaire surveys were undertaken. The first sought to determine the extent and success of using grazing animals in habitat management for conservation; the second, which was supplemented by other sources, identified the constraints on the implementation of sustainable grazing schemes.

From the analysis of 122 responses to the first questionnaire it is apparent that a wide range of habitats were grazed including various grasslands, heaths and moors, fens, salt marshes and sand dunes. The sites were distributed in all parts of the U.K. and varied greatly in size from 0.8ha to 1000ha. The sites were in the ownership of statutory and voluntary conservation organisations, local authorities, industry and private individuals and most were Sites of Special Scientific Interest; a wide range of other conservation designations were also represented. Site managers frequently had more than one grazed site under their control.

Sheep and cattle were the most commonly used stock with 71 and 72 sites respectively, but ponies were also frequent; goats and pigs were used on relatively few sites. Amongst sheep breeds Hebridean and Beulah Speckled Face were the most widely used, but in total 46 breeds or crosses were recorded. Similarly, 54 breeds or crosses of cattle were utilised with only Highland and Friesian breeds recorded from more than five sites. Exmoor was the most frequently used pony breed.

A wide range of reasons were cited for the choice of breed(s) used but by far the most frequent single reason was that the stock used belonged to a local farmer. However, in combination with other reasons grazing behaviour was the most frequent factor determining choice of breed. Stock were obtained from diverse sources but ley pasture farms were a common source of both cattle and sheep, perhaps reflecting the ownership of the stock by local farmers. Some conservation grazing schemes were long-established with up to 12 generations of sheep or 3 generations of cattle and ponies having passed on site.

Reassuringly, 'as a conservation tool' was by far the most frequently identified main objective of using grazing livestock. Also reassuring was the assessment of the effectiveness of stock at achieving conservation objectives, especially controlling scrub/trees, maintaining or improving vegetation structure and developing a vegetation mosaic. Goats were most effective at eliminating existing trees and shrubs whereas cattle and sheep were able to control the spread of trees/scrub through grazing of seedlings. Cattle and ponies were better at improving vegetation structure, developing a vegetation mosaic and controlling bracken. Pigs were useful for increasing the proportion of bare ground.

There were marked differences in grazing preferences between species and breeds of grazing stock, although differences in recording 'effort' between widely and rarely used breeds need to be taken into account. Some of the preferred plant species eaten by stock would generally be

beneficial to conservation management (e.g. coarse grasses) but the eating of others (e.g. Orchidaceae) were detrimental. Differences in both preferred and 'disliked' plants suggest that species and breed of grazing animal should be chosen carefully to achieve the best results at a particular site. Evidence for differences between sexes and ages of grazing animals were less clear and the results merely establish a base for further study.

As might be expected for the hardy stock generally used on conservation sites most were out-wintered. However, a wide range of supplementary feedstuffs was supplied to stock overall but differences between sites were not assessed. Supplementary feeding occurred throughout the year but in summer this may only be mineral or vitamin blocks. The period of grazing on the conservation site varied from all year to as little as two months. Where stock were not grazed all year spring/ summer and autumn/winter grazing periods were almost equally common.

Stock health problems recorded included infections, nutritional disorders and deficiencies, internal and external parasites and dog attacks. The list of recorded ailments was longer for cattle than for sheep; few problems were recorded for ponies or goats. To counter these problems both preventative and remedial veterinary treatments were employed with "worming" being most frequent in both sheep and cattle. Sheep were also frequently vaccinated against clostridial diseases and *Pasteurella* pneumonia.

Almost a third of respondents stated they would prefer to be using a different species or breed of stock. This may reflect the reliance on local farmers to supply stock which is thus less likely to be the hardy, traditional breeds preferred in conservation grazing. Of the breeds to be replaced none was particularly frequently identified; more often the requirement was for an additional breed to supplement the grazing of currently used stock.

From the answers to two questions on the first questionnaire, 42 responses to the second questionnaire and the discussions of the participants at a meeting on the constraints experienced in establishing conservation grazing schemes well over 100 individual problems were identified. These were initially classified into 47 categories which were further grouped into 14 classes. Some of these required changes beyond the scope of individual conservation agencies e.g. to laws, agricultural policy, agri-environment schemes, planning policy and conservation policy. Others could be undertaken by individual conservation agencies provided resources permitted e.g. resources planning, staff training, management of livestock, equipment, monitoring and public relations.

Within these broader categories the difficulties of obtaining the best livestock at the right time and in sufficient numbers was the most commonly expressed problem. Containing livestock and adverse public reactions to fences and to livestock generally were also frequently cited problems. Where possible existing solutions to constraints of effective use of stock were sought and are reported; where solutions do not currently exist suggestions for future action are made.

The analysis undertaken sought to draw on the collective experience of many site managers who have implemented, or tried to implement, conservation grazing schemes in order to identify the key aspects of both successful schemes and the constraints on desirable, but not yet established, schemes. The schemes reviewed are remarkably diverse, but where possible common themes have been identified which will contribute to the development of best practice

for conservation grazing and allow priorities for action to be set. Together these should help to ensure that the use of domestic livestock for conservation grazing achieves the sustainability that is essential if the long-term health of sites of conservation value is to be maintained.

1. Introduction

The use of livestock for habitat management for conservation has developed from a largely experimental technique in the 1950s and early 1960s to become the method of choice for a wide range of habitats and sites. The need to graze sites of conservation interest arises from several features of the habitats which are valued within the British Isles:

- Habitats such as upland and lowland heaths, hay meadows, chalk downland and pasture-woodland were created for, and often by, grazing livestock.

- Such habitats comprise plagio-climax communities that are maintained by grazing or cutting; cessation of these practices allows succession to resume and eventually scrub and woodland develop.

- Intensification of farming has reduced the willingness and ability of farmers to graze livestock on marginal sites which are unable to support the levels of production considered economic without the use of fertilisers and/or supplementary feeding which would destroy the conservation interest of the sites through nutrient enrichment. The dichotomy has been well described as "between the anvil of intensification and the hammer of neglect" (Oates *et al.*, 1998).

- Myxomatosis reduced grazing by rabbits which had been a significant factor in maintaining short swards in many areas; although rabbit populations often eventually recovered to pre-myxomatosis levels many sites were left in need of restorative management which might include livestock grazing. In addition, there are still periodic and localised outbreaks of myxomatosis and more recently viral haemorrhagic disease, that can depress rabbit numbers sufficiently to allow scrub to become established.

- The only alternatives to grazing are cutting or burning; both involve dramatic, sudden and indiscriminate changes in the structure and height of vegetation and can damage or kill less mobile animal species and susceptible plants. Cutting may be impracticable on steep slopes and burning can be difficult and may meet with public disapproval. Thus these techniques achieve the primary aim of arresting succession but may be damaging in other ways.

To meet these challenges conservation managers have adopted grazing as an effective and versatile management technique and a large number of conservation sites (estimated by members of the Grazing Animals Project Steering Group to be well in excess of 600 in the U.K., based on their knowledge of the number of grazed sites within their own organisations) now involve some grazing. However many decisions have to be made on the aims and objectives of grazing which in turn will involve decisions on the species and breed of livestock and on grazing intensity and duration. Resource implications include fencing, handling pens, possibly provision of water and the time needed to check stock and undertake routine livestock management tasks. If conservation managers are unable to find livestock owners willing to graze the sites under the restrictions on intensity, duration, fertiliser use, supplementary feeding etc. they are faced with becoming livestock owners and managers themselves with attendant legal obligations and training demands.

There have been some valuable attempts to collate information on grazing as a conservation management technique for particular habitats e.g. fen (Tolhurst, 1997), heaths (Bacon, 1998) and sea cliffs and sand dunes (Oates *et al.*, 1998). However the variety of approaches generated by the variables identified above and by the diversity of the grazed sites themselves has meant that questions on the use of livestock for conservation management are many and answers are few, with many managers forced to take the decisions outlined above with little or no information. Similarly, each manager will keep records of and (hopefully) monitor their grazing scheme but such information may remain in internal reports or project records within management plans. The collation, analysis and reporting of these data and the facilitation of information exchange are amongst the priorities of the Grazing Animals Project.

1.1 The Grazing Animals Project

The Grazing Animals Project arose from two initiatives aimed at addressing the problems identified above. In June 1997 a workshop on 'The Use of Rare Breeds in Conservation Management' was held at Liverpool John Moores University (LJMU) with a view to promoting the particular attributes of rare breeds of farm livestock which are of value in conservation. Over 60 people attended the workshop; most were professional countryside managers although a few approached the topic from the perspective of rare breed conservation. Ten speakers represented a range of backgrounds, including a number of practitioners already utilising rare breeds in a variety of roles. The proceedings of the conference were published in December 1997 as an extended issue of *Enact*, the English Nature magazine specialising in practical conservation techniques. Six articles summarised the ten presented papers (Alderson and Small, 1997; Braithwaite, Grooby and Newborn, 1997; Grayson, 1997; Oates and Bullock, 1997; Read and Williams, 1997; Simpson and Gee, 1997).

One of the speakers at the LJMU workshop was Helen Read, the Corporation of London ecologist based at Burnham Beeches where Exmoor ponies, British White cattle and Berkshire pigs are used in management of the Burnham Beeches pasture-woodland. Dr. Read had previously held discussions with Neil Sanderson and Matthew Oates about the desirability of establishing a discussion group, similar to the Ancient Tree Forum, concerned with conservation grazing. This idea was further explored in an evening discussion at the LJMU workshop and met with the approval of the delegates present. The purpose of the discussion group, which became known as the Grazing Forum, was to promote the exchange of information and the development of best practice through a newsletter, field meetings and workshops.

The second initiative was by the inter-organisational Forum for the Application of Conservation Techniques (FACT) which had been established by John Bacon of English Nature's Lowlands Team. The Forum's remit is to identify, and then take action on, land management problems that are currently hindering or preventing the delivery of biodiversity targets. The Forum recognised that the largest problems in implementing grazing schemes were the lack of appropriate grazing animals and/or infrastructure and/or trained personnel. The Forum considered that the availability of suitable animals (taking into account grazing preferences, hardiness, age, sex etc.), skilled stock handlers and resource availability should be addressed and hence established the 'Supplying the Animals Working Group'.

It was clear to the initiators that the aims of both groups were complementary and that much could be gained by working together. A meeting was called by John Bacon and held at the

head office of the Rare Breeds Survival Trust (RBST) at the National Agricultural Centre, Stoneleigh Park on 22nd May 1997; organisations represented at that first meeting were English Nature, RBST, Corporation of London and LJMU (with apologies from The National Trust representative). Subsequently it was agreed to continue to co-operate under a single title of the Grazing Animals Project and the initial members of the Steering Group were joined by representatives from the Royal Society for the Protection of Birds, European Forum for Nature Conservation and Pastoralism, the Soil Association, National Farmers' Union, Chisel Farm Organics and an 'information providers' from the Farming and Rural Conservation Agency (Box 1). The current rationale and project outline of the GAP is given in Appendix 1.

Box 1: Members of the Grazing Animals Project Steering Group as at August 1999

John Bacon (English Nature) - Convenor
Lawrence Alderson (Rare Breeds Survival Trust)
Ian Baker (Royal Society for the Protection of Birds)
Karl Barton (Chisel Farm Organics)
Timothy Beech (English Nature & GAP Newsletter Editor)
Andrew Clark (National Farmers' Union)
Matthew Oates (The National Trust)
Michael Pienowski (European Forum for Nature Conservation and Pastoralism)
Helen Read (Corporation of London)
Richard Small (Liverpool John Moores University)
Philip Stocker (The Soil Association)

Philip Tolerton (Farming and Rural Conservation Agency) attends meetings as an observer and information provider; previous FRCA representatives were Roy Dart and Andrew Swash.

A number of activities were planned and implemented in the first two years of GAP, including four field meetings of the Grazing Forum (Burnham Beeches in April 1998, Arnside-Silverdale AONB in September 1998, Skipwith Common in June 1999 and Lullington Heath planned for September 1999). A Supplying the Animals Working Group open meeting in Crewe in March 1998 was called to discuss the problems encountered by land managers when attempting to establish conservation grazing schemes; the results of that discussion are included in this report. GAP has been represented at several meetings (e.g. Grazing Management Options for Native Woodlands, MLURI, Aberdeen; RSPB Wardens' Gathering, Glasgow, September 1998) and a joint FACT/GAP conference is planned for September 1999.

GAP has published a newsletter which is now distributed to approximately 500 interested people; six issues have been produced to July 1999. Within the newsletter a 'small-ads' section entitled Grazelots (to mirror the Forestry Commission's Woodlots) has enabled site managers, graziers, stock breeders etc. to advertise grazing, services, stock or related items. Recently agreed funding by several organisations (see Appendix 1) has allowed Grazelots and Woodlots to be developed into a separate publication (Eco-Ads) covering all aspects of conservation management.

From the comments at the Crewe meeting, field meetings and elsewhere the desirability of co-ordinating the use of grazing animals on a regional basis has emerged. GAP has proposed the development of Regional Grazing Schemes (RGS) and several candidate areas have been identified. The first RGS has been implemented in Hampshire where the County Council has funded an RGS Project Officer post. English Nature have recently (July 1999) provided funding over a three year period for a national co-ordinator for Regional Grazing Schemes; Dr Bill Grayson has been appointed to this position.

English Nature have also provided funding for a contractor to co-ordinate GAP. The contract has recently (July 1999) been awarded to the Broads Authority whose Conservation Officer (Sandie Tolhurst) and Assistant Conservation Officer (Sue McQueen) have been seconded from the Authority for the three years of the contract.

1.2 The Grazing Animals Project Questionnaire

An early meeting of the Steering Group agreed that it was desirable to attempt the collation of the existing knowledge and experience of land managers in establishing and running conservation grazing schemes. The most time and cost effective means to achieve this was the distribution of questionnaires to as many site managers as possible. As noted above this was supplemented by a discussion meeting of the Supplying the Animals Working Group. The results of the analysis of these surveys and the discussion meeting are presented and discussed in this report.

2. Materials and methods

2.1 Questionnaire design

At the request of the GAP Steering Group Dr. Helen Read drafted two questionnaires for discussion; the first (Questionnaire A; see Appendix 2) was designed to gather data on existing grazing projects: questions 4 - 8 sought information on the characteristics of the grazed site, questions 9 - 14 the type(s) and characteristics of the animals used, questions 15 - 26 the grazing regime employed, and questions 28 - 29 the problems encountered in establishing and running the grazing scheme. Most questions included tables to facilitate and standardise responses and some questions included suggestions or alternatives (e.g. questions 6, 16). A few questions were free-form.

The second questionnaire (Questionnaire B; see Appendix 3) was designed to gather information on the problems that were preventing potential, desirable grazing schemes from being implemented. Question styles were similar to those employed in Questionnaire A. Data from Questionnaire B were supplemented by the responses made during the open meeting of the Grazing Animals Working Group held in Crewe in March 1998.

Unfortunately there was no time to trial the questionnaire (as had been envisaged by the Steering Group) on a number of site managers from within the organisations represented on the Steering Group. However all members of the Steering Group had a chance to comment on the draft and modifications were incorporated before distribution to site managers; it was felt that the Steering Group had sufficient practitioners to be able to assess the design adequately.

2.2 Questionnaire Distribution

The final version was circulated to most potential respondents in April 1998 although copies were also sent to new participants in GAP as they made contact up to November 1998. It is not possible to be exact in the number of questionnaires distributed (e.g. a few were photocopied and passed on to colleagues by initial contacts) but approximately 330 were mailed as follows (all values approximate):

- RSPB site wardens nominated by Ian Baker: 55
- National Trust site managers nominated by Matthew Oates: 72
- English Nature site managers nominated by John Bacon: 20
- Participants in the Liverpool John Moores University workshop: 55
- Wildlife Trust Reserve Officers: 45
- Rare Breeds Survival Trust members nominated by Lawrence Alderson: 40
- Miscellaneous, including applicants to join the GAP mailing list: 45

With the addition of photocopied pro-formas a total distribution of 350 may be assumed.

2.3 Questionnaire analysis

Responses to Questionnaire A were collated and analysed by two of us (CP and DAJ) using the SPSS statistical package where possible; some free-form written responses could only be summarised or reported *verbatim*. Analysis aimed to extract general features rather than record the detailed information provided for every site, but that information is kept on the SPSS database and may be used to answer specific questions relating to the use of grazing animals in conservation management. Responses to Questionnaire B were collated by JCB who also analysed the constraints identified at the Crewe meeting. Some of these constraints and their possible solutions, or action taken to overcome them, have been presented by JCB in the GAP Newsletter, but are included in this report for completeness.

3. Results from Questionnaire A

Completed Questionnaires A were returned for 125 sites; unfortunately 3 of these were received after the analysis was substantially complete and are not included in the results presented. Thus the results are based on 122 sites which represent an approximate 35% return rate and approximately 20% of the estimated minimum number of grazed sites in the U.K.

Returns of Questionnaire B were fewer (42 sites) but the information they contained was supplemented by the 122 responses to questions 28 and 29 in Questionnaire A which also sought information on the problems that had been encountered on existing grazing projects, by the collated discussions of the 45 participants (representing 32 organisations) at the Crewe meeting and by the 15 postal returns from invitees who were unable to attend the meeting. These combined data are presented together after consideration of the results from Questionnaire A.

N.B. For all questions there were some 'nil responses'; these are not shown in the tables unless their presence may be taken to impart information in itself, although the extent of the

'nil response' is often recorded in the text. Thus there were 12 nil responses to the question "Who owns it" (i.e. the grazed site) which are not included in Table 1. Where nil responses are not included the percentages shown in tables may not total to 100%.

3.1 Site descriptions

Site names, owners, managing agencies, designations and county are shown in Appendix 4.

3.1.1 Site ownership

The 110 sites for which an owner was identified indicated that the main conservation agencies were well represented in the survey (Table 1); within the 'Other' category no organisation owned more than seven sites but Scottish Natural Heritage, Manx National Heritage, private estates, industry, water companies, conservation charities and trusts, the Corporation of London, the Crown Estate Commission, and County, Metropolitan Borough, City and District Councils were all represented (see Appendix 4).

Table 1. Ownership of grazed sites in survey

Site Owner	Number of Sites	Percentage of Sites (rounded)
The National Trust	23	19
Royal Society for the Protection of Birds	19	16
Local Authorities	12	10
Various [1]	12	10
Private Companies	10	8
Private Landowners	9	7
Wildlife Trusts / RSNC	9	7
English Nature	7	6
Private Estates	6	5
Corporation of London	6	5
Other Charitable Trust	4	3
Crown Estate / Government	3	2
Scottish Natural Heritage	1	1
Manx National Heritage	1	1
TOTALS	122	100

[1] Sites with shared ownership (one site each)
English Nature / "Various"
Dorset Wildlife Trust / The National Trust
Buckinghamshire County Council / The National Trust/ Private Owner
Welwyn & Hitchin District Council / Hertfordshire & Middlesex Wildlife Trust / Private Owner
English Nature / Hampshire County Council
Surrey County Council / Private Owners
The National Trust / Longleat Estate
Lincolnshire Trust for Nature Conservation / Private Owner
Cheshire Wildlife Trust / Hepworths
Lancaster City Council / Lancashire Wildlife Trust / R.S.P.B.
Scottish Wildlife Trust / Private Owner
"Various"

3.1.2 Geographic Distribution of Grazed Sites

The sites were well distributed over England but Wales (8 sites), Scotland (6 sites) and Ulster (2 sites) were under-represented. Within England the regional distribution of sites was Southeast 25, South 20, Southwest 15, East Anglia 11, East Midlands 4, West Midlands 5, Northwest 18 and Northeast 8. The distribution by county is shown in Box 2.

Box 2: Distribution of sites by county

Cornwall 5	Anglesey 1
Devon 7	Conwy 1
Somerset 4	Cheshire 1
Wiltshire 2	Staffordshire 2
Dorset 7	Derbyshire 3
Isle of Wight 2	Merseyside 2[2]
Hampshire 7[1]	Lancashire 9 [2,3]
Surrey 11[1]	Isle of Man 1
West Sussex 1	West Yorkshire 1
East Sussex 4	South Yorkshire 1
Kent 2	East Yorkshire 1
Essex 2	North Yorkshire 1
Hertfordshire 1	Cumbria 7[3]
Buckinghamshire 5	Cleveland 1
Oxfordshire 3	Durham 1
Bedfordshire 1	Northumberland 1
Cambridgeshire 3	North Lanarkshire 2
Suffolk 2	Fifeshire 1
Norfolk 6	Argyllshire 1
Lincolnshire 2	Invernesshire 1
Monmouthshire 1	Orkney 1
Pembrokeshire 4	Londonderry 2
Powys 1	

[1] Totals include one site straddling the Hampshire/Surrey boundary

[2] Totals include one site straddling the Merseyside/Lancashire boundary
[T] Totals include one site straddling the Lancashire/Cumbria boundary

3.1.3 Conservation Status of Sites

The sites varied from those having no formal designation for conservation value to an International Biosphere Reserve with the full gamut of the conservation hierarchy in between (Box 3, Figure 1). Many sites held a range of designations (Figure 1; Appendix 4) and it is possible that others also had such a range but that the respondents only listed the 'top' status; for example, only one site was described as a County Wildlife Trust site but the number of

sites owned or managed by County Wildlife Trusts (Table 1; Appendix 4) suggests many more could have been so described. The same applies to R.S.P.B. reserves.

Some sites were described in terms of broader landscape designations such as Environmentally Sensitive Area (ESA), Area of Outstanding Natural Beauty (AONB) or National Park; clearly in these instances the grazed sites were within the wider category but may constitute a very small proportion of the total area.

Box 3: Conservation status of sites in survey; numbers in brackets indicate frequency with which each designation was recorded

1. None / No Response (13)
2. "Conservation Area" (1)
3. Site of Importance for Nature Conservation (SINC) / Site of Nature Conservation Importance (SNCI) (6)
4. Local Nature Reserve (LNR) (8)
5. Biological Heritage Site / County Nature Conservation Site (2)
6. County Wildlife Trust Reserve (1)
7. RSPB Reserve (2)
8. Site of Special Scientific Interest (SSSI) / Area of Special Scientific Interest (ASSI) (82)
9. National Scenic Area (1)
10. National Nature Reserve (NNR) (27)
11. Special Protection Area (SPA) (16)
12. Proposed Special Area for Conservation (PSAC) (12)
13. Special Area for Conservation (SAC) (6)
14. RAMSAR Site (13)
15. International Biosphere Reserve (1)
16. Heritage Coast (1)
17. Scheduled Ancient Monument (SAM) (3)
18. Environmentally Sensitive Area (ESA) (1)
19. Area of Outstanding Natural Beauty (AONB) (5)
20. National Park (1)

Perhaps not surprisingly given the distribution of the questionnaire the majority (67%) of the sites were SSSI. The frequency of Special Protection Areas and RAMSAR sites may reflect the relatively large number of returns from R.S.P.B. site managers.

3.1.4 Grant schemes

The majority (62%) of sites received grant aid from either the conservation budget, e.g. Wildlife Enhancement Scheme and/or from the agricultural budget e.g. Countryside Stewardship (Figure 2); the remaining 46 sites (38%) either received no grant aid or had no response to the question. Countryside Stewardship was the most frequently cited source of grant aid, contributing to the funding of 43% of sites and was the only source of funding for 40% of sites. Environmentally Sensitive Area payments were the only other source of funding

to be received by more than 10% of sites. Six sites received funding from more than one source.

3.1.5 Area of grazed sites

Sites varied greatly in area from just 0.8ha to 1000ha. The mean ± s.d. area was 90.0 ± 152.3ha but as the mean was clearly inflated by a few very large sites (Figure 3) the median area of 36.0ha may be a better measure. In interpreting Figure 3 note the variation in size classes used; if size classes were constant the distribution would be strongly positively skewed i.e. most sites were small (over 50% were less than 50ha).

3.1.6 General site descriptions

The general descriptions of the grazed sites are shown in Table 2. Most sites were lowland and most were inland, although not necessarily both. Almost half the sites varied in the degree of 'wetness' with approximately one third described as dry and only 15% as wet. The rather subjective and not mutually exclusive categories of Flat / Gently Sloping / Steeply Sloping suggested in the questionnaire were represented in various combinations in a quarter of the sites, but over half were flat or gently sloping.

The soils of the sites were approximately evenly distributed between calcareous, acidic and neutral (Table 3) with a few sites containing a variety of combinations of these categories. Figure 4 shows more detailed information on the soils of 104 grazed sites. Only peat and sand based soils were found on >10% of sites with chalk, clay, alluvium and loam on >5% of sites. Brown earths, gravels, limestone and scree were the only other 'soil' types found in isolation but a wide variety of combinations were recorded. Clay was found on 34 sites (33%), peat and sand on 20 sites (19%) each and alluvium on 18 sites (17%).

Table 2. Description of the land grazed

Description	Number of Sites	Percentage of Total
Upland	14	11.5
Lowland	95	77.9
Upland & Lowland	1	0.8
Coastal	33	27.0
Inland	79	64.8
Wet	18	14.8
Dry	39	32.0
Varied	54	44.3
Flat	44	36.1
Gently sloping	22	18.0
Steeply sloping	22	18.0
Flat + gently sloping	6	4.9
Flat + steeply sloping	4	3.3
Gently + steeply sloping	9	7.4
Flat, gently + steeply sloping	10	8.2

Table 3. Status of soils of grazed areas

Description	Number of Sites	Percentage of Total
Calcareous	33	27.0
Acidic	35	28.7
Neutral	25	20.5
Acidic + Neutral	6	4.9
Calcareous + Neutral	5	4.1
Calcareous + Acidic + Neutral	5	4.1
Acidic + Calcareous	4	3.3

Figure 1. Conservation status of sites (see Box 3 for full designations shown as abbreviations in column headings). Values in last row indicate frequency with which each designation was recorded

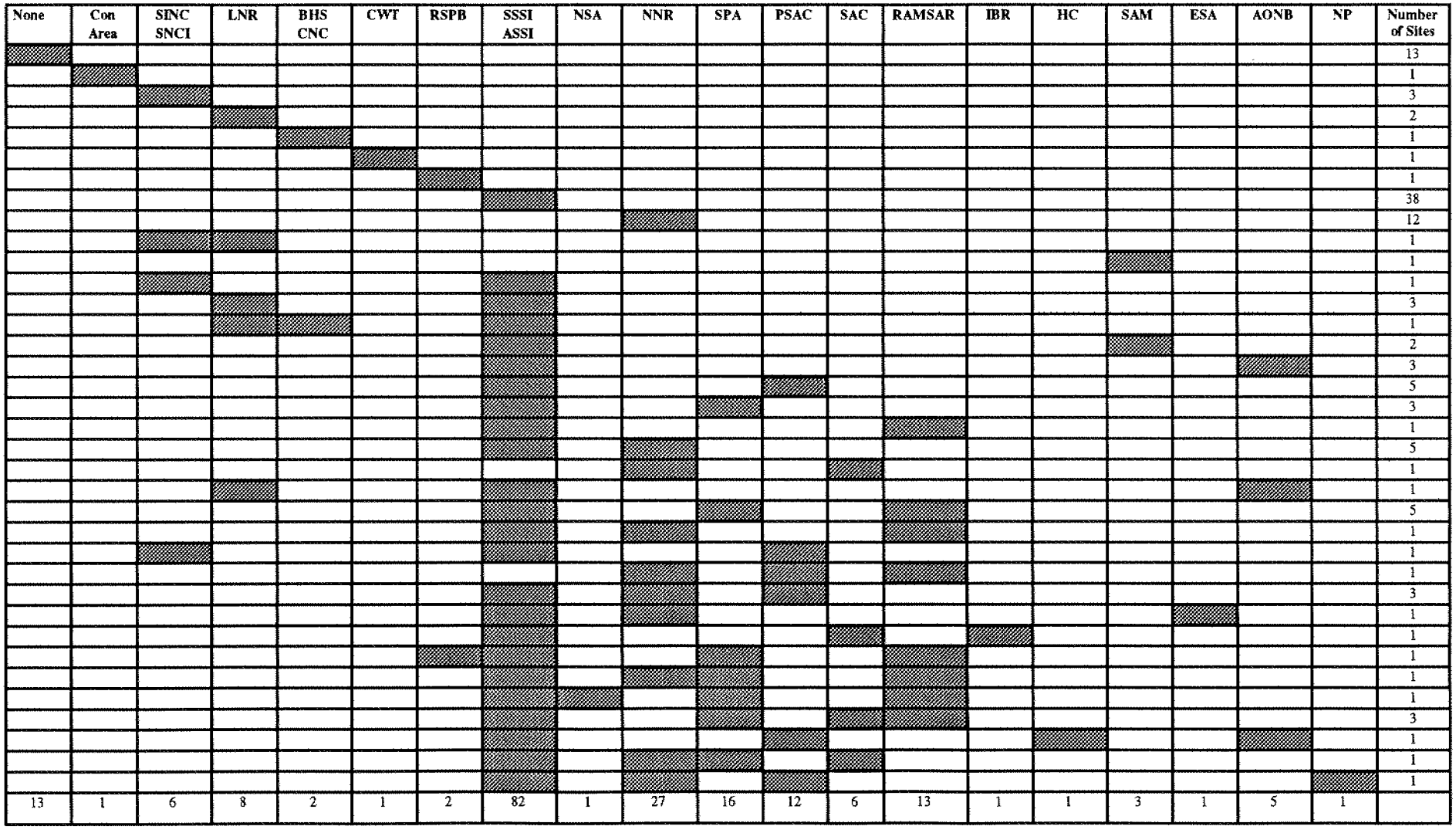

Figure 2. Grant aid received by sites. Values in last row indicate frequency with which each designation was recorded

Countryside Stewardship	Environ-mentally Sensitive Area	Wildlife Enhancement Scheme	Reserve Enhancement Scheme	Habitats Scheme	Woodland Grant Scheme	Section 15 Management Agreement	"English Nature"	Broads Authority	Organic Aid Scheme	Number of Sites
■										49
	■									13
		■								3
			■							1
				■						1
					■					1
						■				1
■	■									1
■		■								1
■			■							1
	■				■					1
	■							■		1
	■						■			1
									■	1
52	17	4	2	1	2	1	1	1	1	

Figure 3. Size distribution of grazed sites

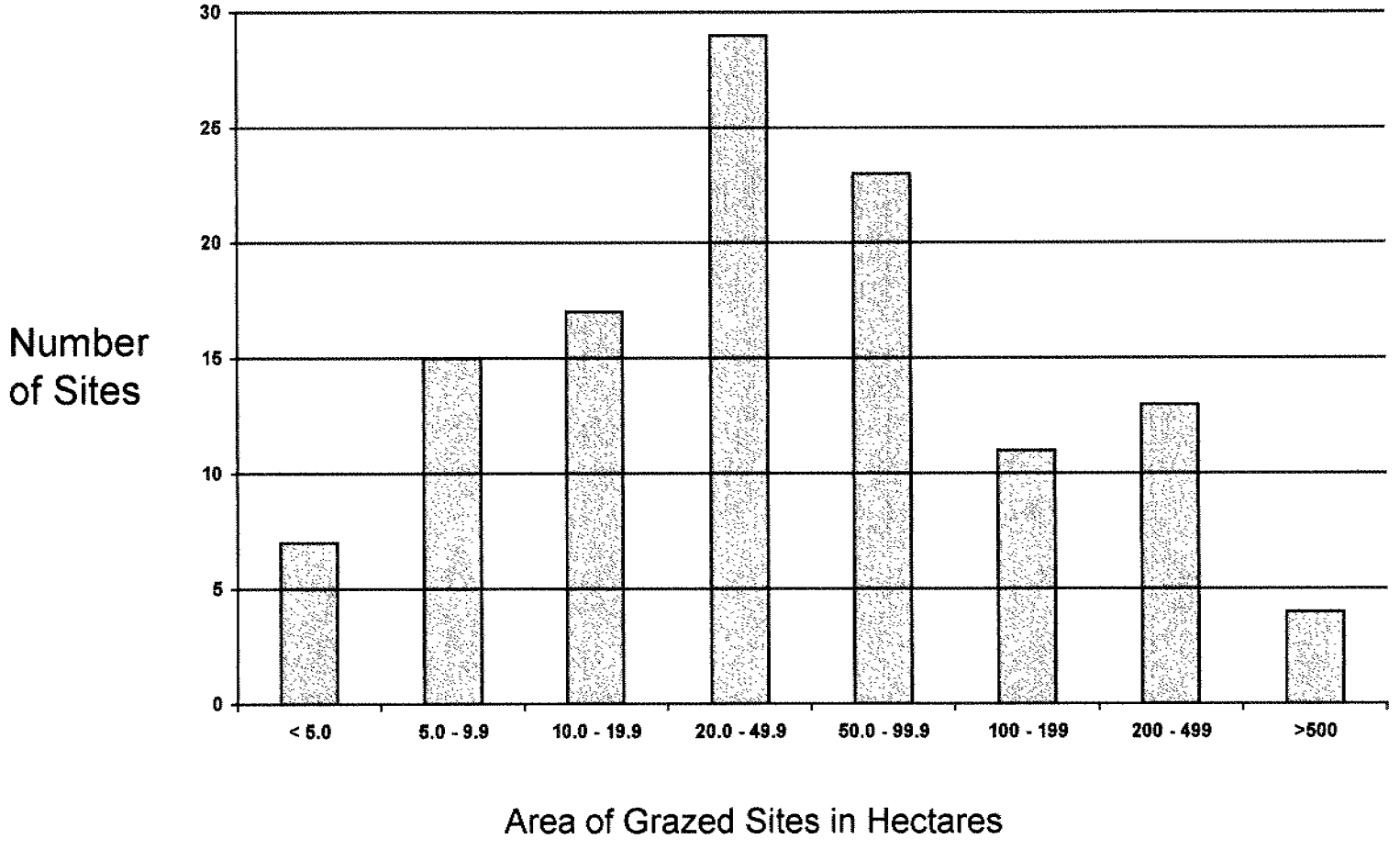

Figure 4. Soil types of grazed land (n= 104); numbers in final row indicate number of sites in which the soils occurred

Peat	Sand	Chalk	Clay	Alluvium	Loam	Brown Earths	Gravel	Scree	Limestone	Slate	Gley	Various	Number of Sites	Percentage of Total
■													14	13.5
	■												12	11.5
		■											10	9.6
			■										9	8.6
				■									8	7.6
					■								7	6.7
						■							5	4.8
			■				■						4	3.8
		■	■										4	3.8
							■						3	2.9
	■		■										3	2.9
■			■										3	2.9
			■			■							2	1.9
		■		■									2	1.9
	■		■				■						2	1.9
								■					1	1.0
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			■							■			1	1.0
■			■	■									1	1.0
	■			■			■						1	1.0
		■	■		■								1	1.0
■	■												1	1.0
			■	■			■						1	1.0
			■	■									1	1.0
			■	■									1	1.0
				■							■		1	1.0
20	20	17	34	18	11	7	11	1	2	1	1	1		

3.1.7 Habitats grazed

All the major grazed habitats were represented in the survey (Figure 5). Not surprisingly, grasslands were most frequent: 45% of sites consisted entirely of grasslands and a further 28% included some grassland. The only other habitat to occur on more than 5% of sites was (lowland) heathland either alone (9%) or in combination with grasslands (9%) or with other habitats (9%). Coastal habitats were represented by sand dunes (all or part of four sites) and salt marshes (all or part of five sites).

Figure 5. Habitat types grazed (n =115); numbers in final row indicate number of sites in which the habitats occurred

Grassland	Heathland	Fen	Moorland	Pasture Woodland	Sand Dunes	Salt Marsh	Number of Sites	Percentage of Total
■							55	45.1
	■						11	9.0
■	■						11	9.0
			■				6	4.9
■		■					5	4.1
■	■	■					4	3.3
						■	4	3.3
■				■			3	2.5
		■					2	1.6
				■			2	1.6
■		■		■			2	1.6
■							2	1.6
■	■				■		2	1.6
					■		1	0.8
	■		■				1	0.8
	■				■		1	0.8
■	■			■			1	0.8
■	■	■		■			1	0.8
■		■				■	1	0.8
87	32	15	7	9	6	5		

3.1.8 National Vegetation Classification Communities

(N.B. Scientific and common names of plants cited in the text are listed in Appendix 5).

A very wide range (108) of National Vegetation Classification (NVC) communities were recorded despite the relatively low response rate to this question (Table 4). The grassland communities were predominant; all ten calcicolous grasslands (CG) were present with CG2 (*Festuca ovina-Avenula pratensis*), CG3 (*Bromus erectus*) and CG4 (*Brachypodium pinnatum*) being most frequent with 29, 23 and 10 sites respectively. Mesotrophic/Neutral grasslands were also well represented with MG1 (*Arrhenatherum elatius*), MG5 (*Cynosurus cristatus-Centaurea nigra*), MG6 (*Lolium perenne-Cynosurus cristatus*), MG7 (*Lolium perenne* leys) and MG13 (*Agrostis stolonifera-Alopecurus geniculatus*) all occurring on ten or more sites. The only frequent acid grassland was U4 (*Festuca ovina-Agrostis capillaris-*

Galium saxatile) found on 10 sites. A wide range of Fen Meadows/Rush Pastures (M) communities were recorded but none was particularly frequent; most common was M25 (*Molinia caerulea-Potentilla erecta* mire) which was found on nine sites. All other communities were found on 8 or fewer sites and most were recorded on just one or two sites.

Where NVC communities were not known respondents were asked to provide a brief description of the main vegetation types present (including any dominant species). The descriptions provided are reproduced in Box 4 with minimal change. It is difficult to summarise these descriptions but many sites included a variety of habitats, often representing seral stages in the succession; in several instances the sites were in the process of 'restoration' i.e. reversal of the succession e.g. from scrub to heathland or scrub to calcareous grasslands. Coastal habitats (salt marshes, coastal grazing marshes, sand dunes and maritime grasslands) were perhaps better represented than for the sites for which NVC classes were available. Otherwise the vegetation described appears to be similar to the NVC sites with grasslands and heathlands predominating.

3.1.9 Site subdivision

The majority (89, 73%) of grazed sites were subdivided; 29 (24%) were not subdivided and there was no response to this question for four sites (3%). A surprisingly large mean of 10.3 subdivisions was recorded but the comparatively huge standard deviation (16.8) indicates that there was a long 'tail' to the upper end of the range. The maximum number of subdivisions recorded was 100 (actually described as "hundreds") and the minimum was 1 (which poses the question whether this could be considered a subdivision). As with the area of the sites, the median (4.0 subdivisions) is a better indicator of a 'normal' value; upper and lower quartiles were 2.0 and 9.0 subdivisions confirming that the distribution has a strong positive skew with the mean lying above the upper quartile.

Just over half the subdivisions (66, 54%) were recorded as permanent and only seven (6%) were temporary; a further ten sites had both temporary and permanent subdivisions. The remaining 39 (32%) respondents stated the question was not applicable or gave no response.

Table 4. National Vegetation Classification (NVC) Communities recorded in grazed areas

NVC Codes	CG										G		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**
Number of Sites	3	29	23	10	1	4	4	1	2	1	1	1	2
Percentage of Total	0.8	7.3	5.8	2.5	0.3	1.0	1.0	0.3	0.5	0.3	0.3	0.3	0.5

NVC Codes	MG										HG		
	1	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**1**	**5**	**6**
Number of Sites	19	10	11	10	1	8	7	4	1	11	1	1	2
Percentage of Total	4.8	2.5	2.8	2.5	0.3	2.0	1.8	1.0	0.3	2.8	0.3	0.3	0.5

NVC Codes	U						H									
	1	**2**	**3**	**4**	**5**	**20**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**
Number of Sites	5	2	3	10	2	4	3	2	4	1	1	2	1	1	3	3
Percentage of Total	1.3	0.5	0.8	2.5	0.5	1.0	0.8	0.5	1.0	0.3	0.3	0.5	0.3	0.3	0.8	0.8

NVC Codes	M														
	6	**9**	**10**	**13**	**14**	**15**	**16**	**17**	**19**	**21**	**22**	**23**	**24**	**25**	**28**
Number of Sites	1	1	1	1	1	3	3	1	2	2	2	6	3	9	3
Percentage of Total	0.3	0.3	0.3	0.3	0.3	0.8	0.8	0.3	0.5	0.5	0.5	1.5	0.8	2.3	0.8

NCV Codes	MC							HC	CC
	2	**5**	**8**	**9**	**10**	**11**	**12**	**5**	**6**
Number of Sites	1	1	3	3	2	1	1	1	1
Percentage of Total	0.3	0.3	0.8	0.8	0.5	0.3	0.3	0.3	0.3

NVC Codes	S										
	4	**5**	**6**	**19**	**20**	**21**	**24**	**25**	**26**	**27**	**28**
Number of Sites	4	1	1	1	1	4	2	1	2	1	1
Percentage of Total	1.0	0.3	0.3	0.3	0.3	1.0	0.5	0.3	0.5	0.3	0.3

NVC Codes	SM									
	6	**8**	**9**	**10**	**12**	**16**	**18**	**23**	**24**	**28**
Number of Sites	1	2	2	1	1	4	1	1	1	1
Percentage of Total	0.3	0.5	0.5	0.3	0.3	1.0	0.3	0.3	0.3	0.3

NVC Codes	SD								
	2	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**16**
Number of Sites	1	1	1	2	1	1	1	1	1
Percentage of Total	0.3	0.3	0.3	0.5	0.3	0.3	0.3	0.3	0.3

NVC Codes	W											
	2	**4**	**8**	**9**	**10**	**17**	**18**	**21**	**22**	**23**	**24**	**25**
Number of Sites	1	1	3	1	1	1	1	6	2	8	1	3
Percentage of Total	0.3	0.3	0.8	0.3	0.3	0.3	0.3	1.5	0.5	2.0	0.3	0.8

Box 4: Main vegetation types of sites for which no NVC survey was available

Elymus saltmarsh.

Oak, birch, aspen, occasional alder buckthorn, bramble, heather, gorse, sheep's sorrel, honeysuckle, composites, tormentil, bedstraw and various grasses.

Typical grazing marsh - coastal, unimproved (291 ha) with approx. 500,000 anthills, improved ryegrass grasslands, seeded from arable 1982-85 (69.7ha).

Naturally reverting calcareous grassland separated by hedges. Main grasses *Agrostis* spp., but much bare ground and wide variety of herbs. Much scrub - mostly blackthorn, gorse, bramble, wild rose. Large section of reed bed and seasonally flooded meadows. Rich mosaic of scrub and herb rich dense grassland in SSSI.

Tall fen 350ha, marshy grassland 184ha, acid grassland 60ha, improved grassland 52ha, scrub grassland 25ha, swamp, flushes, mire, rock, heathland c.10ha.

Humid heath, *Erica tetralix / Calluna*. Large stands of *Ulex europaeus*. Areas of wooded (sallow) carr, scattered pine.

Saltmarsh dominated by saltmarsh grass, with sea aster, annual sea blite, and small amounts of *Salicornia*, sea purslane, *Spartina* and sea couch grass.

Acidic and semi-improved grassland, tall herb and fen, scattered bracken. Neutral, unimproved lowland grassland. Willow, gorse scrub. Tall fen and swamp.

Improved grassland, rushes; reed in dykes.

Lower saltmarsh mostly *Puccinellia* dominated with large stands of *Juncus* on the mid-marsh. High marsh dominated by various grasses and gorse scrub.

Plateau: wavy hair grass, Yorkshire fog, heather, gorse, tormentil, heath bedstraw, Slopes: upright brome, sheep's fescue, salad burnet, devilsbit scabious, bird's-foot trefoil.

Acid heath (H4): *Erica cinerea, Erica tetralix, Calluna vulgaris, Molinia caerulea, Ulex europaeus, Ulex gallii.*

Trees, bracken, briars, permanent pasture.

Wet heath, dry heath, mire, fen, mesotrophic grassland, wood pasture.

Some relict herb rich grassland, but mainly areas cleared of scrub approx. 1983.

Calluna vulgaris, Erica cinerea, Erica tetralix, Deschampsia, Molinia, Ulex minor, Ulex europaeus, Vaccinium.

Permanent pasture, water meadow.

Semi-improved grassland.

Orchid and hay meadows, cowslip, yellow rattle, quaking grass, marsh orchid, early purple orchid; some saltmarsh species e.g. strawberry clover, *Blysmus compressus*. Sterile brome and hogweed rapidly invading.

Scrubby bramble and gorse, sheep's sorrel, nettle; hemlock and sedges in wetter areas.

Heathland dominated by *Calluna*, gorse; chalk grassland and chalk heath.

Dryish woodland: oak, birch; scrub with bramble understorey. Heathland remnants: gorse, broom. Acidic and improved grasslands: *Phragmites, Carex, Juncus* in wetter areas, *Phragmites* in drier areas.

Beech and oak pollards with *Calluna, Deschampsia flexuosa* herb layer. Small patches of birch with holly, bramble.

Heathland with abundant areas of secondary woodland (birch dominated), valley mire and acid grassland, *Sphagnum* and *Molinia*.
Dry heath and heath/grassland mosaic: *Calluna vulgaris*, *Deschampsia flexuosa*, *Erica cinerea*, *Vaccinium myrtillus*.
Maritime grassland: red fescue, thrift, kidney vetch, buckshorn plantain, squill, bluebell, bracken, cocksfoot, gorse, campion, primrose.
Broad leaved dock, creeping thistle, hedge mustard, creeping buttercup, nettle.
Improved grassland, maritime grassland, maritime heath, coarse grassland, bracken, bramble.
Wet heath: *Erica cinerea*, *Molinia*; dry heath: *Calluna*, rush; wet flushes: bog bean.
Maritime/*Festuca* grassland; Maritime heath: *Calluna vulgaris*, western gorse, cocksfoot, bracken, bramble.
Molinia, rush; heather in regeneration areas.
Festuca ovina, *Carex flacca* grassland; patches of *Arrhenatherum elatius*, *Brachypodium sylvaticum*; heaths: *Calluna*, *Erica cinerea*, *Ulex europaeus*, *Ulex minor;* mixed calcareous scrub with holm oak stands.
Unimproved calcareous grassland - *Bromus erectus* dominant; kidney vetch, horseshoe vetch, man orchid, pyramidal orchid, lizard orchid, fragrant orchid. Semi-improved neutral grassland with red star thistle. Scrub and secondary woodland - hawthorn (dominant), dogwood, spindle, blackthorn, whitebeam, wayfaring tree.
Brachypodium sylvaticum, thyme, pyramidal orchid, yellow wort, centaury.
Maritime grassland - fescues, Yorkshire fog, bracken. Maritime heath - heather.
Neutral grassland - *Deschampsia cespitosa* and *Holcus lanatus* dominant; some *Molinia*. *Succisa pratensis* abundant. Woodland mainly oak with gorse, birch, willow scrub invading grassland area.
Alder carr; oak, ash, willow woodland. Semi-natural grassland and fen - meadow sweet, ragged robin, marsh orchid, early purple orchid. Bracken and purple moor grass in wood pasture.
Herb-rich neutral grassland, marshy grassland - soft rush. Ancient hedgerows. Blackthorn, gorse scrub invading meadows. Ash dominated copse.
Sesleria grassland on limestone outcrops. *Festuca-Agrostis* sward on deeper soils, dominated by bracken. Secondary scrub and woodland - hawthorn, hazel, birch, ash, oak.
Molinia, cotton grass, *Erica tetralix*, *Calluna vulgaris*, birch, bracken.
Gorse, bracken, heather, native grasses.
Heather, *Molinia*, *Nardus*, bracken; willow, birch, hazel scrub.
Herb-rich dune grassland: hairy rock cress, pyramidal orchid, downy oat grass, moonwort, rigid grass, frog orchid, common centaury, early and northern marsh orchids, marsh helleborine, hemp agrimony, field gentian, fragrant orchid, crested hair-grass, common twayblade, early forget-me-not, adders tongue, bee orchid, grass of Parnassus, stone bramble
Unimproved grassland.
Improved and unimproved calcareous grassland. Scattered calcareous scrub, chalk heath.
Mixed plantation; semi-improved acid grassland, semi-improved neutral grassland, improved grassland, marsh grassland, mire, raised bog.
Parkland and grassland.